**Relationships between Sensory-Motor Function and Occupational Performance or Specific Diagnosis**

### **Tzischinsky, O., Meiri, G., Manelis, L., Bar-Sinai, A., Flusser, H., Michaelovski, A., . . . Dinstein, I. (2018). Sleep disturbances are associated with specific sensory sensitivities in children with autism. *Molecular Autism,9*(1). doi:10.1186/s13229-018-0206-8**

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#### **Background**: Sensory abnormalities and sleep disturbances are highly prevalent in children with autism, but the potential relationship between these two domains has rarely been explored. Understanding such relationships is important for identifying children with autism who exhibit more homogeneous symptoms.

#### **Methods**: Here, we examined this relationship using the Caregiver Sensory Profile and the Children's Sleep Habits Questionnaire, which were completed by parents of 69 children with autism and 62 age-matched controls.

#### **Results**: In line with previous studies, children with autism exhibited more severe sensory abnormalities and sleep disturbances than age-matched controls. The sleep disturbance scores were moderately associated with touch and oral sensitivities in the autism group and with touch and vestibular sensitivities in the control group. Hypersensitivity towards touch, in particular, exhibited the strongest relationship with sleep disturbances in the autism group and single-handedly explained 24% of the variance in total sleep disturbance scores. In contrast, sensitivity in other sensory domains such as vision and audition was not associated with sleep quality in either group.

#### **Conclusions**: While it is often assumed that sensitivities in all sensory domains are similarly associated with sleep problems, our results suggest that hypersensitivity towards touch exhibits the strongest relationship with sleep disturbances when examining children autism. We speculate that hypersensitivity towards touch interferes with sleep onset and maintenance in a considerable number of children with autism who exhibit severe sleep disturbances. This may indicate the existence of a specific sleep disturbance mechanism that is associated with sensitivity to touch, which may be important to consider in future scientific and clinical studies.

**Zwicker, J. G., Suto, M., Harris, S. R., Vlasakova, N., & Missiuna, C. (2017). Developmental coordination disorder is more than a motor problem: Children describe the impact of daily struggles on their quality of life. *British Journal of Occupational Therapy,81*(2), 65-73. doi:10.1177/0308022617735046**

## Introduction: Affecting 5–6% of children, developmental coordination disorder is a neurodevelopmental disorder characterized by poor motor coordination and difficulty learning motor skills. Although quantitative studies have suggested that children with developmental coordination disorder experience reduced quality of life, no known qualitative studies

## Methods: Guided behave reported what daily life is like from their perspective’s an inductive realistic approach and using semi-structured, individual interviews, 13 children (8–12 years) were asked to describe what life is like in their own words. Three researchers coded interviews manually to identify relevant content. An experienced qualitative researcher conducted a second, in-depth thematic analysis using NVivo to identify patterns and themes.

## Findings: Two themes – milestones as millstones and the perils of printing – illuminated participants’ challenges in completing everyday activities at home and at school. The third theme – more than a motor problem – revealed the social and emotional impact of these struggles and from being excluded from play. The fourth theme – coping strategies – described their efforts to be resilient.

## Conclusion: Parents, educators, physicians, and therapists working with children with developmental coordination disorder must recognize how their quality of life is affected by the physical and emotional toll of their efforts to participate successfully in daily activities.

 **Bertilsson, I., Gyllensten, A. L., Opheim, A., Gard, G., & Hammarlund, C. S. (2018). Understanding one’s body and movements from the perspective of young adults with autism: A mixed-methods study. *Research in Developmental Disabilities,78*, 44-54. doi:10.1016/j.ridd.2018.05.002**

#### **Background:** There are but a few studies of how persons with autism perceive their bodies and movements. Difficulties in perceiving the surrounding world along with disturbed motor coordination and executive functions may affect physical and psychological development.

#### **Purpose:** To explore the experiences of body and movements in young adults with autism and how two physiotherapeutic instruments may capture these experiences.

#### **Methods:** Eleven young adults (16-22 years) with autism were interviewed and assessed using Bruininks-Oseretsky Test of Motor Proficiency (BOT2) and Body Awareness Scale Movement Quality and Experience (BAS MQ-E). Following a mixed- methods design, the interviews were deductively analyzed and conceptually integrated to the results of the two assessments.

#### **Results:** Experiencing conflicting feelings about their bodies/movements, led to low understanding of themselves. The assessments captured these experiences relatively well, presenting both movement quality and quantity. Positive experiences and better movement quality related to having access to more functional daily strategies.

#### **Conclusion:** Combining motor proficiency and body awareness assessments was optimal to understand the participants' experiences.

### **Overvliet, K. E., & Krampe, R. T. (2018). Haptic two-dimensional shape identification in children, adolescents, and young adults. *Journal of Experimental Child Psychology,166*, 567-580. doi:10.1016/j.jecp.2017.09.024**

We investigated the influence of image mediation (the process that translates tactile information into a visual image) on the development of haptic two-dimensional (2D) shape identification in 78 participants from five different age groups: preschoolers (4-5 years), first graders (6-7 years), fifth graders (10-11 years), young adolescents (12-13 years), and young adults (18-28 years). Participants attempted to haptically recognize everyday objects (three-dimensional [3D] haptic condition) and tangible line drawings (2D haptic condition) and to recognize objects presented through a serial visual "peek hole" version of the haptic line drawing task (2D visual condition). All groups were excellent at 3D haptic identification. However, preschoolers and first graders scored low in both visual and haptic line drawing tasks. From fifth grade onward, participants were reliably better at the visual peek hole task compared with the haptic line drawing task, which improved only gradually in young adolescent and adult age groups. We argue that both the spatial reference frame and working memory capacity constrain image mediation and children's increasing abilities to correctly haptically identify 2D shapes.

**Williams, K. L., Kirby, A. V., Watson, L. R., Sideris, J., Bulluck, J., & Baranek, G. T. (2018). Sensory features as predictors of adaptive behaviors: A comparative longitudinal study of children with autism spectrum disorder and other developmental disabilities. *Research in Developmental Disabilities,81*, 103-112. doi:10.1016/j.ridd.2018.07.002**

**Background**: Children with autism spectrum disorder (ASD) and other developmental disabilities (DD) exhibit sensory features that differ from their typically developing peers. Prior cross-sectional research has demonstrated significant associations between elevated sensory features and lower adaptive behavior scores, yet there is limited prospective research examining longitudinal associations.
**Purpose**: To examine the longitudinal prediction of early sensory response patterns (i.e., hyperresponsiveness, hyporesponsiveness, and sensory interests, repetitions, and seeking behaviors) to later adaptive behavior outcomes in children with ASD and DD.
**Methods**: Children with ASD (n = 51) and DD (n = 30) were seen at two time points (Time 1: M(SD) = 5.6(2.5) years; Time 2: M(SD) = 9.0(2.2) years). We used a series of regression models with both observational and parent-report measures of sensoryresponse patterns, and including group interactions.
**Results**:All three sensory response patterns significantly predicted aspects of adaptive behaviors, with some differences based on assessment format and diagnostic group. Across groups and sensory patterns, we found some evidence that elevated sensoryfeatures early in childhood predicted lower adaptive behavior skills later in childhood.
**Conclusions**: Sensory features may interfere with development of adaptive behaviors, suggesting a need for effective interventions addressing sensory features early in development.

### **Foitzik, K., & Brown, T. (2017). Relationship between sensory processing and sleep in typically developing children. *American Journal of Occupational Therapy,72*(1). doi:10.5014/ajot.2018.027524**

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#### **Objective:** The relationship between sensory processing factors and the sleep habits and patterns of typically developing children ages 8-12 yr was investigated.

#### **Methods:** Forty-five typically developing children and their parents or caregivers took part. Parents completed the Sensory Processing Measure-Home Form, Children's Sleep Hygiene Scale, and Children's Sleep Habits Questionnaire, and the children completed the Children's Report of Sleep Patterns. Spearman ρ correlation and linear regression analyses were completed with the children's sleep habits and patterns as the dependent variables and the sensory processing factors as the independent variables.

#### **Results:** Sensory processing factors were significantly associated with the children's sleep habits and patterns, as reported by parents and children. Predictive relationships were established between the children's sensory processing factors and sleep habits and patterns.

#### **Conclusion:** Occupational therapy practitioners should consider sensory processing factors when working with children who present with suspected sleep problems.

### **Celik, H. I., Elbasan, B., Gucuyener, K., Kayihan, H., & Huri, M. (2017). Investigation of the Relationship Between Sensory Processing and Motor Development in Preterm Infants. *American Journal of Occupational Therapy,72*(1). doi:10.5014/ajot.2018.026260**

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#### **Objective:** The aim of this study was to analyze the correlation between sensory processing and motor development in preterm infants.

#### **Methods:** We included 30 preterm and 30 term infants with corrected and chronological ages between 10 and 12 mo. We used the Test of Sensory Functions in Infants to evaluate sensory processing and the Alberta Infant Motor Scale to evaluate motor development.

#### **Results:** The Spearman correlation test indicated a strong positive relationship between sensory processing and motor development in preterm infants (r = .63, p < .001).

#### **Conclusion:** Given the relationship between sensory processing and motor development in the preterm group, the evaluation of sensory processing and motor development in preterm infants was considered necessary for the effective implementation of physiotherapy assessment and interventions.

### **Little, L. M., Dean, E., Tomchek, S., & Dunn, W. (2017). Sensory processing patterns in autism, attention deficit hyperactivity disorder, and typical development. *Physical & Occupational Therapy In Pediatrics,38*(3), 243-254. doi:10.1080/01942638.2017.1390809**

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#### **Purpose:** The purpose of this study was to examine sensory processing in children ages 3-14 years with autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and typical development (TD) using the Sensory Profile 2nd Edition (Dunn, 2014).

#### **Methods:** Participants included 239 children (ASD = 77; ADHD = 78; TD = 84) matched on age and gender. Multivariate analysis of covariance was used to compare the extent to which the three grsoups differed on sensory processing patterns (i.e., sensitivity, avoiding, registration, seeking) and sensory systems (i.e., auditory, visual, touch, movement, body position, oral, conduct, attention, social). We also examined the effect of chronological age.

#### **Results:** Children with ASD and ADHD did not differ in sensory processing patterns which were elevated as compared to a TD group. Children with ASD showed the highest rate of oral processing differences, followed by ADHD and TD. Children with ADHD had higher visual processing scores than children with ASD and TD. Older children had lower scores for seeking, auditory, visual, movement, touch, and conduct than younger children, regardless of diagnosis.

#### **Conclusions:** Findings suggest that sensory features may be an area of overlap of behaviors in ASD and ADHD, which may have implications for intervention approaches for children with these conditions.

### **Slagt, M., Dubas, J. S., Aken, M. A., Ellis, B. J., & Deković, M. (2018). Sensory processing sensitivity as a marker of differential susceptibility to parenting. *Developmental Psychology,54*(3), 543-558. doi:10.1037/dev0000431**

In this longitudinal multi informant study negative emotionality and sensory processing sensitivity were compared as susceptibility markers among kindergartners. Participating children (N = 264, 52.9% boys) were Dutch kindergartners (Mage = 4.77, SD = 0.60), followed across three waves, spaced seven months apart. Results show that associations between parenting and child behavior did not depend on children's negative emotionality. Sensory processing sensitivity, however, interacted with both (changes in) negative and (changes in) positive parenting in predicting externalizing, but not prosocial, behavior. Depending on the interaction, vantage sensitivity and differential susceptibility models were supported. The findings suggest that sensory processing sensitivity may be a more proximal correlate of individual differences in susceptibility, compared with negative emotionality.

 **Panagiotidi, M., Overton, P. G., & Stafford, T. (2018). The relationship between ADHD traits and sensory sensitivity in the general population. *Comprehensive Psychiatry,80*, 179-185. doi:10.1016/j.comppsych.2017.10.008**

Preliminary studies in children and adults with Attention Deficit Hyperactivity Disorder (ADHD) report both hypo-responsiveness and hyper-responsiveness to sensory stimuli, as well as problems modulating sensory input. As it has been suggested that those with ADHD exist at the extreme end of a continuum of ADHD traits, which are also evident in the general population, we investigated the link between ADHD and sensory sensitivity in the general population. Two online questionnaires measuring ADHD traits and sensory responsivity across various sensory domains were administered to 234 participants. Results showed a highly significant positive correlation between the number of ADHD traits and the frequency of reported sensory processing problems. An increased number of sensory difficulties across all modalities were associated with the level of ADHD. Furthermore, ADHD traits predicted sensory difficulties and exploratory factor analysis revealed a factor that combined ADHD trait and sensory processing items. This is the first study to identify a positive relationship between sensory processing and ADHD traits in the general population. Our results suggest that sensory difficulties could be part of the ADHD phenotype.

# Damiano-Goodwin, C. R., Woynaroski, T. G., Simon, D. M., Ibañez, L. V., Murias, M., Kirby, A., . . . Cascio, C. J. (2018). Developmental sequelae and neurophysiologic substrates of sensory seeking in infant siblings of children with autism spectrum disorder. *Developmental Cognitive Neuroscience,29*, 41-53. doi:10.1016/j.dcn.2017.08.005

It has been proposed that early differences in sensory responsiveness arise from atypical neural function and produce cascading effects on development across domains. This longitudinal study prospectively followed infants at heightened risk for autism spectrum disorder (ASD) based on their status as younger siblings of children diagnosed with ASD (Sibs-ASD) and infants at relatively lower risk for ASD (siblings of typically developing children; Sibs-TD) to examine the developmental sequelae and possible neurophysiological substrates of a specific sensory response pattern: unusually intense interest in nonsocial sensory stimuli or "sensory seeking." At 18 months, sensory seeking and social orienting were measured with the Sensory Processing Assessment, and a potential neural signature for sensory seeking (i.e., frontal alpha asymmetry) was measured via resting state electroencephalography. At 36 months, infants' social symptomatology was assessed in a comprehensive diagnostic evaluation. Sibs-ASD showed elevated sensory seeking relative to Sibs-TD, and increased sensory seeking was concurrently associated with reduced social orienting across groups and resting frontal asymmetry in Sibs-ASD. Sensory seeking also predicted later social symptomatology. Findings suggest that sensory seeking may produce cascading effects on social development in infants at risk for ASD and that atypical frontal asymmetry may underlie this atypical pattern of sensory responsiveness.

### **Tavassoli, T., Miller, L. J., Schoen, S. A., Brout, J. J., Sullivan, J., & Baron-Cohen, S. (2018). Sensory reactivity, empathizing and systemizing in autism spectrum conditions and sensory processing disorder. *Developmental Cognitive Neuroscience,29*, 72-77. doi:10.1016/j.dcn.2017.05.005**

Although the DSM-5 added sensory symptoms as a criterion for ASC, there is a group of children who display sensory symptoms but do not have ASC; children with sensory processing disorder (SPD). To be able to differentiate these two disorders, our aim was to evaluate whether children with ASC show more sensory symptomatology and/or different cognitive styles in empathy and systemizing compared to children with SPD and typically developing (TD) children. The study included 210 participants: 68 children with ASC, 79 with SPD and 63 TD children. The Sensory Processing Scale Inventory was used to measure sensory symptoms, the Autism Spectrum Quotient (AQ) to measure autistic traits, and the Empathy Quotient (EQ) and Systemizing Quotient (SQ) to measure cognitive styles. Across groups, a greater sensory symptomatology was associated with lower empathy. Further, both the ASC and SPD groups showed more sensory symptoms than TD children. Children with ASC and SPD only differed on sensory under-reactivity. The ASD group did, however, show lower empathy and higher systemizing scores than the SPD group. Together, this suggest that sensory symptoms alone may not be adequate to differentiate children with ASC and SPD but that cognitive style measures could be used for differential diagnosis.

**Green, S. A., Hernandez, L. M., Bowman, H. C., Bookheimer, S. Y., & Dapretto, M. (2018). Sensory over-responsivity and social cognition in ASD: Effects of aversive sensory stimuli and attentional modulation on neural responses to social cues. *Developmental Cognitive Neuroscience,29*, 127-139. doi:10.1016/j.dcn.2017.02.005**

Sensory over-responsivity (SOR) is a common condition in autism spectrum disorders (ASD) that is associated with greater social impairment. However, the mechanisms through which sensory stimuli may affect social functioning are not well understood. This study used fMRI to examine brain activity while interpreting communicative intent in 15 high-functioning youth with ASD and 16 age- and IQ-matched typically-developing (TD) controls. Participants completed the task with and without a tactile sensory distracter, and with and without instructions directing their attention to relevant social cues. When completing the task in the presence of the sensory distracter, TD youth showed increased activity in auditory language and frontal regions whereas ASD youth showed decreased activation in these areas. Instructions mitigated this effect such that ASD youth did not decrease activation during tactile stimulation; instead, the ASD group showed increased medial prefrontal activity. SOR severity modulated the effect of the tactile stimulus on social processing. Results demonstrate for the first time a neural mechanism through which sensory stimuli cause disruption of social cognition, and that attentional modulation can restore neural processing of social cues through prefrontal regulation. Findings have implications for novel, integrative interventions that incorporate attentional directives to target both sensory and social symptoms.

**Lopez, C., Hemimou, C., Golse, B., & Vaivre-Douret, L. (2018). Developmental dysgraphia is often associated with minor neurological dysfunction in children with developmental coordination disorder (DCD). *Neurophysiologie Clinique,48*(4), 207-217. doi:10.1016/j.neucli.2018.01.002**

#### **Objectives:** Children with developmental coordination disorder (DCD) are particularly affected by handwriting disorders, which remain poorly understood and are not clearly defined. The aim of our study is to provide a better understanding of handwriting disorders, and specifically of dysgraphia in children with DCD.

#### **Methods:** Sixty-five children with DCD (5-15 years), enrolled according to DSM-5, were assessed with handwriting testing and standardized assessments of neuropsychological, neurovisual, MRI and neuro psychomotor functions, with special attention paid to muscular tone examination.

#### **Results:** While handwriting disorders were strongly represented in our sample of children with DCD (89%), dysgraphia appeared uncommon (17%) and was closely related to several specific dysfunctions of laterality establishment; mild pyramidal tract dysfunction with distal phasic stretch reflex (PSR) in lower limbs; digital praxis slowness (both P<0.05).

#### **Discussion:** In our sample, dysgraphia was closely related to minor neurological dysfunction (MND) suggesting a disturbance of motor control at the level of the corticospinal motor pathway. This highlights the uncommon character of dysgraphia in children with DCD for which diagnosis should be made through a particular attention to evaluation of MND with muscular tone examination. This consideration, both in the research setting and in clinical practice, appears necessary to avoid inaccurate clinical diagnosis and to optimize appropriate therapeutic management.

### **Hofsten, C. V., & Rosander, K. (2018). The Development of Sensorimotor Intelligence in Infants. *Studying the Perception-Action System as a Model System for Understanding Development Advances in Child Development and Behavior,*73-106. doi:10.1016/bs.acdb.2018.04.003**

Infancy is the most dynamic part of human development. During this period, all basic sensorimotor and cognitive abilities are established. In this chapter, we will trace some of the important achievements of this development with a focus on how infants achieve predictive control of actions, i.e., how they come to coordinate their behavior with the ongoing events in the world without lagging behind. With the maturation of the brain, new possibilities that have profound effects on cognition open up. Some of them are core abilities, i.e., they function at birth or very early in development. Important examples are the structured perception of objects and surfaces and the control of arm movements. Closely after birth, infants move their arms to the vicinity of objects in front of them demonstrating that they have some control of their arms and indicating that they perceive objects as such. Another example is the rapid onset of smooth-pursuit eye movements during the second month of life and the emerging ability to predict when and where an occluded moving object will reappear. At 4 months of age, out of sight is no longer of mind. The child's sensorimotor system is especially designed to facilitate the extraction of knowledge about the world including other people. In addition, the infant is endowed with motives that ensure that the innate predispositions are transformed into a system of knowledge for guiding actions predictively. By perceiving and acting on the world, infants develop their cognition and through developmental studies; we can learn more about these processes.

**Hannant, P., Cassidy, S., Weyer, R. V., & Mooncey, S. (2018). Sensory and motor differences in Autism Spectrum Conditions and developmental coordination disorder in children: A cross-syndrome study. *Human Movement Science,58*, 108-118. doi:10.1016/j.humov.2018.01.010**

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Recent research has shown that Developmental coordination disorder (DCD) can present with some similar symptomology as Autism Spectrum Conditions (ASC). This paper therefore explored the similarities and differences in coordination and sensory responsivity between DCD and ASC. 77 children took part: 42 (35 male, 7 female) with ASC (ages 7-21: mean age 12.23 years), 26 (19 male, 7 female) with DCD (ages 7-21; mean age 11.07 years) and 9 (2 male, 7 female) with ASC and DCD (ages 8-15; mean age 12.27). All groups completed a battery of validated parent report measures online that included motor coordination (DCDQ), sensory responsivity (SPC-R) and social communication measures (AQ). Results showed no significant differences in coordination, and some significant differences in sensory responsivity between ASC and DCD (increased visual and auditory responsivity and decreased proprioception). Exploratory analysis showed that these differences showed good validity in identifying the diagnosis of ASC and DCD. These results elucidate the underlying causes of motor coordination difficulties in both conditions. Specifically, ASC coordination difficulties appear linked to visual processing impairments, whilst DCD coordination difficulties appear to be linked to spatial processing. This may aid better diagnosis and intervention for these conditions.

**Bröring, T., Königs, M., Oostrom, K. J., Lafeber, H. N., Brugman, A., & Oosterlaan, J. (2018). Sensory processing difficulties in school-age children born very preterm: An exploratory study. *Early Human Development,117*, 22-31. doi:10.1016/j.earlhumdev.2017.12.003**

**Background:** Very preterm birth has a detrimental impact on the developing brain, including widespread white matter brain abnormalities that threaten efficient sensory processing. Yet, sensory processing difficulties in very preterm children are scarcely studied, especially at school age.
**Purpose:** To investigate somatosensory registration, multisensory integration and sensory modulation.
Participants: 57 very preterm school-age children (mean age=9.2years) were compared to 56 gender and age matched full-term children.
**Methods:** Group differences on somatosensory registration tasks (Registration of Light Touch, Sensory Discrimination of Touch, Position Sense, Graphestesia), a computerized multisensory integration task, and the parent-reported Sensory Profile were investigated using t-tests and Mann-Whitney U tests.
**Results:** In comparison to full-term children, very preterm children are less accurate on somatosensory registration tasks, including Registration of Light Touch (d=0.34), Position Sense (d=0.31) and Graphestesia (d=0.42) and show more sensory modulation difficulties (d=0.41), including both behavioral hyporesponsivity (d=0.52) and hyperresponsivity (d=0.56) to sensory stimuli. Tactile discrimination and multisensory integration efficiency were not affected in very preterm children. Aspects of sensory processing were only modestly related.
**Conclusion**: Very preterm children show sensory processing difficulties regarding somatosensory registration and sensory modulation and preserved multisensory (audio-visual) integration. Follow-up care for very preterm children should involve screening of sensory processing difficulties at least up to school age.

**Kaur, M., Srinivasan, S. M., & Bhat, A. N. (2018). Comparing motor performance, praxis, coordination, and interpersonal synchrony between children with and without Autism Spectrum Disorder (ASD). *Research in Developmental Disabilities,72*, 79-95. doi:10.1016/j.ridd.2017.10.025**

Children with Autism Spectrum Disorder (ASD) have basic motor impairments in balance, gait, and coordination as well as autism-specific impairments in praxis/motor planning and interpersonal synchrony. Majority of the current literature focuses on isolated motor behaviors or domains. Additionally, the relationship between cognition, symptom severity, and motor performance in ASD is unclear. We used a comprehensive set of measures to compare gross and fine motor, praxis/imitation, motor coordination, and interpersonal synchrony skills across three groups of children between 5 and 12 years of age: children with ASD with high IQ (HASD), children with ASD with low IQ (LASD), and typically developing (TD) children. We used the Bruininks-Oseretsky Test of Motor Proficiency and the Bilateral Motor Coordination subtest of the Sensory Integration and Praxis Tests to assess motor performance and praxis skills respectively. Children were also examined while performing simple and complex rhythmic upper and lower limb actions on their own (solo context) and with a social partner (social context). Both ASD groups had lower gross and fine motor scores, greater praxis errors in total and within various error types, lower movement rates, greater movement variability, and weaker interpersonal synchrony compared to the TD group. In addition, the LASD group had lower gross motor scores and greater mirroring errors compared to the HASD group. Overall, a variety of motor impairments are present across the entire spectrum of children with ASD, regardless of their IQ scores. Both, fine and gross motor performance significantly correlated with IQ but not with autism severity; however, praxis errors (mainly, total, overflow, and rhythmicity) strongly correlated with autism severity and not IQ. Our study findings highlight the need for clinicians and therapists to include motor evaluations and interventions in the standard-of-care of children with ASD and for the broader autism community to recognize dyspraxia as an integral part of the definition of ASD.

**Ropar, D., Greenfield, K., Smith, A. D., Carey, M., & Newport, R. (2018). Body representation difficulties in children and adolescents with autism may be due to delayed development of visuo-tactile temporal binding. *Developmental Cognitive Neuroscience,29*, 78-85. doi:10.1016/j.dcn.2017.04.007**

Recent research suggests visuo-tactile binding is temporally extended in autism spectrum disorders (ASD), although it is not clear whether this specifically underlies altered body representation in this population. In the current study children and adolescents with ASD, and typically developing controls, placed their hand into mediated reality system (MIRAGE) and saw two identical live video images of their own right hand. One image was in the proprioceptively correct location (veridical hand) and the other was displaced to either side. While visuo-tactile feedback was applied via brushstroke to the participant's (unseen) right finger, they viewed one hand image receiving synchronous brushstrokes and the other receiving brushstrokes with a temporal delay (60, 180 and 300ms). After brushing, both images disappeared from view and participants pointed to a target, with direction of movement indicating which hand was embodied. ASD participants, like younger mental aged-matched controls, showed reduced embodiment of the spatially incongruent, but temporally congruent, hand compared to chronologically age-matched controls at shorter temporal delays. This suggests development of visuo-tactile integration may be delayed in ASD. Findings are discussed in relation to atypical body representation in ASD and how this may contribute to social and sensory difficulties within this population.

**Leno, V. C., Chandler, S., White, P., Yorke, I., Charman, T., Pickles, A., & Simonoff, E. (2018). Alterations in electrophysiological indices of perceptual processing and discrimination are associated with co-occurring emotional and behavioural problems in adolescents with autism spectrum disorder. *Molecular Autism,9*(1). doi:10.1186/s13229-018-0236-2**

**Background**: Many young people with autism spectrum disorder (ASD) experience emotional and behavioural problems. However, the causes of these co-occurring difficulties are not well understood. Perceptual processing atypicalities are also often reported in individuals with ASD, but how these relate to co-occurring emotional and behavioural problems remains unclear, and few studies have used objective measurement of perceptual processing.
**Methods**: Event-related potentials (ERPs) were recorded in response to both standard and deviant stimuli (which varied in pitch) in an auditory oddball paradigm in adolescents (mean age of 13.56 years, SD = 1.12, range = 11.40-15.70) with ASD (n = 43) with a wide range of IQ (mean IQ of 84.14, SD = 24.24, range 27-129). Response to deviant as compared to standard stimuli (as indexed by the mismatch negativity (MMN)) and response to repeated presentations of standard stimuli (habituation) were measured. Multivariate regression tested the association between neural indices of perceptual processing and co-occurring emotional and behavioural problems.
**Results**: Greater sensitivity to changes in pitch in incoming auditory information (discrimination), as indexed by increased MMN amplitude, was associated with higher levels of parent-rated behaviour problems. MMN amplitude also showed a trend positive correlation with parent-rated sensory hyper-sensitivity. Conversely, greater habituation at the later N2 component was associated with higher levels of emotional problems. Upon more detailed analyses, this appeared to be driven by a selectively greater ERP response to the first (but not the second or third) standard stimuli that followed deviant stimuli. A similar pattern of association was found with other measures of anxiety. All results remained in covariation analyses controlling for age, sex and IQ, although the association between MMN amplitude and behaviour problems became non-significant when controlling for ASD severity.
**Conclusions**: Findings suggest that alterations in mechanisms of perceptual processing and discrimination may be important for understanding co-occurring emotional and behavioural problems in young people with ASD.

**Lönnberg, P., Niutanen, U., Parham, L. D., Wolford, E., Andersson, S., Metsäranta, M., & Lano, A. (2018). Sensory-motor performance in seven-year-old children born extremely preterm. *Early Human Development,120*, 10-16. doi:10.1016/j.earlhumdev.2018.03.012**

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#### **Background**: Children born preterm are prone to motor problems. Research on their motor performance has, however, rarely been integrated with sensory processing.

#### **Purpose**: To examine sensory-motor performance in children born extremely preterm (EPT).

#### Method: In a longitudinal prospective cohort study, 49 EPT (born <28 gestational weeks; 32 boys and 17 girls) and 33 term-born (16 boys and 17 girls) children were assessed with six individual subtests from the Sensory Integration and Praxis Tests at the age of 7.0 to 7.3 years.

#### **Results**: The rate of test z-scores indicating dysfunction [from -2 standard deviations (SD) to < -1 SD for mild and < -2 SD for moderate-to-severe] was significantly higher in EPT children than in term-born children in all the subtests. When comparing mean performance adjusted for gender and mother's education, EPT children performed worse than term-born children in Design Copying (z-score difference - 0.83; 95% confidence interval -1.32 to -0.34), Motor Accuracy (-0.82; -1.26 to -0.38), Postural Praxis (-0.95; -1.45 to -0.45), Manual Form Perception (-0.59; -1.12 to -0.06), and Finger Identification (-0.88; -1.45 to -0.31). Additional adjustment for Full-Scale Intelligence Quotient rendered difference in Manual Form Perception non-significant.

#### **Conclusion**: Seven-year-old EPT children perform worse than their term-born peers in tests for visual-motor, somatosensory, and motor planning performance.

**2017**

**Kaur, M., Srinivasan, S. M., & Bhat, A. N. (2018). Comparing motor performance, praxis, coordination, and interpersonal synchrony between children with and without Autism Spectrum Disorder (ASD). *Research in Developmental Disabilities,* *72*, 79-95. doi:10.1016/j.ridd.2017.10.025**

Children with Autism Spectrum Disorder (ASD) have basic motor impairments in balance, gait, and coordination as well as autism-specific impairments in praxis/motor planning and interpersonal synchrony. Majority of the current literature focuses on isolated motor behaviors or domains. Additionally, the relationship between cognition, symptom severity, and motor performance in ASD is unclear. We used a comprehensive set of measures to compare gross and fine motor, praxis/imitation, motor coordination, and interpersonal synchrony skills across three groups of children between 5 and 12 years of age: children with ASD with high IQ (HASD), children with ASD with low IQ (LASD), and typically developing (TD) children. We used the Bruininks-Oseretsky Test of Motor Proficiency and the Bilateral Motor Coordination subtest of the Sensory Integration and Praxis Tests to assess motor performance and praxis skills respectively. Children were also examined while performing simple and complex rhythmic upper and lower limb actions on their own (solo context) and with a social partner (social context). Both ASD groups had lower gross and fine motor scores, greater praxis errors in total and within various error types, lower movement rates, greater movement variability, and weaker interpersonal synchrony compared to the TD group. In addition, the LASD group had lower gross motor scores and greater mirroring errors compared to the HASD group. Overall, a variety of motor impairments are present across the entire spectrum of children with ASD, regardless of their IQ scores. Both, fine and gross motor performance significantly correlated with IQ but not with autism severity; however, praxis errors (mainly, total, overflow, and rhythmicity) strongly correlated with autism severity and not IQ. Our study findings highlight the need for clinicians and therapists to include motor evaluations and interventions in the standard-of-care of children with ASD and for the broader autism community to recognize dyspraxia as an integral part of the definition of ASD

**Redman-Bentley, D., Armstrong, D., Walker, K., & Remick-Waltman, K. (2017). Balance and visual skills: Comparison of children with sensory processing disorders and typical development. *Archives of Physical Medicine and Rehabilitation,* *98*(10). doi:10.1016/j.apmr.2017.08.113**

**Purpose:** To determine differences in balance and visual skill between children with sensory processing disorders (SPD) and typical development, and to investigate the relationship between balance and visual skills in these children. Design Clinical features of children with SPD were examined using the Short Sensory Profile, Smart Balance Master and vision tests. Physical therapists, optometrists, or trained student research assistants conducted tests. All tests occurred during one 90-minute session. Results were compared to typically developing children. Setting Academic medical institution.

**Participants**: Children ages 7-11 years and their parents, recruited from community school districts and clinics, volunteered for study. Children in typical group (n=75) exhibited no health conditions; those in sensory group (n=75) presented with ADHD/ASD/LD, or scored definite SPD on the Short Sensory Profile. The institution approved the protocol; parents and children signed informed consent/assent forms. Interventions None. Main Outcome Measure(s) Primary measures at start of the study comprised Sensory Organization Test (SOT) using computerized dynamic posturography and visual tests including stereoacuity, convergence, accommodation, oculomotor, developmental eye movement, visual motor integration and visual tracing. Results Data were available for 75 children in typical group and 73 in sensory group; one child was untestable, one excluded on vision. Normality tests revealed population was not from normal distribution. Non-parametric and parametric tests were used to compare differences on SOT and visual test scores; Spearman correlation was used to show association between SOT and visual tests. Groups differed significantly on most vision and all SOT tests (p values from 0.001-0.030). Correlations varied for the groups; some correlations were weak but significant. Conclusion/Discussion Special vision tests may be useful to screen children with potential SPD. Balance may be an issue more in children with SPD than those developing typically.

**Beaudry-Bellefeuille, I., & Lane, S. J. (2017). Examining sensory over responsiveness in preschool children with retentive fecal incontinence. *American Journal of Occupational Therapy,* *71*(5). doi:10.5014/ajot.2017.022707**

The development of bowel control is an important activity of daily living in early childhood, and challenges in this area can limit participation in key occupations. Retentive fecal incontinence (RFI) is a common disorder in children. Up to 50% of children do not respond adequately to initial medical intervention, and behaviors around toileting, some related to sensory over responsivity (SOR), may be partly responsible. Therefore, this study investigated the relationship between RFI and SOR and also examined the discriminative validity of the Toileting Habit Profile Questionnaire (THPQ). Per parent report, children with RFI (n = 16) showed significantly more behaviors related to SOR compared with typically developing children (n = 27). In addition, results indicated that the THPQ effectively discriminates between children with RFI and typically developing children. Results are discussed regarding RFI and SOR, the impact of RFI on childhood occupational engagement, and the role of occupational therapy with this population.

**Allen, S., & Casey, J. (2017). Developmental coordination disorders and sensory processing and integration: Incidence, associations and co-morbidities. *British Journal of Occupational Therapy,* *80*(9), 549-557. doi:10.1177/0308022617709183**

Introduction Children with developmental coordination disorder or sensory processing and integration difficulties face challenges to participation in daily living. To date there has been no exploration of the co-occurrence of developmental coordination disorders and sensory processing and integration difficulties. Method Records of children meeting Diagnostic and Statistical Manual – V criteria for developmental coordination disorder (n = 93) age 5 to 12 years were examined. Data on motor skills (Movement Assessment Battery for Children – 2) and sensory processing and integration (Sensory Processing Measure) were interrogated. Results Of the total sample, 88% exhibited some or definite differences in sensory processing and integration. No apparent relationship was observed between motor coordination and sensory processing and integration. The full sample showed high rates of some difficulties in social participation, hearing, body awareness, balance and motion, and planning and ideation. Further, children with co-morbid autistic spectrum disorder showed high rates of difficulties with touch and vision. Conclusion Most, but not all, children with developmental coordination disorder presented with some difficulties in sensory processing and integration that impacted on their participation in everyday activities. Sensory processing and integration difficulties differed significantly between those with and without co-morbid autistic spectrum disorder.

**Little, L., Dean, E., Tomchek, S., & Dunn, W. (2018). Sensory Processing Patterns in Autism, Attention Deficit Hyperactivity Disorder, and Typical Development. *Physical & Occupational Therapy In Pediatrics , 38*(3), 243-254. doi:10.1080/01942638.2017.1390809**

**Purpose**: The purpose of this study was to examine sensory processing in children ages 3–14 years with autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and typical development (TD) using the Sensory Profile 2nd Edition (Dunn, 2014).

**Methods**: Participants included 239 children (ASD = 77; ADHD = 78; TD = 84) matched on age and gender. Multivariate analysis of covariance was used to compare the extent to which the three groups differed on sensory processing patterns (i.e., sensitivity, avoiding, registration, seeking) and sensory systems (i.e., auditory, visual, touch, movement, body position, oral, conduct, attention, social). We also examined the effect of chronological age.

**Results**: Children with ASD and ADHD did not differ in sensory processing patterns which were elevated as compared to a TD group. Children with ASD showed the highest rate of oral processing differences, followed by ADHD and TD. Children with ADHD had higher visual processing scores than children with ASD and TD. Older children had lower scores for seeking, auditory, visual, movement, touch, and conduct than younger children, regardless of diagnosis.

**Conclusions**: Findings suggest that sensory features may be an area of overlap of behaviors in ASD and ADHD, which may have implications for intervention approaches for children with these conditions.

**Summers, J., Shahrami, A., Cali, S., D’Mello, C., Kako, M., Palikucin-Reljin, A., . . . Lunsky, Y. (2017). Self-injury in Autism Spectrum Disorder and Intellectual Disability: Exploring the role of reactivity to pain and sensory input. *Brain Sciences,* *7*(12), 140. doi:10.3390/brainsci7110140**

This paper provides information about the prevalence and topography of self-injurious behavior in children and adults with autism spectrum disorder and intellectual disability. Dominant models regarding the etiology of self-injury in this population are reviewed, with a focus on the role of reactivity to pain and sensory input. Neuroimaging studies are presented, and suggestions are offered for future research.

**Sanz-Cervera, P., Pastor-Cerezuela, G., González-Sala, F., Tárraga-Mínguez, R., & Fernández-Andrés, M. (2017). Sensory processing in children with Autism Spectrum Disorder and/or Attention Deficit Hyperactivity Disorder in the home and classroom contexts. *Frontiers in Psychology,* *8*, 1772. doi:10.3389/fpsyg.2017.01772**

Children with neurodevelopmental disorders often show impairments in sensory processing (SP) and higher functions. The main objective of this study was to compare SP, praxis and social participation (SOC) in four groups of children: ASD Group (n = 21), ADHD Group (n = 21), ASD+ADHD Group (n = 21), and Comparison Group (n = 27). Participants were the parents and teachers of these children who were 5-8 years old (M = 6.32). They completed the Sensory Processing Measure (SPM) to evaluate the sensory profile, praxis and SOC of the children in both the home and classroom contexts. In the home context, the most affected was the ASD+ADHD group. The ADHD group obtained higher scores than the ASD group on the Body Awareness (BOD) subscale, indicating a higher level of dysfunction. The ASD group, however, did not obtain higher scores than the ADHD group on any subscale. In the classroom context, the most affected were the two ASD groups: the ASD+ADHD group obtained higher scores than the ADHD group on the Hearing (HEA) and Social Participation (SOC) subscales, and the ASD group obtained higher scores than the ADHD group on the SOC subscale. Regarding sensory modalities, difficulties in proprioception seem to be more characteristic to the ADHD condition. As for higher-level functioning, social difficulties seem to be more characteristic to the ASD condition. Differences between the two contexts were only found in the ASD group, which could be related to contextual hyperselectivity, an inherent autistic feature. Despite possible individual differences, specific intervention programs should be developed to improve the sensory challenges faced by children with different diagnoses.

**Machado, A., Oliveira, S., Magalhães, L., Miranda, D., & Bouzada, M. (2017). Sensory processing during childhood in preterm infants: A systematic review. *A Revista Paulista de Pediatria,* *35*(1), 92-101. doi:10.1590/1984-0462/;2017;35;1;00008**

**Objective**: To conduct a systematic search for grounded and quality evidence of sensory processing in preterm infants during childhood. DATA **Source**: The search of the available literature on the theme was held in the following electronic databases: Medical Literature Analysis and Retrieval System Online (Medline)/PubMed, Latin American and Caribbean Literature in Health Sciences (Lilacs)/Virtual Library in Health (BVS), Índice Bibliográfico Español de Ciencias de la Salud (IBECS)/BVS, Scopus, and Web of Science. We included only original indexed studies with a quantitative approach, which were available in full text on digital media, published in Portuguese, English, or Spanish between 2005 and 2015, involving children aged 0-9years.

**Data Synthesis:** 581 articles were identified and eight were included. Six studies (75%) found high frequency of dysfunction in sensory processing in preterm infants. The association of sensory processing with developmental outcomes was observed in three studies (37.5%). The association of sensory processing with neonatal characteristics was observed in five studies (62.5%), and the sensory processing results are often associated with gestational age, male gender, and white matter lesions.

**Conclusions**: The current literature suggests that preterm birth affects the sensory processing, negatively. Gestational age, male gender, and white matter lesions appear as risk factors for sensory processing disorders in preterm infants. The impairment in the ability to receive sensory inputs, to integrate and to adapt to them seems to have a negative effect on motor, cognitive, and language development of these children. We highlight the feasibility of identifying sensory processing disorders early in life, favoring early clinical interventions.

**Repetto, L. P., Jasmin, E., Fombonne, E., Gisel, E., & Couture, M. (2017). Longitudinal study of sensory features in children with Autism Spectrum Disorder. *Autism Research and Treatment,* *2017*, 1-8. doi:10.1155/2017/1934701**

**Background**: Between 45 and 95% of children with Autism Spectrum Disorder (ASD) present sensory features that affect their daily functioning. However, the data in the scientific literature are not conclusive regarding the evolution of sensory features in children with ASD. The main objective of this study was to analyze the sensory features of children within the age of 3-4 (T1) when they received their ASD diagnosis and two years later (T2) when they started school.

**Methods**: We conducted a prospective cohort study to assess sensory features in 34 children with ASD over time. The data were collected using a standardized assessment tool, the Sensory Profile.

**Results**: Our analyses show that sensory features in children with ASD are stable from the age of three to six years. The stability of sensory scores is independent of correction by covariates, such as cognitive level and autism severity scores.

 **Conclusions**: Children with ASD have sensory features that persist from the time of diagnosis at the age of 3 to 4 years to school age. This persistence of sensory features from an early age underscores the need to support these children and their parents. Sensory features should be detected early and managed to improve functional and psychosocial outcomes.

**Flanagan, J., Schoen, S., & Miller, L. J. (2017). Early identification of sensory processing challenges in infants at risk for sensory processing challenges. *American Journal of Occupational Therapy,* *71*(4). doi:10.5014/ajot.2017.71s1-po5154**

This groundbreaking pilot study found group differences between infants and toddlers at high and low risk for sensory processing disorder (SPD) and may provide valuable information for future longitudinal studies on early indicators of SPD. Results have clinical implications for occupational therapists.

**Jorquera-Cabrera, S., Romero-Ayuso, D., Rodriguez-Gil, G., & Triviño-Juárez, J. (2017). Assessment of sensory processing characteristics in children between 3 and 11 years old: A systematic review. *Frontiers in Pediatrics,* *5*. doi:10.3389/fped.2017.00057**

The assessment of sensory perception, discrimination, integration, modulation, praxis, and other motor skills, such as posture, balance, and bilateral motor coordination, is necessary to identify the sensory and motor factors influencing the development of personal autonomy. The aim of this work is to study the assessment tools currently available for identifying different patterns of sensory processing. There are 15 tests available that have psychometric properties, primarily for the US population. Nine of them apply to children in preschool and up to grade 12. The assessment of sensory processing is a process that includes the use of standardized tests, administration of caregiver questionnaires, and clinical observations. The review of different studies using PRISMA criteria or Osteba Critical Appraisal Cards reveals that the most commonly used tools are the Sensory Integration and Praxis Test, the Sensory Processing Measure, and the Sensory Profile.

**Thye, M. D., Bednarz, H. M., Herringshaw, A. J., Sartin, E. B., & Kana, R. K. (2017). The impact of atypical sensory processing on social impairments in autism spectrum disorder. *Developmental Cognitive Neuroscience,* *16*. doi:10.1016/j.dcn.2017.04.010**

Altered sensory processing has been an important feature of the clinical descriptions of autism spectrum disorder (ASD). There is evidence that sensory dysregulation arises early in the progression of ASD and impacts social functioning. This paper reviews behavioral and neurobiological evidence that describes how sensory deficits across multiple modalities (vision, hearing, touch, olfaction, gustation, and multisensory integration) could impact social functions in ASD. Theoretical models of ASD and their implications for the relationship between sensory and social functioning are discussed. Furthermore, neural differences in anatomy, function, and connectivity of different regions underlying sensory and social processing are also discussed. We conclude that there are multiple mechanisms through which early sensory dysregulation in ASD could cascade into social deficits across development. Future research is needed to clarify these mechanisms, and specific focus should be given to distinguish between deficits in primary sensory processing and altered top-down attentional and cognitive processes.

**Schoen, S. A., Miller, L. J., & Mulligan, S. (2017). Categorizing sensory processing and integration challenges: The first step in evidence-based practice. *American Journal of Occupational Therapy,* *71*(4). doi:10.5014/ajot.2017.71s1-rp201a**

This study addresses the need to define the phenotype of sensory processing and integration subtypes, information necessary for appropriate treatment planning and creation of homogenous samples for research. Cluster analysis identified three distinct modulation subgroups with unique characteristics.

**Reynolds, J. E., Kerrigan, S., Elliott, C., Lay, B. S., & Licari, M. K. (2016). Poor imitative performance of unlearned gestures in children with probable developmental coordination disorder. *Journal of Motor Behavior,* *49*(4), 378-387. doi:10.1080/00222895.2016.1219305**

It has been hypothesized that deficits in imitation, linked to abnormal functioning of the mirror neuron system (MNS), may contribute to the motor impairments associated with developmental coordination disorder (DCD). The authors aimed to examine imitation of complex novel postures and sequences of gestures in children with and without probable DCD (pDCD), using the postural praxis and sequencing praxis subtests of the Sensory Integration and Praxis Tests (Ayres, 1989 ). Participants were 29 boys with pDCD between 6.08 and 13.33 years old, and 29 group age-matched typically developing boys between 6.08 and 13.83 years old. Responses of children with pDCD on both imitation tasks were less accurate than controls, with group differences more apparent with increasing task complexity. Furthermore, as a group, children with pDCD were slower and had a higher number of non-mirror-imitated responses. There was considerable variability within the pDCD group, with some children displaying imitation scores within the normative range. Given the importance of imitation and visual learning for motor development, the difficulties in imitation displayed by some children with pDCD have the potential to impact on movement acquisition. Interventions to target imitation may be beneficial for these children. The results show that children with pDCD had difficulty imitating complex novel postures, children with pDCD had difficulty imitating gesture sequences, children with pDCD had slower responses than controls, group differences in imitation performance increased with task complexity, and not all children with pDCD displayed imitation deficits.

**Hand, B. N., Lane, A. E., Boeck, P. D., Basso, D. M., Nichols-Larsen, D. S., & Darragh, A. R. (2017). Caregiver Burden Varies by Sensory Subtypes and Sensory Dimension Scores of Children with Autism. *Journal of Autism and Developmental Disorders*. doi:10.1007/s10803-017-3348-1**

Understanding characteristics associated with burden in caregivers of children with autism spectrum disorder (ASD) is critical due to negative health consequences. We explored the association between child sensory subtype, sensory dimension scores, and caregiver burden. A national survey of caregivers of children with ASD aged 5-13 years was conducted (n = 367). The relationship between variables of interest and indicators of caregiver burden, including health-related quality of life (HRQOL) and caregiver strain, was examined with canonical correlation analyses. Caregiver strain was, but caregiver HRQOL was not, significantly associated with child sensory subtype and sensory dimension scores. Caregiver age, child age, and household income were also associated with caregiver strain. Potential explanatory mechanisms for these findings, derived from published qualitative studies, are discussed.

**Miller, L. J., Schoen, S. A., Mulligan, S., & Sullivan, J. (2017). Identification of Sensory Processing and Integration Symptom Clusters: A Preliminary Study. *Occupational Therapy International,* 1-10. doi:10.1155/2017/2876080**

Rationale. This study explored subtypes of sensory processing disorder (SPD) by examining the clinical presentations of cluster groups that emerged from scores of children with SPD on the Sensory Processing 3-Dimension (SP-3D) Inventory. Method. A nonexperimental design was used involving data extraction from the records of 252 children with SPD. Exploratory cluster analyses were conducted with scores from the SP-3D Inventory which measures sensory overresponsivity (SOR), sensory under responsivity (SUR), sensory craving (SC), postural disorder, dyspraxia, and sensory discrimination. Scores related to adaptive behavior, social-emotional functioning, and attention among children with different sensory modulation patterns were then examined and compared. Results. Three distinct cluster groups emerged from the data: High SOR only, High SUR with SOR, and High SC with SOR. All groups showed low performance within multiple domains of adaptive behavior. Atypical behaviors associated with social-emotional functioning and attention varied among the groups. Implications. The SP-3D Inventory shows promise as a tool for assisting in identifying patterns of sensory dysfunction and for guiding intervention. Better characterization can guide intervention precision and facilitate homogenous samples for research.

**2016**

**Chang, S. H., & Yu, N. Y. (2016). Comparison of motor praxis and performance in children with varying levels of developmental coordination disorder. *Human movement science*, *48*, 7-14.**

The praxis test is a less well-documented method to determine functional manifestations of childhood dyspraxia. For this study, children aged 6-8 years were recruited as follows: 17 children with DCD, 18 at risk of DCD and 35 without obvious problems in motor coordination. The Movement Assessment Battery for Children (MABC-2) was used to measure motor performance and identify the motor incoordination. This study developed a battery of tests to assess limb praxis using a praxis imagery questionnaire, gesture representation, and questions about knowledge of object use. In the comparison of subtests within the praxis test, significant differences were observed across groups on the praxis imagery questionnaire and gesture representation tests but not on knowledge of object use. Similar results were observed in the correlation analyses, in which a weak relationship between MABC-2 and praxis tests was observed. The DCD group had lower scores on the praxis imagery questionnaire, whereas the group at risk of DCD had lower scores on most gesture production tests. Our study provides a better understanding of the nature of the childhood dyspraxia and sheds light on its effect on motor coordination to identify praxis tests with specific clinical meanings in children with movement disorders.

**Lee, K., Lambert, H., Wittich, W., Kehayia, E., & Park, M. (2016). The use of movement-based interventions with children diagnosed with autism for psychosocial outcomes—A scoping review. *Research in Autism Spectrum Disorders*, *24*, 52-67.**

Over the past decade, research evidence on the sensory motor challenges associated with autism spectrum disorder (ASD) raises questions about the unilateral focus on psychosocial criteria for the diagnostic category and shifts attention from perspectives that focus solely on behavioral deficits towards a more embodied perspective of the spectrum. The focus on embodiment in autism research forges a link between psychosocial deficits and sensory motor challenges. Further, sensory motor actions and experiences are the foundation for cognition, emotions and communication within conceptualizations of embodiment. This unifies theoretical divisions between body and mind. This shift of perspective raises the question of whether or not there is a gap between emergent research knowledge and its implementation in practice. Thus, the aim of this scoping review was to understand the extent of research on interventions focused on the use of sensory motor based or movement based interventions (MBI) to target psychosocial outcomes for children with autism. Using a combination of a descriptive numerical analysis and a thematic analysis of fourteen studies, this scoping review provides the preliminary evidence of the efficacy of MBIs for children with ASD and questions actual research practices to measure psychosocial changes.

**Farmer, M., Echenne, B., & Bentourkia, M. H. (2016). Study of clinical characteristics in young subjects with Developmental coordination disorder. *Brain and Development*, *38*(6), 538-547.**

**Background:**Developmental Coordination Disorder (DCD) is a chronic neurological disorder observed in children. DCD is characterized by slowness in activities and motor impairment that affects the children's daily living and academic achievements, and later their professional and social behavior. Our aim in this work was to report characteristics frequencies in a group of children with DCD and to propose a subtyping of DCD characteristics.

**Methods**: Thirty-three clinical DCD characteristics, the mostly reported in the literature, were assessed in 129 patients, boys and girls aged from 4 years to 18 years, and their subtyping was proposed. The statistical analyses were carried out with the Chi square, the t-test and the correlation for the statistical differences, and with the Ward clustering method for subtyping.

**Results**: We found that there were 3.17 boys for one girl, all patients were characterized as slow, 47% were left-handers or ambidextrous, 36% and 26% had orofacial and verbal dyspraxia, respectively, 83% were found anxious, and 84% were described as being clumsy.

**Conclusions**: It appears from these results that a child with DCD expresses more than a single difficulty. Three subtypes emerged from the statistical analysis in this study: (1) clumsiness and other characteristics except language difficulties; (2) self-esteem and peer relation without clumsiness and language difficulties; (3) language difficulties and orofacial dyspraxia.

**Stewart, C. R., Sanchez, S. S., Grenesko, E. L., Brown, C. M., Chen, C. P., Keehn, B., ... & Müller, R. A. (2016). Sensory symptoms and processing of nonverbal auditory and visual stimuli in children with autism spectrum disorder. *Journal of autism and developmental disorders*, *46*(5), 1590-1601.**

Atypical sensory responses are common in autism spectrum disorder (ASD). While evidence suggests impaired auditory-visual integration for verbal information, findings for nonverbal stimuli are inconsistent. We tested for sensory symptoms in children with ASD (using the Adolescent/Adult Sensory Profile) and examined unisensory and bisensory processing with a nonverbal auditory-visual paradigm, for which neurotypical adults show bisensory facilitation. ASD participants reported more atypical sensory symptoms overall, most prominently in the auditory modality. On the experimental task, reduced response times for bisensory compared to unisensory trials were seen in both ASD and control groups, but neither group showed significant race model violation (evidence of intermodal integration). Findings do not support impaired bisensory processing for simple nonverbal stimuli in high-functioning children with ASD.

**Doumas, M., McKenna, R., & Murphy, B. (2016). Postural control deficits in autism spectrum disorder: the role of sensory integration. *Journal of autism and developmental disorders*, *46*(3), 853-861.**

We investigated the nature of sensory integration deficits in postural control of young adults with ASD. Postural control was assessed in a fixed environment, and in three environments in which sensory information about body sway from visual, proprioceptive or both channels was inaccurate. Furthermore, two levels of inaccurate information were used within each channel (gain 1 and 1.6). ASD participants showed greater postural sway when information from both channels was inaccurate. In addition, control participants' ellipse area at gain 1.6 was identical to ASD participants' at gain 1, reflecting hyper-reactivity in ASD. Our results provide evidence for hyper-reactivity in posture-related sensory information, which reflects a general, rather than channel-specific sensory integration impairment in ASD.

**Hong, S. Y., Jung, N. H., & Kim, K. M. (2016). The correlation between proprioception and handwriting legibility in children. *Journal of physical therapy science*, *28*(10), 2849-2851.**

**Purpose**: This study investigated the association between proprioception, including joint position sense and kinetic sense, and handwriting legibility in healthy children.

**Methods**: Assessment of joint position sense, kinetic sense, and handwriting legibility was conducted for 19 healthy children. Joint position sense was assessed by asking the children to flex their right elbow between 30° to 110° while blindfolded. The range of elbow movement was analyzed with Compact Measuring System 10 for 3D motion Analysis. Kinetic sense was assessed using the Sensory Integration and Praxis Test. The children were directed to write 30 words from the Korean alphabet, and the legibility of their handwriting was scored for form, alignment, space, size, and shape. To analyze the data, descriptive statistics and Spearman correlation analysis were conducted using IBM SPSS Statistics 20.0.

**Results**: There was significant negative correlation between handwriting legibility and Kinetic sense. A significant correlation between handwriting legibility and Joint position sense was not found.

**Conclusion**:This study showed that a higher Kinetic sense was associated with better legibility of handwriting. Further work is needed to determine the association of handwriting legibility and speed with Joint position sense of the elbow, wrist, and fingers.

[**Reynolds JE**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Reynolds%20JE%5BAuthor%5D&cauthor=true&cauthor_uid=27726691)**,**[**Kerrigan S**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Kerrigan%20S%5BAuthor%5D&cauthor=true&cauthor_uid=27726691)**,**[**Elliott C**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Elliott%20C%5BAuthor%5D&cauthor=true&cauthor_uid=27726691)**,**[**Lay BS**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Lay%20BS%5BAuthor%5D&cauthor=true&cauthor_uid=27726691)**, &** [**Licari MK**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Licari%20MK%5BAuthor%5D&cauthor=true&cauthor_uid=27726691)**. (2016). Poor imitative performance of unlearned gestures in children with probable developmental coordination disorder.** [**J Mot Behav.**](https://www.ncbi.nlm.nih.gov/pubmed)**11, 1-10.**

It has been hypothesized that deficits in imitation, linked to abnormal functioning of the mirror neuron system (MNS), may contribute to the motor impairments associated with developmental coordination disorder (DCD). The authors aimed to examine imitation of complex novel postures and sequences of gestures in children with and without probable DCD (pDCD), using the postural praxis and sequencing praxis subtests of the Sensory Integration and Praxis Tests (Ayres, 1989 ). Participants were 29 boys with pDCD between 6.08 and 13.33 years old, and 29 group age-matched typically developing boys between 6.08 and 13.83 years old. Responses of children with pDCD on both imitation tasks were less accurate than controls, with group differences more apparent with increasing task complexity. Furthermore, as a group, children with pDCD were slower and had a higher number of non-mirror-imitated responses. There was considerable variability within the pDCD group, with some children displaying imitation scores within the normative range. Given the importance of imitation and visual learning for motor development, the difficulties in imitation displayed by some children with pDCD have the potential to impact on movement acquisition. Interventions to target imitation may be beneficial for these children. The results show that children with pDCD had difficulty imitating complex novel postures, children with pDCD had difficulty imitating gesture sequences, children with pDCD had slower responses than controls, group differences in imitation performance increased with task complexity, and not all children with pDCD displayed imitation deficits.

**Philpott-Robinson, K., Lane, A. E., & Harpster, K. (2016). Sensory features of toddlers at risk for Autism Spectrum Disorder. *American Journal of Occupational Therapy*, *70*(4), 7004220010p1-7004220010p8.**

**Objective:** We observed sensory features in toddlers ages 12-24 months with risk factors for autism spectrum disorder (ASD) and explored their relationship to general development and early signs of ASD.

**Methods:** Participants (N = 46) included toddlers with higher risk for ASD. All participants were administered standardized assessments of sensory features, early signs of ASD, and general development at a single study visit.

**Results:** Sensory features in toddlers were characterized as either adaptive or reactive. Toddlers with more difficulties in oral sensory processing displayed more early signs of ASD. Typical oral and auditory processing were associated with higher cognitive function, and toddlers with fewer sensory features overall had more mature language skills.

**Conclusion:** Specific sensory features were associated with both early signs of ASD and less mature general development. Replication of this preliminary study is required.

**Clince, M., Connolly, L., & Nolan, C. (2016). Comparing and exploring the sensory processing patterns of higher education students with Attention Deficit Hyperactivity Disorder and Autism Spectrum Disorder. *American Journal of Occupational Therapy*, *70*(2), 7002250010p1-7002250010p9.**

Research regarding sensory processing and adults with attention deficit hyperactivity disorder (ADHD) or autism spectrum disorder (ASD) is limited. This study aimed to compare sensory processing patterns of groups of higher education students with ADHD or ASD and to explore the implications of these disorders for their college life.

#### **Method**: The Adolescent/Adult Sensory Profile was administered to 28 students with ADHD and 27 students with ASD. Students and professionals were interviewed.

#### **Results**:The majority of students received scores that differed from those of the general population. Students with ADHD received significantly higher scores than students with ASD in relation to sensation seeking; however, there were no other major differences.

#### **Conclusion**: Few differences exist between the sensory processing patterns of students with ADHD and ASD; however, both groups differ significantly from the general population. Occupational therapists should consider sensory processing patterns when designing supports for these groups.

**Ziereis, S., & Jansen, P. (2016). Correlation of motor abilities and executive functions in children with ADHD. *Applied Neuropsychology: Child*, *5*(2), 138-148.**

Children with attention-deficit hyperactivity disorder (ADHD) commonly experience issues with both cognitive and motor abilities. This study aimed to determine whether a correlation exists between these 2 domains in children with ADHD. Tasks assessing executive function and motor performance were carried out with a sample of 50 children. The data demonstrated significant correlations between performance in motor activities and working memory. Performance in working memory was explained predominantly by manual dexterity and catching and aiming. These results support the hypothesis that training of these motor tasks could improve executive functioning in children with ADHD.

**Howe, F. E., & Stagg, S. D. (2016). How sensory experiences affect adolescents with an autistic spectrum condition within the classroom. *Journal of autism and developmental disorders*, *46*(5), 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, 2002a), 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.

**Tavassoli, T., Bellesheim, K., Siper, P. M., Wang, A. T., Halpern, D., Gorenstein, M., ... & Buxbaum, J. D. (2016). Measuring sensory reactivity in autism spectrum disorder: application and simplification of a clinician-administered sensory observation scale. *Journal of autism and developmental disorders*, *46*(1), 287-293.**

Sensory reactivity is a new DSM-5 criterion for autism spectrum disorder (ASD). The current study aims to validate a clinician-administered sensory observation in ASD, the Sensory Processing Scale Assessment (SPS). The SPS and the Short Sensory Profile (SSP) parent-report were used to measure sensory reactivity in children with ASD (n = 35) and typically developing children (n = 27). Sixty-five percent of children with ASD displayed sensory reactivity symptoms on the SPS and 81.1 % on the SSP. SPS scores significantly predicted SSP scores. We next identified the five SPS tasks that best differentiated groups. Our results indicate that a combination of parent-report and at least the five most differentiating observational tasks may be most sensitive in identifying the presence of sensory reactivity issues.

**Bitsika, V., Sharpley, C. F., & Mills, R. (2016). Are sensory processing features associated with depressive symptoms in boys with an ASD?. *Journal of autism and developmental disorders*, *46*(1), 242-252.**

The association between Sensory Processing Features (SPF) and depressive symptoms was investigated at two levels in 150 young males (6-18 years) with an ASD. First, a significant correlation was found between SPF and total depressive symptom scores. Second, different aspects of SPF significantly predicted different depressive symptom factors, with Low Registration (or sensory hyposensitivity) being the most powerful predictor of depressive symptoms. There were also differences in these associations according to whether parents' ratings or the boys' self-reports were used to assess SPF and depressive symptoms. Implications for assessment and treatment of SPF-related depressive symptoms are discussed.

[**Cascio CJ**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cascio%20CJ%5BAuthor%5D&cauthor=true&cauthor_uid=24091471)**,**[**Lorenzi J**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Lorenzi%20J%5BAuthor%5D&cauthor=true&cauthor_uid=24091471)**, &** [**Baranek GT**](https://www.ncbi.nlm.nih.gov/pubmed/?term=Baranek%20GT%5BAuthor%5D&cauthor=true&cauthor_uid=24091471)**. (2016). Self-reported pleasantness ratings and examiner-coded defensiveness in response to touch in children with ASD: Effects of stimulus material and bodily location.** [**J Autism Dev Disord.**](https://www.ncbi.nlm.nih.gov/pubmed)**46(5):1528-37. doi: 10.1007/s10803-013-1961-1.**

Tactile defensiveness, characterized by behavioral hyperresponsiveness and negative emotional responses to touch, is a common manifestation of aberrant sensory processing in autism spectrum disorders (ASD) and other developmental disabilities (DD). Variations in tactile defensiveness with the properties of the stimulus and the bodily site of stimulation have been addressed in adults with self-report of perceived tactile pleasantness, but not in children. We presented three materials (pleasant, unpleasant, social) at three bodily sites and measured both examiner-coded defensiveness and self-reported pleasantness from a group of children with ASD and two comparison groups (one with DD, one with typical development (TD)). The main findings were: (1) children with ASD and DD showed significantly more defensiveness reactions and lower pleasantness ratings than the TD group, with higher variability, (2) there was a double dissociation for the effects of material and bodily site of stimulation: while bodily site predicted behavioral defensiveness, material predicted pleasantness rating. Additionally, it was noted that (3) the most pleasant material and the social touch conditions best distinguished ASD and DD from TD on defensiveness, and (4) within the ASD group, social impairment and defensiveness in bodily sites associated with social touch were positively correlated, suggesting a clinically relevant distinction between social and discriminative touch in ASD.

**Coulthard, H., & Sahota, S. (2016). Food neophobia and enjoyment of tactile play: Associations between preschool children and their parents. *Appetite*, *97*, 155-159.**

A cross-sectional study was conducted to examine whether the relationship between enjoyment of tactile play and food neophobia observed in children (Coulthard & Thakker, 2015) would be related to levels seen in their parents. One hundred and twenty six participants were recruited from playgroup centres in the Walsall area of the West Midlands, UK; 63 children (2-5 years; 30 girls and 33 boys) and 63 attendant parents (53 mothers and 10 fathers). Children and their parents' enjoyment of a tactile play task was rated by both the parent and a researcher, and questionnaire measures of food neophobia and tactile sensitivity were completed by the parent for both themselves and their children. Strong associations were found between parent and child scores across all the measures; food neophobia, tactile sensitivity and tactile play enjoyment. The variables most strongly related to child food neophobia were parental neophobia and enjoyment of tactile play (parent and child). These findings indicate that family resemblance exists not only for food neophobia, but for tactile sensory processing as well, and may represent a possible inherited route to neophobia. The findings strengthen the suggestion that tactile processing is associated with food neophobia although the causal nature of this relationship is still not known.

**2015**

**Bodison, S. C. (2015). Developmental dyspraxia and the play skills of children with autism. *American Journal of Occupational Therapy*, *69*(5), 6905185060p1-6905185060p6.**

**Objective:** This study sought to investigate the impact of developmental dyspraxia on the play skills of children with autism spectrum disorder (ASD).

**Method:** The praxis abilities of 32 children with ASD (mean age = 7.5 yr) were assessed using two subtests of the Sensory Integration and Praxis Tests and the Planning and Ideas domain of the Sensory Processing Measure Home Form. Play and leisure skills were measured with the Vineland Adaptive Behavior Scales, Second Edition. Utilizing correlation coefficients, we investigated the relationship between developmental dyspraxia and the play skills of children with ASD.

**Results:** Children with ASD demonstrated definite dysfunction in imitative praxis abilities, the generation of ideas, and participation in age-appropriate play and leisure activities.

**Conclusion:** Praxis problems in children with ASD greatly affect their successful participation in play and leisure activities.

**Thornton, A., Licari, M., Reid, S., Armstrong, J., Fallows, R., & Elliott, C. (2015). Cognitive Orientation to (Daily) Occupational Performance intervention leads to improvements in impairments, activity and participation in children with Developmental Coordination Disorder. *Disability and rehabilitation*, 1-8.**

**Introduction**: Children diagnosed with Developmental Coordination Disorder (DCD) present with a variety of impairments in fine and gross motor function, which impact on their activity and participation in a variety of settings. This research aimed to determine if a 10-week group-based Cognitive Orientation to Daily Occupational Performance (CO-OP) intervention improved outcome measures across the impairment, activity and participation levels of the International Classification of Functioning, Disability and Health (ICF) framework. Methods: In this quasi-experimental, pre–post-test, 20 male children aged 8–10 years (9y1m ± 9 m) with a confirmed diagnosis of DCD participated in either the 10 week group intervention based on the CO-OP framework (n = 10) or in a control period of regular activity for 10 weeks (n = 10). Outcome measures relating to impairment (MABC-2, motor overflow assessment), activity (Handwriting Speed Test) and participation [Canadian Occupational Performance Measure, (COPM) and Goal Attainment Scale) were measured at weeks 0 and 10 in the intervention group. Results: Children who participated in the CO-OP intervention displayed improvements in outcome measures for impairment, activity and participation, particularly a reduction in severity of motor overflow. Parent and child performance and satisfaction ratings on the COPM improved from baseline to week 10 and all goals were achieved at or above the expected outcome. No significant changes were reported for the control group in impairment and activity (participation was not measured for this group). Conclusion: The strategies implemented by children in the CO-OP treatment group, targeted towards individualised goal attainment, show that CO-OP, when run in a group environment, can lead to improvements across all levels of the ICF.

**Demopoulos, C., Brandes-Aitken, A. N., Desai, S. S., Hill, S. S., Antovich, A. D., Harris, J., & Marco, E. J. (2015). Shared and divergent auditory and tactile processing in children with autism and children with sensory processing dysfunction relative to typically developing peers. *Journal of the International Neuropsychological Society*, *21*(06), 444-454.**

The aim of this study was to compare sensory processing in typically developing children (TDC), children with Autism Spectrum Disorder (ASD), and those with sensory processing dysfunction (SPD) in the absence of an ASD. Performance-based measures of auditory and tactile processing were compared between male children ages 8–12 years assigned to an ASD (N=20), SPD (N=15), or TDC group (N=19). Both the SPD and ASD groups were impaired relative to the TDC group on a performance-based measure of tactile processing (right-handed graphesthesia). In contrast, only the ASD group showed significant impairment on an auditory processing index assessing dichotic listening, temporal patterning, and auditory discrimination. Furthermore, this impaired auditory processing was associated with parent-rated communication skills for both the ASD group and the combined study sample. No significant group differences were detected on measures of left-handed graphesthesia, tactile sensitivity, or form discrimination; however, more participants in the SPD group demonstrated a higher tactile detection threshold (60%) compared to the TDC (26.7%) and ASD groups (35%). This study provides support for use of performance-based measures in the assessment of children with ASD and SPD and highlights the need to better understand how sensory processing affects the higher order cognitive abilities associated with ASD, such as verbal and non-verbal communication, regardless of diagnostic classification. (JINS, 2015, 21, 444–454)

**Tavassoli, T., Bellesheim, K., Tommerdahl, M., Holden, J. M., Kolevzon, A., & Buxbaum, J. D. (2015). Altered tactile processing in children with autism spectrum disorder. *Autism Research*.**

Although tactile reactivity issues are commonly reported in children with autism spectrum disorder (ASD), the underlying mechanisms are poorly understood. Less feed-forward inhibition has been proposed as a potential mechanism for some symptoms of ASD. We tested static and dynamic tactile thresholds as a behavioral proxy of feed-forward inhibition in 42 children (21 children with ASD and 21 typically developing [TD] children). Subthreshold conditioning typically raises the dynamic detection threshold, thus comparison of the dynamic to the static threshold generates a metric that predicts gamma-aminobutyric acid (GABA) mediated feed-forward inhibition. Children with ASD had marginally higher static thresholds and a significantly lower ratio between thresholds as compared with TD children. The lower ratio, only seen in children with ASD, might be indicative of less inhibition. Static thresholds were correlated with autism spectrum quotient scores, indicating the higher the tactile threshold, the more ASD traits. The amount of feed-forward inhibition (ratio between dynamic/static) was negatively correlated with autism diagnostic observation schedule repetitive behavior scores, meaning the less inhibition the more ASD symptoms. In summary, children with ASD showed altered tactile processing compared with TD children; thus measuring static and dynamic thresholds could be a potential biomarker for ASD and might be useful for prediction of treatment response with therapeutics, including those that target the GABAergic system.

**Rahkonen, P., Lano, A., Pesonen, A. K., Heinonen, K., Räikkönen, K., Vanhatalo, S., ... & Metsäranta, M. (2015). Atypical sensory processing is common in extremely low gestational age children. *Acta Paediatrica*, *104*(5), 522-528.**

**Purpose:** Atypical sensory processing is common in children born extremely prematurely. We investigated sensory processing abilities in extremely low gestational age (ELGA) children and analysed associated neonatal risk factors, neuroanatomical findings and neurodevelopmental outcome.

**Methods:** We carried out a prospective study of 44 ELGA children, including 42 who had undergone brain magnetic resonance imaging (MRI) at term-equivalent age, when they were 2 years of corrected age. Their sensory processing abilities were assessed with the Infant/Toddler Sensory Profile questionnaire and their neurodevelopmental with a structured Hempel neurological examination, Griffiths Mental Developmental Scales and Bayley Scales of Infant and Toddler Development Third Edition.

**Results:** Sensory profiles were definitely or probably atypical (<−1 SD) in half of the ELGA children, and the most common behavioral pattern was low registration (23%). Sensation seeking was associated with abnormalities in grey and/or white matter in the brain MRI (p < 0.01). Atypical oral sensory processing was associated with surgical closure of the patent ductus arteriosus (p = 0.02, adjusted p < 0.01).

**Conclusion:** Atypical sensory processing in ELGA children was common, and children with neonatal neuroanatomical lesions tended to present specific behavioral responses to sensory stimuli. Surgical closure of the patent ductus arteriosus may predispose infants to feeding problems due to atypical oral sensory processing.

**McCormick, C., Hepburn, S., Young, G. S., & Rogers, S. J. (2015). Sensory symptoms in children with autism spectrum disorder, other developmental disorders and typical development: A longitudinal study. *Autism*, 1362361315599755.**

Sensory symptoms are prevalent in autism spectrum disorder but little is known about the early developmental patterns of these symptoms. This study examined the development of sensory symptoms and the relationship between sensory symptoms and adaptive functioning during early childhood. Three groups of children were followed across three time points from 2 to 8 years of age: autism spectrum disorder, developmental delay, and typical development. At each time point, parents filled out questionnaires regarding their child’s sensory symptoms and adaptive functioning. At the initial time point, parents of children with autism spectrum disorder reported more sensory symptoms in their children than parents in the typical development group. Parents in the autism spectrum disorder group reported more sensory symptoms than parents in the developmental delay group within smell, taste, and auditory domains. While the typical development group decreased in reported sensory symptoms across the study period, the clinical groups demonstrated no significant change across assessment points. Sensory symptoms for all groups were not independently predictive of adaptive functioning when verbal mental age was also included in the model. The young age range at the initial assessment and pattern of results suggest that sensory symptoms are present early in the etiology of autism spectrum disorder and other developmental disorders and remain stable over time.

**Matsushima, K., Matsubayashi, J., Toichi, M., Funabiki, Y., Kato, T., Awaya, T., & Kato, T. (2016). Unusual sensory features are related to resting-state cardiac vagus nerve activity in autism spectrum disorders. *Research in Autism Spectrum Disorders*, *25*, 37-46.**

The relationship between unusual sensory features (hyper-reactivity, hypo-reactivity, and unusual sensory interests) and the [parasympathetic nervous system](http://topics.sciencedirect.com/topics/page/Parasympathetic_nervous_system) in [autism](http://topics.sciencedirect.com/topics/page/Autism) spectrum disorder (ASD) has recently garnered interest. The purpose of this study was to investigate whether unusual sensory features are associated with resting-state cardiac [vagus nerve](http://topics.sciencedirect.com/topics/page/Vagus_nerve) activity in ASD children. [Electrocardiogram](http://topics.sciencedirect.com/topics/page/Electrocardiography) signals were recorded during three 2-min resting periods to quantify the high frequency (HF) component of [heart rate variability](http://topics.sciencedirect.com/topics/page/Heart_rate_variability) ([HRV](http://topics.sciencedirect.com/topics/page/Heart_rate_variability)) in 37 children with ASD aged 6–12 and 32 typically developing children. Parent-reported questionnaires (Short Sensory Profile, SSP; Social Responsiveness Scale-2, SRS-2) assessed atypical sensory behaviors in daily life and autistic traits. Children with ASD consistently showed lower HF-HRV than typically developing children across the three resting periods. The SSP “*Visual/Auditory Sensitivity*” score was correlated with resting-state HF-HRV in the ASD group, indicating that ASD children with more severe visual/auditory hyper-reactivity in daily life have lower vagus nerve activity. The SRS-2 “*Restricted Interests and Repetitive Behavior*” score was also correlated with resting-state HF-HRV in the ASD group. These findings suggest that ASD children with lower vagus nerve activity may have inadequate self-regulatory capacity and difficulty regulating behavioral responses to unpredictable and unavoidable visual/auditory stimuli in daily life.

**Tavassoli, T., Bellesheim, K., Siper, P. M., Wang, A. T., Halpern, D., Gorenstein, M., ... & Buxbaum, J. D. (2016). Measuring sensory reactivity in Autism Spectrum Disorder: Application and simplification of a clinician-administered sensory observation scale. *Journal of autism and developmental disorders*, *46*(1), 287-293.**

Sensory reactivity is a new DSM-5 criterion for autism spectrum disorder (ASD). The current study aims to validate a clinician-administered sensory observation in ASD, the Sensory Processing Scale Assessment (SPS). The SPS and the Short Sensory Profile (SSP) parent-report were used to measure sensory reactivity in children with ASD (n = 35) and typically developing children (n = 27). Sixty-five percent of children with ASD displayed sensory reactivity symptoms on the SPS and 81.1 % on the SSP. SPS scores significantly predicted SSP scores. We next identified the five SPS tasks that best differentiated groups. Our results indicate that a combination of parent-report and at least the five most differentiating observational tasks may be most sensitive in identifying the presence of sensory reactivity issues.

**Schaaf, R. C., & Lane, A. E. (2015). Toward a best-practice protocol for assessment of sensory features in ASD. *Journal of autism and developmental disorders*, *45*(5), 1380-1395.**

Sensory difficulties are a commonly occurring feature of autism spectrum disorders and are now included as one manifestation of the ‘restricted, repetitive patterns of behavior, interests, or activities’ diagnostic criteria of the DSM5 necessitating guidelines for comprehensive assessment of these features. To facilitate the development of such guidelines, this paper provides an overview of the literature on sensory features in autism spectrum disorder. We summarize the literature pertaining to: terminology, current assessment practices, sensory development, and the relationship of sensory features to core symptoms of autism. The paper concludes with recommendations for clinical assessment of sensory features in Autism.

**Liu, W. Y., Lien, H. Y., Wang, H. S., Wong, A. M. K., Tang, S. F. T., & Lin, Y. H. (2015). Deficits in sensory organization for postural stability in children with Tourette syndrome. *Clinical neurology and neurosurgery*, *129*, S36-S40.**

Tourette syndrome (TS) is a childhood-onset developmental disorder characterized by involuntary motor and vocal tics. Previous studies have indicated that children with TS demonstrate postural control anomalies when standing. The aim of this study was to compare postural stability under normal and altered sensory conditions in children with TS and healthy control (HC) children. A convenience sample of twelve children with TS (9 boys and 3 girls; 9.4 ± 1.1 yr) and 12 HC age- and gender-matched children (9.2 ± 1.1 yr) participated in this study. The Sensory Organization Test (SOT) was used to assess postural stability under six altered sensory conditions (1. normal vision, fixed support; 2. eyes closed, fixed support; 3. vision sway-referenced, fixed support; 4. normal vision, support sway-referenced; 5. eyes closed, support surface sway-referenced; 6. both vision and support surface sway-referenced) using the SMART Balance Master® 8.2 (NeuroCom® International, Inc, Clackamas, OR, USA). The results showed significant differences between the two groups in conditions 5 and 6 (p=0.003 and 0.002, respectively). The mean composite equilibrium score in children with TS was significantly lower than that of HC children (p<0.000). The results suggested that children with TS had greater difficulty in maintaining postural stability, especially when vestibular information was challenged. The results of this study provide supporting evidence for possible deficits in impaired access to vestibular information and sensorimotor integration of postural control in children with TS.

**Mazor-Karsenty, T., Parush, S., Bonneh, Y., & Shalev, L. (2015). Comparing the executive attention of adult females with ADHD to that of females with sensory modulation disorder (SMD) under aversive and non-aversive auditory conditions. *Research in developmental disabilities*, *37*, 17-30.**

Certain behavioral expressions of sensory modulation disorder (SMD) such as distractibility, hyperactivity, and [impulsivity](http://topics.sciencedirect.com/topics/page/Impulsivity) are often similar to those of [attention deficit/hyperactivity disorder](http://topics.sciencedirect.com/topics/page/Attention_deficit_hyperactivity_disorder) ([ADHD](http://topics.sciencedirect.com/topics/page/Attention_deficit_hyperactivity_disorder)) in [pediatric](http://topics.sciencedirect.com/topics/page/Pediatrics) and adult populations. There is also a high [comorbidity](http://topics.sciencedirect.com/topics/page/Comorbidity) rate between these two diagnoses and absence of research regarding the objective neuropsychological differentiation between them. In the present study we employed a factorial design which enabled us to: (a) systematically examine the effects of SMD and ADHD on executive attention in a sample of adult females using a Stroop-like task, and (b) measure the effect of aversive conditions (sounds) on executive attention. The experimental measures used were the *Stroop-like Location – Direction Task* (*SLDT*) to assess executive attention and the battery of aversiveness to sounds (BAS), a standardized measure of aversive sounds that was developed for this study and enabled individual customization of aversive auditory sounds. Results revealed, as expected, a specific core deficit in executive attention for the ADHD factor. In addition to that, the present study provides an important, pioneering finding of SMD impairment in a unique combination of a cognitively demanding task with aversive sounds, providing preliminary objective evidence differentiating SMD from ADHD.

**Nederkoorn, C., Jansen, A., & Havermans, R. C. (2015). Feel your food. The influence of tactile sensitivity on picky eating in children. *Appetite*, *84*, 7-10.**

Children who are very picky in eating frequently refuse the intake of foods. This rejection is not only based on the evaluation of taste, but also on tactile qualities of foods. It matters whether food is crispy or slimy, consistent, or with bits and pips. It is hypothesised that children who are more sensitive to touch and dislike the feel of various tactile stimuli in general, are also more dismissive of tactile stimulation in their mouth and therefore more selective in their eating. In the present study, 44 children between the ages of 4 and 10 were asked to feel different tactile stimuli with their hands and to taste different foods. Results showed a significant positive correlation between the evaluations of the two modalities, especially for the younger subjects. This suggests that tactile sensitivity might play a role in the acceptance of food. Future research could explore if training children to tolerate more tactile stimuli would also increase their appreciation of a wider variety of foods.

**Li, K. Y., Su, W. J., Fu, H. W., & Pickett, K. A. (2015). Kinesthetic deficit in children with developmental coordination disorder. *Research in developmental disabilities*, *38*, 125-133.**

The aim of this study was to measure and compare kinesthetic sensitivity in children with developmental coordination disorder (DCD) and typically developing (TD) children between 6 and 11 years old. 30 children with DCD aged 6 to 11 years (5 in each age group) and 30 TD children participated in the study. Participants placed their forearms on a passive motion apparatus which extended the elbow joint at constant velocities between 0.15 and 1.35°s(-1). Participants were required to concentrate on detection of passive arm motion and press a trigger held in their left hand once they sensed it. The detection time was measured for each trial. The DCD group was significantly less sensitive in detection of passive motion than TD children. Further analysis of individual age groups revealed that kinesthetic sensitivity was worse in DCD than TD children for age groups beyond six years of age. Our findings suggested that individual with DCD lag behind their TD counterparts in kinesthetic sensitivity. Between the ages of 7 and 11 years the difference between groups is quantifiable and significant with 11 year old children with DCD performing similar to 7 year old TD children.

**Kirby, A. V., Little, L. M., Schultz, B., & Baranek, G. T. (2015). Observational characterization of sensory interests, repetitions, and seeking behaviors. *American Journal of Occupational Therapy*, *69*(3), 6903220010p1-6903220010p9.**

Sensory interests, repetitions, and seeking behaviors (SIRS) are common among children with autism spectrum disorder (ASD) and other developmental disabilities (DD) and involve unusual actions that intensify or reinforce a sensory experience. Researchers and practitioners typically use parent-report measures or informal clinical observations to understand the presence and nature of SIRS. In this study, we used a scoring supplement to the Sensory Processing Assessment for Young Children, an observational measure, to characterize SIRS across three groups of children-those with ASD (n=40), DD (n=37), and typical development (n=39). Group differences were identified in frequency and intensity of overall SIRS, complexity of SIRS, and incidence of particular types of SIRS (i.e., posturing, sighting, proprioceptive seeking, spinning). Facial affect was also explored and found to be primarily neutral during engagement in SIRS across groups. Implications for practice and future research are discussed.

**Adams, J. N., Feldman, H. M., Huffman, L. C., & Loe, I. M. (2015). Sensory processing in preterm preschoolers and its association with executive function. *Early human development*, *91*(3), 227-233.**

**Background:** Symptoms of abnormal sensory processing have been related to preterm birth,but have not yet been studied specifically in preterm preschoolers. The degree of association between sensory processing and other domains is important for understanding the role of sensory processing symptoms in the development of preterm children.

**Purpose:** To test two related hypotheses: (1) preterm preschoolers have more sensory processing symptoms than full term preschoolers and (2) sensory processing is associated with both executive function and adaptive function in preterm preschoolers.

**Study design:** Cross-sectional study.

**Subjects:** Preterm children (≤34weeks of gestation; n=54) and full term controls (≥37weeks of gestation; n=73) ages 3-5years.

**Outcome Measure:** Sensory processing was assessed with the Short Sensory Profile. Executive function was assessed with (1) parent ratings on the Behavior Rating Inventory of Executive Function - Preschool version and (2) a performance-based battery of tasks. Adaptive function was assessed with the Vineland Adaptive Behavior Scales-II.

**Results:** Preterm preschoolers showed significantly more sensory symptoms than full term controls. A higher percentage of preterm than full term preschoolers had elevated numbers of sensory symptoms (37% vs. 12%). Sensory symptoms in preterm preschoolers were associated with scores on executive function measures, but were not significantly associated with adaptive function.

**Conclusion:** Preterm preschoolers exhibited more sensory symptoms than full term controls. Preterm preschoolers with elevated numbers of sensory symptoms also showed executive function impairment. Future research should further examine whether sensory processing and executive function should be considered independent or overlapping constructs.

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**Rahkonen, P., Lano, A., Pesonen, A. K., Heinonen, K., Räikkönen, K., Vanhatalo, S., ... & Metsäranta, M. (2015). Atypical sensory processing is common in extremely low gestational age children. *Acta Paediatrica*, *104*(5), 522-528.**

**Purpose:** Atypical sensory processing is common in children born extremely prematurely. We investigated sensory processing abilities in extremely low gestational age (ELGA) children and analysed associated neonatal risk factors, neuroanatomical findings and neurodevelopmental outcome.

**Methods:** We carried out a prospective study of 44 ELGA children, including 42 who had undergone brain magnetic resonance imaging (MRI) at term-equivalent age, when they were 2 years of corrected age. Their sensory processing abilities were assessed with the Infant/Toddler Sensory Profile questionnaire and their neurodevelopmental with a structured Hempel neurological examination, Griffiths Mental Developmental Scales and Bayley Scales of Infant and Toddler Development Third Edition.

**Results:** Sensory profiles were definitely or probably atypical (<-1 SD) in half of the ELGA children, and the most common behavioural pattern was low registration (23%). Sensation seeking was associated with abnormalities in grey and/or white matter in the brain MRI (p < 0.01). Atypical oral sensory processing was associated with surgical closure of the patent ductus arteriosus (p = 0.02, adjusted p < 0.01).

**Conclusion:** Atypical sensory processing in ELGA children was common, and children with neonatal neuroanatomical lesions tended to present specific behavioural responses to sensory stimuli. Surgical closure of the patent ductus arteriosus may predispose infants to feeding problems due to atypical oral sensory processing.

**Fernández-Andrés, M. I., Pastor-Cerezuela, G., Sanz-Cervera, P., & Tárraga-Mínguez, R. (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 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.

**Kirby, A. V., White, T. J., & Baranek, G. T. (2015). Caregiver strain and sensory features in children with autism spectrum disorder and other developmental disabilities. *American journal on intellectual and developmental disabilities*, *120*(1), 32-45.**

Caring for children with disabilities contributes to increased levels of parent stress or caregiver strain. However, the potential relationship of sensory features to strain among caregivers of children with autism spectrum disorder (ASD) and other developmental disabilities (DD) is unknown. Sensory features include overreactions, underreactions, and unusual interests in sensations, which may negatively impact family functioning. This descriptive study confirmed three caregiver strain types (i.e., objective, subjective internalized, subjective externalized) and explored differences among ASD (n  =  71) and DD (n  =  36) groups, with the ASD group reporting higher levels. Furthermore, this study explored the contribution of sensory features to caregiver strain, finding differential contributions to strain in the ASD group and covariate contributions (i.e., child cognition, mother's education) in the DD group.

**Wigham, S., Rodgers, J., South, M., McConachie, H., & Freeston, M. (2015). The interplay between sensory processing abnormalities, intolerance of uncertainty, anxiety and restricted and repetitive behaviors in autism spectrum disorder. *Journal of autism and developmental disorders*, *45*(4), 943-952.**

Sensory processing abnormalities, anxiety and restricted and repetitive behaviors (RRBs) frequently co-occur in autism spectrum disorders (ASD). Though the relationship between these phenomena is not well understood, emerging evidence indicates intolerance of uncertainty (IU) may play an important role. This study aimed to determine pathways between sensory abnormalities and RRBs, and the role anxiety and IU may have. We gathered caregiver report data for 53 children with ASD aged 8-16 years. We found sensory under responsiveness and sensory over responsiveness were significantly associated with repetitive motor and insistence on sameness behaviors, and the relationships significantly mediated by IU and anxiety. Our findings indicate different mechanisms may underpin repetitive motor and insistence on sameness RRBs, which can inform treatment interventions.

**Pfeiffer, B., Daly, B. P., Nicholls, E. G., & Gullo, D. F. (2015). Assessing sensory processing problems in children with and without attention deficit hyperactivity disorder. *Physical & occupational therapy in pediatrics*, *35*(1), 1-12.**

**Purpose:** This exploratory study investigated whether children with attention-deficit/hyperactivity disorder (ADHD) are at greater risk than children without ADHD for problems with sensory processing and if certain sensory systems are more closely associated with the core symptoms of ADHD, specifically inattention and hyperactivity/impulsivity.

**Methods:** The sample included 20 children with ADHD and 27 children without ADHD, ages 5 to 10 years. Assessments included the Sensory Processing Measure-Home Form and the Conners 3rd edition-Parent Short Form.

**Results:** After controlling for age, children with ADHD exhibited more sensory processing problems on all scales of the Sensory Processing Measure with small to medium effect sizes observed (η(2) = .27 to .61). For children with ADHD, the Social Participation (r = .50) and Planning and Ideas (r = .73) subtests of the Sensory Processing Measure were significantly associated with hyperactivity/impulsivity, but not with inattention on the subtests of the Conners Parent Short Form.

**Conclusion:** The results suggest the importance of assessing sensory processing issues in children with ADHD to guide in the intervention process.

**Schaaf, R. C., Benevides, T. W., Leiby, B. E., & Sendecki, J. A. (2015). Autonomic dysregulation during sensory stimulation in children with autism spectrum disorder. *Journal of autism and developmental disorders*, *45*(2), 461-472.**

Autonomic nervous system (ANS) activity during sensory stimulation was measured in 59 children with autism spectrum disorder (ASD) ages 6-9 in comparison to 30 typically developing controls. Multivariate comparisons revealed significant differences between groups in the respiratory sinus arrhythmia (parasympathetic measure) vector of means across sensory stimuli (p = 0.02) and in change from domain to domain (p = 0.01). Sympathetic activity, measured by pre-ejection period, did not differ significantly between groups, although it was higher in ASD participants. Findings suggest that participants with ASD demonstrated a different pattern of parasympathetic activity during sensory stimulation. Findings are discussed in relation to the biological mechanisms of sensory processing in autism, insight into the autism phenotype, and the utility of ANS activity as an outcome’s marker.

**Leonard, H. C., Bernardi, M., Hill, E. L., & Henry, L. A. (2015). Executive functioning, motor difficulties, and Developmental Coordination Disorder. *Developmental neuropsychology*, *40*(4), 201-215.**

The current study assessed a comprehensive range of executive functions (EFs) in children with poor motor skills, comparing profiles of children with a diagnosis of developmental coordination disorder (DCD) and those identified with motor difficulties (MD). Children in both groups performed more poorly than typically developing controls on nonverbal measures of working memory, inhibition, planning, and fluency, but not on tests of switching. The similar patterns of strengths and weaknesses in children with MD and DCD have important implications for parents, teachers, and clinicians, as children with MD may struggle with EF tasks even though their motor difficulties are not identified.

**Van der Linde, B. W., van Netten, J. J., Otten, B., Postema, K., Geuze, R. H., & Schoemaker, M. M. (2015). Activities of daily living in children with Developmental Coordination Disorder: Performance, Learning, and Participation. *Physical therapy*, *95*(11), 1496-1506.**

**Background:** Children with developmental coordination disorder (DCD) face evident motor difficulties in daily functioning. Little is known, however, about their difficulties in specific activities of daily living (ADL).

**Objective:** The purposes of this study were: (1) to investigate differences between children with DCD and their peers with typical development for ADL performance, learning, and participation, and (2) to explore the predictive values of these aspects.

**Design:** This was a cross-sectional study.

**Methods:** In both a clinical sample of children diagnosed with DCD (n=25 [21 male, 4 female], age range=5-8 years) and a group of peers with typical development (25 matched controls), the children's parents completed the DCDDaily-Q. Differences in scores between the groups were investigated using t tests for performance and participation and Pearson chi-square analysis for learning. Multiple regression analyses were performed to explore the predictive values of performance, learning, and participation.

**Results:** Compared with their peers, children with DCD showed poor performance of ADL and less frequent participation in some ADL. Children with DCD demonstrated heterogeneous patterns of performance (poor in 10%-80% of the items) and learning (delayed in 0%-100% of the items). In the DCD group, delays in learning of ADL were a predictor for poor performance of ADL, and poor performance of ADL was a predictor for less frequent participation in ADL compared with the control group.

**Limitations:** A limited number of children with DCD were addressed in this study.

**Conclusions:** This study highlights the impact of DCD on children's daily lives and the need for tailored intervention.

### **Van Damme, T., Sabbe, B., Van West, D., & Simons, J. (2015). Motor abilities of adolescents with a disruptive behavior disorder: The role of comorbidity with ADHD. *Research in developmental disabilities*, *40*, 1-10.**

The aim of this study was to explore the incidence, type and severity of motor impairment in male adolescents with a disruptive behavior disorder (DBD) and evaluate the role of comorbid ADHD. The Bruininks-Oseretsky test of motor proficiency, Second Edition was administered to examine a detailed motor profile and to compare the motor abilities of individuals with DBD (n = 99) to those of controls (n = 87). Additional subgroup analyses were conducted within the clinical population and encompassed (1) analyzing differences in motor profiles between individuals diagnosed with oppositional defiant disorder (ODD) or conduct disorder (CD) and (2) comparing the motor profiles of individuals with or without comorbid ADHD. The results indicated that individuals with a DBD showed a mixed motor impairment profile. Even after controlling for IQ, the DBD group obtained significantly lower scores in comparison to controls. The ODD and CD subgroups showed a similar motor profile. Presence of comorbid ADHD did not produce major differences in the motor profile. As approximately 79% of the adolescents with a DBD suffered from motor impairment, motor ability needs to be adequately addressed in research as well as in clinical practice.

### **Tomchek, S. D., Little, L. M., & Dunn, W. (2015). Sensory pattern contributions to developmental performance in children with Autism Spectrum Disorder. *American Journal of Occupational Therapy*, *69*(5), 6905185040p1-6905185040p10.**

Sensory processing differences in preschool-age children with autism spectrum disorder (ASD) affect their engagement in everyday activities, thereby influencing opportunities to practice and develop skills such as social communication and adaptive behavior. The purpose of this study was to investigate the extent to which specific sensory processing patterns relate to aspects of development (i.e., adaptive behavior, expressive and receptive language, fine and gross motor skills, social behavior) in a sample of preschool-age children with ASD (N=400). A retrospective chart review was used to gather clinical data. Results suggest that sensory processing patterns differentially affect children's developmental skills and adaptive behavior. Certain sensory processing patterns predicted children's development of language, motor, and adaptive skills. These findings have clear implications for occupational therapy practice with young children with ASD. Practitioners should consider how sensory processing in ASD both supports and limits children's ability to engage in social communication and learning opportunities.

**2014**

**Roley, S.S., Mailoux, Z., Parham, L.D., Schaaf, R.C., Lane, C.J., & Cermak, S. (2014). Sensory Integration and Praxis Patterns in Children With Autism. *American Journal of Occupational Therapy, 69*(1), 6901220010p1-6901220010p8. doi:10.5014/ajot.2015.012476.**

**Objective:** We sought to characterize sensory integration (SI) and praxis patterns of children with autism spectrum disorder (ASD) and discern whether these patterns relate to social participation.

**Method:** We extracted Sensory Integration and Praxis Tests (SIPT) and Sensory Processing Measure (SPM) scores from clinical records of children with ASD ages 4–11 yr (*N* = 89) and used SIPT and SPM standard scores to describe SI and praxis patterns. Correlation coefficients were generated to discern relationships among SI and praxis scores and these scores’ associations with SPM Social Participation scores.

**Results:** Children with ASD showed relative strengths in visual praxis. Marked difficulties were evident in imitation praxis, vestibular bilateral integration, somatosensory perception, and sensory reactivity. SPM Social Participation scores were inversely associated with areas of deficit on SIPT measures.

**Conclusion:** Children with ASD characteristically display strengths in visuo praxis and difficulties with somatopraxis and vestibular functions, which appear to greatly affect participation.

**Kirby AV., Dickie VA., & Baranek GT. (2014). Sensory experiences of children with autism spectrum disorder: In their own words. *Autism.* doi: 10.1177/1362361314520756.**

First-person perspectives of children with autism spectrum disorder are rarely included in research, yet their voices may help more clearly illuminate their needs. This study involved phenomenological interviews with children with autism spectrum disorder (*n* = 12, ages 4–13) used to gain insights about their sensory experiences. This article addresses two study aims: determining the feasibility of interviewing children with autism spectrum disorder and exploring how they share information about their sensory experiences during the qualitative interview process. With the described methods, children as young as 4 years old and across a broad range of autism severity scores successfully participated in the interviews. The manner with which children shared information about their sensory experiences included themes of normalizing, storytelling, and describing responses. The interviews also revealed the importance of context and the multisensory nature of children’s experiences. These findings contribute strategies for understanding the sensory experiences of children with autism spectrum disorder with implications for practice and future research.

**Miller M., Chukoskie L., Zinni M., Townsend J., & Trauner D. (2014). Dyspraxia, motor function and visual–motor integration in autism. *Behavioural Brain Research, 269*, 95-102. doi:10.1016/j.bbr.2014.04.011.**

This project assessed dyspraxia in high-functioning school aged children with autism with a focus on Ideational Praxis. We examined the association of specific underlying motor function including eye movement with ideational dyspraxia (sequences of skilled movements) as well as the possible role of visual–motor integration in dyspraxia. We found that compared to IQ-, sex- and age-matched typically developing children, the children with autism performed significantly worse on: Ideational and Buccofacial praxis; a broad range of motor tests, including measures of simple motor skill, timing and accuracy of saccadic eye movements and motor coordination; and tests of visual–motor integration. Impairments in individual children with autism were heterogeneous in nature, although when we examined the praxis data as a function of a qualitative measure representing motor timing, we found that children with poor motor timing performed worse on all praxis categories and had slower and less accurate eye movements while those with regular timing performed as well as typical children on those same tasks. Our data provide evidence that both motor function and visual–motor integration contribute to dyspraxia. We suggest that dyspraxia in autism involves cerebellar mechanisms of movement control and the integration of these mechanisms with cortical networks implicated in praxis.

[**Stevenson RA**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Stevenson%20RA%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**,** [**Siemann JK**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Siemann%20JK%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**,** [**Schneider BC**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Schneider%20BC%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**,** [**Eberly HE**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Eberly%20HE%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**, &** [**Woynaroski TG**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Woynaroski%20TG%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**,** [**Camarata SM**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Camarata%20SM%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**,** [**Wallace MT**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Wallace%20MT%5BAuthor%5D&cauthor=true&cauthor_uid=24431427)**. (2014). Multisensory temporal integration in autism spectrum disorders. *The Journal of Neuroscience, 34*(3), 691-7. doi: 10.1523/JNEUROSCI.3615-13.2014.**

The new DSM-5 diagnostic criteria for autism spectrum disorders (ASDs) include sensory disturbances in addition to the well-established language, communication, and social deficits. One sensory disturbance seen in ASD is an impaired ability to integrate multisensory information into a unified percept. This may arise from an underlying impairment in which individuals with ASD have difficulty perceiving the temporal relationship between cross-modal inputs, an important cue for multisensory integration. Such impairments in multisensory processing may cascade into higher-level deficits, impairing day-to-day functioning on tasks, such as speech perception. To investigate multisensory temporal processing deficits in ASD and their links to speech processing, the current study mapped performance on a number of multisensory temporal tasks (with both simple and complex stimuli) onto the ability of individuals with ASD to perceptually bind audiovisual speech signals. High-functioning children with ASD were compared with a group of typically developing children. Performance on the multisensory temporal tasks varied with stimulus complexity for both groups; less precise temporal processing was observed with increasing stimulus complexity. Notably, individuals with ASD showed a speech-specific deficit in multisensory temporal processing. Most importantly, the strength of perceptual binding of audiovisual speech observed in individuals with ASD was strongly related to their low-level multisensory temporal processing abilities. Collectively, the results represent the first to illustrate links between multisensory temporal function and speech processing in ASD, strongly suggesting that deficits in low-level sensory processing may cascade into higher-order domains, such as language and communication.

**Lidstonea J., Uljarevića, M., Sullivanb J., Rodgersc J., McConachied H., Freestonc M., Couteurd AL., Priore M., & Leekama S. (2014). Relations among restricted and repetitive behaviors, anxiety and sensory features in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 8*(2), 82-92. doi:10.1016/j.rasd.2013.10.001.**

The purpose of this study was to explore how atypical reactions to sensory stimuli contribute to the relation between restricted and repetitive behaviors and anxiety in children with autism spectrum disorders (ASD). In Study 1, factor analysis of restricted and repetitive behaviors was carried out using the Repetitive Behavior Questionnaire-2 (RBQ-2), completed by 120 parents of 2- to 17-year-olds with ASD. Two subtypes resulted: repetitive sensory and motor behaviors, and insistence on sameness, accounting for 40% of the variance. This two-factor solution was retained even when the sensory items of the RBQ-2 were removed. In Study 2, 49 of the same parents also completed the Spence Anxiety Scales and the Sensory Profile. The insistence on sameness factor was significantly associated with anxiety while the repetitive motor behaviors factor was not. The relation between anxiety and insistence on sameness was mediated by sensory avoiding and to a lesser extent by sensory sensitivity. Implications for arousal explanations of ASD and for clinical practice are discussed.

**Van Jaarsveld, A. (2014).** **Patterns of sensory integration dysfunction in children from South Africa.** ***South African Journal of Occupational Therapy, 44*(2), 1-6.** **http://www.scielo.org.za/scielo.php?script=sci\_arttext&pid=S2310-38332014000200002&lng=en&tlng=en.**

While patterns of sensory integration *(*SI*)* function and dysfunction have been studied in the US for more than 50 years exploration of whether or not similar patterns exist in cultures and communities outside of that country has been limited, with no studies conducted in South Africa to date. The purpose of this study was to investigate and describe the similarities and differences of patterns of SI dysfunction between children in South Africa and those in the US. A quantitative, analytical study was conducted on a convenience sample of 223 children who were identified as experiencing sensory integration difficulties. The Sensory Integration and Praxis Tests (SIPT) were used as the measuring instrument and correlation and factor analyses were applied in order to describe similarities and differences. Consistencies in tests loading on patterns of Visuo dyspraxia, Somatodyspraxia, Bilateral Integration and Sequencing dysfunctions and Tactile and Visual Discrimination dysfunctions were found. Therefore, this research confirmed similarities in the patterns of dysfunction in children in South Africa and confirmed the value of the SIPT in identifying sensory integration dysfunctions cross-culturally.

[**Williams CM**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Williams%20CM%5BAuthor%5D&cauthor=true&cauthor_uid=23349518)**,** [**Tinley P**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Tinley%20P%5BAuthor%5D&cauthor=true&cauthor_uid=23349518)**,** [**Curtin M**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Curtin%20M%5BAuthor%5D&cauthor=true&cauthor_uid=23349518)**,** [**Wakefield S**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Wakefield%20S%5BAuthor%5D&cauthor=true&cauthor_uid=23349518)**, &** [**Nielsen S**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Nielsen%20S%5BAuthor%5D&cauthor=true&cauthor_uid=23349518)**. (2014). Is idiopathic toe walking really idiopathic? The motor skills and sensory processing abilities associated with idiopathic toe walking gait. *J Child Neurol, 29*(1), 71-8. doi: 10.1177/0883073812470001.**

This study aimed to investigate any differences between the motor skills and sensory processing abilities of children between the ages of 4 and 8, who do and do not have an idiopathic toe walking gait. Children in each cohort were tested with a number of norm referenced assessments. A total of 60 children participated, 30 within each cohort. Those with an idiopathic toe walking gait were found to have different Sensory Profile quadrant scores (P = .002), poorer performance on the Bruininks-Oseretsky Test of Motor Proficiency (P ≤ .001), a lower vibration perception threshold (P = .001), and poorer performance on the Standing Walking Balance subtest of the Sensory Integration and Praxis Test (P = .047), compared with non-toe walking peers. Although this research does not give a causative factor for toe walking gait, it provides a number of theories as to why this gait may not be idiopathic in nature.

[**Koester**](http://ajot.aota.org/solr/searchResults.aspx?author=AnjaLi+Carrasco+Koester)**, AC.,** [**Mailloux**](http://ajot.aota.org/solr/searchResults.aspx?author=Zoe+Mailloux)**, Z.,** [**Coleman**](http://ajot.aota.org/solr/searchResults.aspx?author=Gina+Geppert+Coleman)**, GG.,** [**Mori**](http://ajot.aota.org/solr/searchResults.aspx?author=Annie+Baltazar+Mori)**, AB.,** [**Paul**](http://ajot.aota.org/solr/searchResults.aspx?author=Steven+M.+Paul)**, SM.,** [**Blanche**](http://ajot.aota.org/solr/searchResults.aspx?author=Erna+Blanche)**, E.,**  [**Muhs**](http://ajot.aota.org/solr/searchResults.aspx?author=Jill+A.+Muhs)**, JA.,** [**Lim**](http://ajot.aota.org/solr/searchResults.aspx?author=Deborah+Lim)**, L., &** [**Cermak**](http://ajot.aota.org/solr/searchResults.aspx?author=Sharon+A.+Cermak)**, SA. (2014). Sensory Integration functions of children with cochlear implants. *American Journal of Occupational Therapy 68*(5)*,* 562-569. doi:10.5014/ajot.2014.012187.**

**Objective:** We investigated sensory integration (SI) function in children with cochlear implants (CIs).

**Method:** We analyzed deidentified records from 49 children ages 7 mo to 83 mo with CIs. Records included Sensory Integration and Praxis Tests (SIPT), Sensory Processing Measure (SPM), Sensory Profile (SP), Developmental Profile 3 (DP–3), and Peabody Developmental Motor Scales (PDMS), with scores depending on participants’ ages. We compared scores with normative population mean scores and with previously identified patterns of SI dysfunction.

**Results:** One-sample *t* tests revealed significant differences between children with CIs and the normative population on the majority of the SIPT items associated with the vestibular and proprioceptive bilateral integration and sequencing (VPBIS) pattern. Available scores for children with CIs on the SPM, SP, DP–3, and PDMS indicated generally typical ratings.

**Conclusion:** SIPT scores in a sample of children with CIs reflected the VPBIS pattern of SI dysfunction, demonstrating the need for further examination of SI functions in children with CIs during occupational therapy assessment and intervention planning.

**Barela, JA., Barbosa de Freitas, P., Viana, AR., & Razuk, M. (2014). Dyslexia and the integration of sensory cues into motor action. *Psychology, 5*(16), 8. doi: 0.4236/psych.2014.516192.**

Besides difficulties in mastering literacy, dyslexic children also show poor postural control that might be related to how sensory cues coming from different sensory channels are integrated and trigger proper motor activity. The purpose of this study was to review the body of literature about the functioning of the postural control system in dyslexic children and understand how they use sensory information to produce motor actions. It has been demonstrated that dyslexic children sway more than non-dyslexic ones. Studies have shown that although manipulation of vision and somatosensory information provided by a moving room and a moving touch bar, respectively, in- duced correspondent body sway in dyslexic children, their postural responses to such manipula- tions were less coherent as compared to non-dyslexic children. When dyslexic children applied higher force on the moving bar, however, coherence between body sway and sensory manipula- tions was similar for dyslexic and non-dyslexic children. Finally, in the absence of peripheral visu- al cues, induced body sway in dyslexic children was temporally delayed regarding visual stimulus. Taken together, these results indicate that poor postural control in dyslexic children is related to impairments in the manner sensory information is acquired and used to produce postural res- ponses. The need of dyslexic children to apply more force on the touch bar to improve coherence between sensory stimulus and body sway, together with the fact that in conditions in which visual cues were less informative, dyslexic children took longer to process sensory stimuli and produce motor responses, suggests that dyslexic children are more dependent on the quality of sensory cues.

[**Su,**](http://www.ncbi.nlm.nih.gov/pubmed/?term=Su%20CT%5Bauth%5D) **CT. & Parham, LD. (2014). Validity of sensory systems as distinct constructs. *American Journal of Occupational Therapy, 68*(5), 546-554. doi: 10.5014/ajot.2014.012518**

This study investigated the validity of sensory systems as distinct measurable constructs as part of a larger project examining Ayres’s theory of sensory integration. Confirmatory factor analysis (CFA) was conducted to test whether sensory questionnaire items represent distinct sensory system constructs. Data were obtained from clinical records of two age groups, 2- to 5-yr-olds (*n* = 231) and 6- to 10-yr-olds (*n* = 223). With each group, we tested several CFA models for goodness of fit with the data. The accepted model was identical for each group and indicated that tactile, vestibular–proprioceptive, visual, and auditory systems form distinct, valid factors that are not age dependent. In contrast, alternative models that grouped items according to sensory processing problems (e.g., over- or underresponsiveness within or across sensory systems) did not yield valid factors. Results indicate that distinct sensory system constructs can be measured validly using questionnaire data.

**Hazen, EP., Stornelli, JL., O’Rourke, JA., Koesterer, K., & McDougle, CJ. (2014). Sensory symptoms in Autism Spectrum Disorders.** ***Harvard Review of Psychiatry, 22*(2), 112-124.** **doi: 10.1097/01.HRP.0000445143.08773.58.**

The aim of this review is to summarize the recent literature regarding abnormalities in sensory functioning in individuals with autism spectrum disorder (ASD), including evidence regarding the neurobiological basis of these symptoms, their clinical correlates, and their treatment. Abnormalities in responses to sensory stimuli are highly prevalent in individuals with ASD. The underlying neurobiology of these symptoms is unclear, but several theories have been proposed linking possible etiologies of sensory dysfunction with known abnormalities in brain structure and function that are associated with ASD. In addition to the distress that sensory symptoms can cause patients and caregivers, these phenomena have been correlated with several other problematic symptoms and behaviors associated with ASD, including restrictive and repetitive behavior, self-injurious behavior, anxiety, inattention, and gastrointestinal complaints. It is unclear whether these correlations are causative in nature or whether they are due to shared underlying pathophysiology. The best-known treatments for sensory symptoms in ASD involve a program of occupational therapy that is specifically tailored to the needs of the individual and that may include sensory integration therapy, a sensory diet, and environmental modifications. While some empirical evidence supports these treatments, more research is needed to evaluate their efficacy, and other means of alleviating these symptoms, including possible psychopharmacological interventions, need to be explored. Additional research into the sensory symptoms associated with ASD has the potential to shed more light on the nature and pathophysiology of these disorders and to open new avenues of effective treatments.

# Taylor S., Conelea CA., McKay D., Crowe KB., & Abramowitz JS. (2014). Sensory intolerance: latent structure and psychopathologic correlates. *Compr Psychiatry, 55*(5), 1279-84. doi: .1016/j.comppsych.2014.03.007.

# Background: Sensory intolerance refers to high levels of distress evoked by everyday sounds (e.g., sounds of people chewing) or commonplace tactile sensations (e.g., sticky or greasy substances). Sensory intolerance may be associated with obsessive-compulsive (OC) symptoms, OC-related phenomena, and other forms of psychopathology. Sensory intolerance is not included as a syndrome in current diagnostic systems, although preliminary research suggests that it might be a distinct syndrome.

# Objectives: First, to investigate the latent structure of sensory intolerance in adults; that is, to investigate whether it is syndrome-like in nature, in which auditory and tactile sensory intolerance co-occur and are associated with impaired functioning. Second, to investigate the psychopathologic correlates of sensory intolerance. In particular, to investigate whether sensory intolerance is associated with OC-related phenomena, as suggested by previous research.

#### **Method: A** sample of 534 community-based participants were recruited via Amazon.com's Mechanical Turk program. Participants completed measures of sensory intolerance, OC-related phenomena, and general psychopathology.

#### **Results:** Latent class analysis revealed two classes of individuals: those who were intolerant of both auditory and tactile stimuli (n=150), and those who were relatively undisturbed by auditory or tactile stimuli (n=384). Sensory-intolerant individuals, compared to those who were comparatively sensory tolerant, had greater scores on indices of general psychopathology, more severe OC symptoms, a higher likelihood of meeting caseness criteria for OC disorder, elevated scores on measures of OC-related dysfunctional beliefs, a greater tendency to report OC-related phenomena (e.g., a greater frequency of tics), and more impairment on indices of social and occupational functioning. Sensory-intolerant individuals had significantly higher scores on OC symptoms even after controlling for general psychopathology.

#### **Conclusions:** Consistent with recent research, these findings provide further evidence for a sensory intolerance syndrome. The findings provide a rationale for conducting future research for determining whether a sensory intolerance syndrome should be included in the diagnostic nomenclature.

# Brandwein AB., Foxe JJ., Butler JS., Frey HP., Bates JC., Shulman LH., & Molholm S. (2014). Neurophysiological indices of atypical auditory processing and multisensory integration are associated with symptom severity in autism. *Journal of Autism and Developmental Disorders, 45*(1), 230-244. doi: 10.1007/s10803-014-2212-9.

Atypical processing and integration of sensory inputs are hypothesized to play a role in unusual sensory reactions and social-cognitive deficits in autism spectrum disorder (ASD). Reports on the relationship between objective metrics of sensory processing and clinical symptoms, however, are surprisingly sparse. Here we examined the relationship between neurophysiological assays of sensory processing and (1) autism severity and (2) sensory sensitivities, in individuals with ASD aged 6–17. Multiple linear regression indicated significant associations between neural markers of auditory processing and multisensory integration, and autism severity. No such relationships were apparent for clinical measures of visual/auditory sensitivities. These data support that aberrant early sensory processing contributes to autism symptoms, and reveal the potential of electrophysiology to objectively subtype autism.

# Lifshitz N., Josman N., & Tirosh E. (2014). Disorganization as related to discoordination and attention deficit. *J Child Neurol, 29*(1), 66-70. doi: 10.1177/0883073812469295.

Our objective was to examine the association of attention deficit and disorganization in boys with and without specific developmental disorder of motor function. Four groups of boys between the age of 7 and 12 years-(1) Disorganization + coordination disorder (n = 30); (2) Coordination disorder (n = 33); (3) Disorganization (n = 28); and (4) Control (n = 29)-were included. Teachers completed the Questionnaire for Assessing the Students' Organizational Abilities for the Teacher and the Conners' Teachers Rating Scale-Revised. The Movement Assessment Battery for Children and 2 subscales of an intelligence test (vocabulary and similarities) were administered. A significantly increased rate of attention deficit in children with organizational deficit was identified. Attention deficit in children with specific motor disorder was exclusively associated with an organizational deficit. Organizational deficit in childhood is highly associated with attention deficit, and this association is particularly relevant in children with specific coordination disorder.

# Haapala EA., Poikkeus AM., Tompuri T., Kukkonen-Harjula K., Leppänen PH., Lindi V., & Lakka TA. (2014). Associations of motor and cardiovascular performance with academic skills in children. *Med Sci Sports Exerc, 46*(5), 1016-24. doi:10.1249/MSS.0000000000000186.

#### Purpose: We investigated the associations of cardiovascular and motor performance in grade 1 with academic skills in grades 1-3.

#### Methods: The participants were 6- to 8-yr-old children with complete data in grades 1-2 for 174 children and in grade 3 for 167 children. Maximal workload during exercise test was used as a measure of cardiovascular performance. The shuttle run test (SRT) time, the errors in balance test, and the number of cubes moved in box and block test (BBT) were measures of motor performance. Academic skills were assessed using reading fluency, reading comprehension, and arithmetic skill tests.

#### Results: Among boys, longer SRT time was associated with poorer reading fluency in grades 1-3 (β = -0.29 to -0.39, P < 0.01), reading comprehension in grades 1-2 (β = -0.25 to -0.29, P < 0.05), and arithmetic skills in grades 1-3 (β = -0.33 to -0.40, P < 0.003). Poorer balance was related to poorer reading comprehension (β = -0.20, P = 0.042). The smaller number of cubes moved in BBT was related to poorer reading fluency in grades 1-2 (β = 0.23-0.28, P < 0.03), reading comprehension in grade 3 (β = 0.23, P = 0.037), and arithmetic skills in grades 1-2 (β = 0.21-0.23, P < 0.043). Among girls, longer SRT time was related to poorer reading fluency in grade 3 (β = -0.27, P = 0.027) and arithmetic skills in grade 2 (β = -0.25, P = 0.040). The smaller number of cubes moved in BBT was associated with worse reading fluency in grade 2 (β = 0.26, P = 0.030). Cardiovascular performance was not related to academic skills.

**Chorna, O., Solomon, JE., Slaughter, JC., Stark, AR., & Maitre, NL. (2014). Abnormal sensory reactivity in preterm infants during the first year correlates with adverse neurodevelopmental outcomes at 2 years of age. *Arch Dis Child Fetal Neonatal Ed*, 99(6), 475-479. doi:10.1136/archdischild-2014-306486.**

**Background**: Sensory experience is the basis for learning in infancy. In older children, abnormal sensory reactivity is associated with behavioural and developmental disorders. We hypothesised that in preterm infants, abnormal sensory reactivity during infancy would be associated with perinatal characteristics and correlate with 2-year neurodevelopmental outcomes.

**Methods**: We conducted a prospective observational study of infants with birth weight ≤1500 g using the Test of Sensory Function in Infants (TSFI) in the first year. Infants with gestational age ≤30 weeks were tested with the Bayley Scales of Infant and Toddler Development III (BSID III) at 24 months.

**Results**: Of the 72 participants evaluated at 4–12 months corrected age (median 8 months), 59 (82%) had a least one TSFI score concerning for abnormal sensory reactivity. Lower gestational age was associated with abnormal reactivity to deep pressure and vestibular stimulation (p<0.001). Poor ocular-motor control predicted worse cognitive and motor scores in early childhood (OR 16.7; p=0.004), but was tightly correlated to the presence of severe white matter injury. Poor adaptive motor function in response to tactile stimuli predicted worse BSID III motor (p=0.01) and language scores (p=0.04) at 2 years, even after adjusting for confounders.

**Conclusions**:Abnormal sensory reactivity is common in preterm infants; is associated with immaturity at birth, severe white matter injury and lower primary caregiver education; and predicts neurodevelopmental delays. Early identification of abnormal sensory reactivity of very preterm infants may promote parental support and education and may facilitate improved neurodevelopment.

**Jung, H., Young, JW., Kang, JW., Choi, WC., & Kim, KM. (2014). Visual perception of ADHD children with Sensory Processing Disorder. *Korean Neuropsychiatric Association*, *11*(2), 119-123. http://dx.doi.org/10.4306/pi.2014.11.2.119**

**Objective**: The aim of the present study was to investigate the visual perception difference between ADHD children with and without sensory processing disorder, and the relationship between sensory processing and visual perception of the children with ADHD.

**Method:** Participants were 47 outpatients, aged 6-8 years, diagnosed with ADHD. After excluding those who met exclusion criteria, 38 subjects were clustered into two groups, ADHD children with and without sensory processing disorder (SPD), using SSP reported by their parents, then subjects completed K-DTVP-2. Spearman correlation analysis was run to determine the relationship between sensory processing and visual perception, and Mann-Whitney-U test was conducted to compare the K-DTVP-2 score of two groups respectively.

**Results**:The ADHD children with SPD performed inferiorly to ADHD children without SPD in the on 3 quotients of K-DTVP-2. The GVP of K-DTVP-2 score was related to Movement Sensitivity section (r=0.368\*) and Low Energy/Weak section of SSP (r=0.369\*).

**Conclusion**: The result of the present study suggests that among children with ADHD, the visual perception is lower in those children with co-morbid SPD. Also, visual perception may be related to sensory processing, especially in the reactions of vestibular and proprioceptive senses. Regarding academic performance, it is necessary to consider how sensory processing issues affect visual perception in children with ADHD.

**Kadkol Moushami S., Parkar SR., & Chadha N. (2014). Sensory Processing and visuomotor integration in preschoolers: Understanding the link. *Indian Journal of Physiotherapy and Occupational Therapy - An International Journal, 8*(2), 1-4. doi : 10.5958/j.0973-5674.8.2.048.**

**Objective:** To comment on the correlation between VMI scores and the sensory processing of children in the age group 3–7 years

**Method:** The typically developing children with no known cognitive, mental or physical affectation were assessed using the Beery's Visuo Motor Integration test (Short Form) and the Structured Clinical Observations of Sensory Processing.

**Results:** There was a significant and positive relationship found between the VMI scores and the structured clinical observations of Diadokokinesis, Sequential Finger Touching, Protective extension, Praxis, Free Play and Play Preferences and Conscious and Automatic Eye Movements.

**Conclusion:**T here is a positive correlation between the visuo motor skills and sensory processing skills of children. Affectation of visuo motor skills may be resultant of faulty sensory processing. The remediation programs for visuo motor skill affectations should therefore be structured after assessing the sensory processing of the child and keeping in background the sensory processing deficiencies of the child.

# McCormick C., Hess D., Macari SL., Ozonoff S., Green C., & Rogers S. (2014). Electrodermal and behavioral responses of children with Autism Spectrum Disorders to sensory and repetitive stimuli. *Autism Research, 7*(4), 468-480. doi: 10.1002/aur.1382.

Parents frequently report that their children with autism spectrum disorders (ASD) respond atypically to sensory stimuli. Repetitive behaviors are also part of the ASD behavioral profile. Abnormal physiological arousal may underlie both of these symptoms. Electrodermal activity (EDA) is an index of sympathetic nervous system arousal. The goals of this study were twofold: (1) to pilot methods for collecting EDA data in young children and (2) to examine hypothesized relationships among EDA, and sensory symptoms and repetitive behaviors in children with ASD as compared with children with typical development. EDA was recorded on 54 young children with ASD and on 33 children with typical development (TD) during a protocol that included baseline, exposure to sensory and repetitive stimuli, and play. Parents completed standardized questionnaires regarding their child's sensory symptoms and repetitive behaviors. Frequency and type of repetitive behavior during play was coded offline. Comparisons between EDA data for ASD and TD groups indicated no significant between-group differences in any measures. Parents of children with ASD reported more abnormal responses to sensory stimuli and more repetitive behaviors, but scores on these measures were not significantly correlated with EDA or with frequency of observed repetitive behaviors. Parent report of frequency and severity of sensory symptoms was significantly correlated with reports of repetitive behaviors in both groups. Although parents of children with ASD report high levels of sensory symptoms and repetitive behaviors, these differences are not related to measured EDA arousal or reactivity.

**Lane, A.E., Molloy, C.A., & Bishop S.L. (2014). Classification of children with Autism Spectrum Disorder by sensory subtype: A case for sensory-based phenotypes. *Autism Research, 7*(3), 322-333. doi: 10.1002/aur.1368.**

This study examines whether sensory differences can be used to classify meaningful subgroups of children with autism spectrum disorder (ASD). Caregivers of children with ASD aged 2–10 years (*n* = 228) completed the Short Sensory Profile. Model-based cluster analysis was used to extract sensory subtypes. The relationship of these subtypes to age, gender, autism symptom severity, and nonverbal intelligence quotient (IQ) was further explored. Four distinct sensory subtypes were identified: (a) sensory adaptive; (b) taste smell sensitive; (c) postural inattentive; and (d) generalized sensory difference. The sensory subtypes differ from each other on two dimensions: (a) the *severity* of reported sensory differences; and (b) the *focus* of differences across auditory, taste, smell, vestibular and proprioceptive domains. Examination of the clinical features of each subtype reveals two possible mechanisms of sensory disturbance in autism: (a) sensory hyperreactivity; and (b) difficulties with multisensory processing. Further, the sensory subtypes are not well explained by other variables such as age, gender, IQ, and autism symptom severity. We conclude that classification of children using sensory differences offers a promising method by which to identify phenotypes in ASD. Sensory-based phenotypes may be useful in identifying behavioral features responsive to specific interventions thereby improving intervention effectiveness. Further validation of the sensory-based phenotypes by establishing neural and physiological correlates is recommended.

**Conelea, C.A., Carter A.C., & Freeman J.B. (2014). Sensory over-responsivity in a sample of children seeking treatment for anxiety.** ***Journal of Developmental & Behavioral Pediatrics, 35*(8), 510-521. doi: 10.1097/DBP.0000000000000092.**

**Objective**: Sensory over-responsivity (SOR) refers to an exaggerated, intense, or prolonged behavioral response to ordinary sensory stimuli. The relationship of SOR to psychiatric disorders remains poorly understood. The current study examined the SOR construct within typically developing children with clinically significant anxiety, including the prevalence and course of SOR symptoms and relationship between SOR symptoms, demographic factors, and psychopathology.

**Method**: Children presenting at an anxiety specialty clinic (n = 88) completed a psychiatric diagnostic assessment, which included parent-report measures of SOR, anxiety, obsessive-compulsive disorder (OCD), and global behavior and child-report measures of anxiety, depression, and OCD.

**Results**: Sensory over-responsivity symptoms were very common: 93.2% were bothered by at least 1 tactile or auditory sensation, and the mean number of bothersome sensations was 9.2 (SD = 7.4). SOR symptoms were reported to be “moderately bothersome” on average and to onset at an early age. Sensory Over-Responsivity Inventory (SensOR) scores did not differ by psychiatric disorder diagnosis, but SensOR scores significantly correlated with measures of OCD and depression. Higher SensOR scores were associated with greater global impairment.

**Conclusion**: A high rate of SOR symptom occurrence was observed in this sample of children seeking anxiety treatment, suggesting that SOR may not be entirely independent of anxiety and may be closely associated with OCD. Future research on the validity and nosology of SOR using psychiatric samples is warranted.

# Foxa C., Snowa PC., & Holland K. (2014). The relationship between sensory processing difficulties and behaviour in children aged 5–9 who are at risk of developing conduct disorder. *Emotional and Behavioural Difficulties, 19*(1), 71-88. doi: 10.1080/13632752.2013.854962.

Behaviou ral problems in childhood are common, with significant and wide-ranging implications for individuals, families and the community. There is some evidence that sensory processing difficulties are associated with behavioural problems in children with disabilities such as autism spectrum disorders (ASDs) and attention-deficit/hyperactivity disorder (ADHD). However, there has been minimal research into the association between sensory processing difficulties and behavioural problems in the absence of these disorders. The aim of this investigation was to determine the prevalence of sensory processing difficulties in children aged 5 to 9 who have been identified as at risk of developing conduct disorder, and to examine the relationship between sensory processing difficulties and behavioural problems. Participants were children aged 5 to 9 selected to participate in an early intervention program for children at risk of developing conduct disorder. Behaviour problems were assessed using the Eyberg Child Behaviour Inventory (ECBI; Eyberg and Robinson 1983) and the Strengths and Difficulties Questionnaire (SDQ; Goodman 1997). Sensory processing was assessed using the parent-reported Short Sensory Profile (SSP; McIntosh et al. 1999). Sensory processing difficulties were identified in 55.2%, which is higher than the estimated prevalence in the community (5.3–13.7%). Significant correlations were found between sensory processing difficulties and severity of behavioural problems. Using multiple regression analysis, sensory processing difficulties made a significant unique contribution to behavioural problems, and contributed more to the model than did other variables – language difficulties and socio-economic status. Notwithstanding the need for further research, these findings suggest that sensory processing should be considered in the assessment and management of children with behaviour problems.

# Engel-Yeger B., Almog M., & Kessel A. (2014). The sensory profile of children with asthma. *Acta Pædiatrica, 103*(11), 490-494. doi: 10.1111/apa.12746.

**Purpose:** Sensory hypersensitivity is one expression of sensory processing disorders (SPD) and results from the inability to regulate an appropriate response to a sensory input in an adaptive manner. We explored the sensory processing profile of children with asthma, based on reports from parents.

**Methods:** We studied 86 children between the ages of four and 11 years: 37 diagnosed with asthma and 49 healthy controls. The parents of all participants filled out the Short Sensory Profile (SSP) that measures the child's behavioural reactions to sensory stimuli in daily environments.

**Results:** Sensory processing disorders were more prevalent among children with asthma (F7,71 = 4.16, p = 0.001; *ή*2 = 0.29) than among healthy controls and were mainly reflected by hypersensitivity. While about 90% of the healthy children were reported to actively seek sensory stimuli, only 53% of the asthmatic children showed this trend. In the study group, 25.7% of the children's scores reflected abnormal sensory performance, compared with 0% of the controls (*χ*2=21.93; p < 0.001).

**Conclusion:** Children with asthma may suffer from SPD. Our finding supports previous reports that suggest that the central nervous system is involved in the pathogenesis of atopic conditions. The sensory profile of children with asthma should be evaluated and treated as required.

# Wigham S., Rodgers J., South M., McConachie H., & Freeston M. (2014). The interplay between sensory processing abnormalities, intolerance of uncertainty, anxiety and restricted and repetitive behaviors in Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders.* doi:10.1007/s10803-014-2248-x.

Sensory processing abnormalities, anxiety and restricted and repetitive behaviors (RRBs) frequently co-occur in [Autism Spectrum Disorders (ASD)](http://link.springer.com/search?dc.title=Autism+Spectrum+Disorders+%28ASD%29&facet-content-type=ReferenceWorkEntry&sortOrder=relevance). Though the relationship between these phenomena is not well understood, emerging evidence indicates intolerance of uncertainty (IU) may play an important role. This study aimed to determine pathways between sensory abnormalities and RRBs, and the role anxiety and IU may have. We gathered caregiver report data for 53 children with ASD aged 8–16 years. We found sensory *under* responsiveness and sensory *over* responsiveness were significantly associated with repetitive motor and insistence on sameness behaviours, and the relationships significantly mediated by IU and anxiety. Our findings indicate different mechanisms may underpin repetitive motor and insistence on sameness RRBs, which can inform treatment interventions.

# Demchick BB., Eskow KG., & Crabtree LA. (2014). Autism and transitioning youth: A pilot study of sensory processing and family quality of life. *Journal of Occupational Therapy, Schools, & Early Intervention, 7*(1), 54-69. doi: 10.1080/19411243.2014.898492.

This pilot study explored sensory processing in 10 transition-aged youth substantially impacted by autism and investigated the influence of sensory processing difficulties on family quality of life. These were explored through interviews with family members and through the completion of the Adolescent/Adult Sensory Profile. Results revealed difficulties in sensory processing, with trends noted in the types of problems seen in these young adults. Sensory processing influenced family quality of life, with families modifying activities to accommodate their young adult’s sensory needs. Implications of these results for occupational therapy are discussed, both for practice with youth served under the Individuals with Disabilities Education Act and for practice with young adults following transition.

**2012**

# Ausderau, K., Sideris, J., Furlong, M., Little, L.M., Bulluck, J., & Baranek GT. (2012). National survey of sensory features in children with ASD: factor structure of the sensory experience questionnaire (3.0). *J Autism Dev Disord, 44*(4), 915-25. doi: 10.1007/s10803-013-1945-1.

This national online survey study characterized sensory features in 1,307 children with autism spectrum disorder (ASD) ages 2-12 years using the Sensory Experiences Questionnaire Version 3.0 (SEQ-3.0). Using the SEQ-3.0, a confirmatory factor analytic model with four substantive factors of hypothesized sensory response patterns (i.e., hypo responsiveness; hyperresponsiveness; sensory interests, repetitions and seeking behaviors; enhanced perception), five method factors of sensory modalities (i.e., auditory, visual, tactile, gustatory/olfactory, vestibular/proprioceptive), and one of social context were tested with good model fit. Child and family characteristics associated with the sensory response patterns were explored. The effect of sensory response patterns on autism severity was tested, controlling for key child and family characteristics. The SEQ-3.0 demonstrates an empirically valid factor structure specific to ASD that considers sensory response patterns, modalities, and social context.

**2011**

**Wengel, T., Hanlon-Dearman, A.C., & Fjeldsted, B. (2011). Sleep and sensory characteristics in young children with fetal alcohol spectrum disorder. *J Dev Behav Pediatr., 32(5)*:384-92.**

**Background:** Fetal alcohol spectrum disorder (FASD) is a syndrome that results from prenatal alcohol exposure and is defined by significant neurobehavioral impairments. Sleep disruption has been recognized as a clinically important symptom of FASD that has multiple negative effects on the child's health, ability to function adaptively, as well as on family and caregivers. However, few studies have addressed and characterized the sleep problems in this population.

**Objective**: The objective of this study was to characterize sleep in FASD and describe the impact of sensory processing difficulties on sleep patterns in children with FASD.

**Methods:** Children with FASD were compared with age-matched typically developing children between 3 and 6 years of age. Sleep was assessed using actigraphy, a sleep log, and the Children's Sleep Habits Questionnaire. The Sensory Profile™, completed by caregivers, was used to evaluate the child's sensory processing abilities. Overall differences in sensory processing were correlated with actigraphic parameters measured in alcohol exposed and control groups.

**Results**: Data show that children with FASD have significantly more sleep disturbances than typically developing children, including increased bedtime resistance, shortened sleep duration, increased sleep anxiety, and increased night awakenings and parasomnias. Actigraphy reveals a significant difference between groups for sleep onset latency. **Conclusions:** This study demonstrates that sensory processing deficits are widespread in children with FASD and that these deficits are associated with multiple sleep problems. Children with FASD should be screened for sleep-related disorders and would benefit from occupational therapy for sensory-based treatment aimed at sleep regulation and consolidation.

**Stein, L.I., Polido, J.C., Mailloux, Z., Coleman, G.G., & Cermak, S.A. (2011). Oral care and sensory sensitivities in children with autism spectrum disorders. *Spec Care Dentist, 31(3)*,102-10. doi:10.1111/j.1754-4505.2011.00187.x.**

Children with autism spectrum disorders (ASD) are at high risk for oral disease. The aim of this study was to examine the contribution of sensory processing problems to challenges in receiving oral care for children with ASD. A questionnaire was sent to the parents of 206 children with disabilities to test the hypotheses that children with ASD, relative to children with other disabilities, experience greater difficulty with home-based and professional oral care, and that these difficulties may relate in part to sensory processing problems. The results partially supported these hypotheses. Compared to children with other disabilities, those with ASD had greater behavioral difficulties and sensory sensitivities that parents believed interfered with their child's oral care. Among children with ASD, sensory sensitivities were associated with oral care difficulties in the home and dental office, and with behavioral difficulties in the dental office. Utilizing strategies to modify the sensory environment may help facilitate oral care in children with ASD.

**Engel-Yeger, B., Hardal-Nasser, R., & Gal, E. (2011). Sensory processing dysfunctions as expressed among children with different severities of intellectual developmental disabilities. *Res Dev Disabil*, 32(5):1770-1775.**

High frequency of sensory processing dysfunctions (SPD) is prevalent among children with intellectual developmental disabilities and contributes to their maladaptive behaviors. However, the knowledge about the expressions of SPD in different levels of IDD severity is limited. As SPD may reduce adaptive responses and limit participation, this knowledge should be elaborated. The purpose of the present study was to examine the specific expressions of sensory processing among children with different severity levels of IDD. Participants were 91 children aged 4-9 years with mild, moderate severe-profound and IDD. Their parents completed the short sensory profile (SSP). According the results, SPD were manifested across all levels of IDD. Groups differed in specific behaviors related to sensory stimuli. The highest percentage of children with severe sensory processing difficulties was found among children with mild and severe IDD level. SPD may characterize children with all severity levels of IDD. Nevertheless, the probability that children with a specific IDD level will be more vulnerable to specific aspects of SPD emphasizes the need for early evaluation and intervention to address the specific sensory needs of children with different IDD levels. This may enhance their development, performance and participation in daily living.

**Stefanics, G., Fosker, T., Huss, M., Mead,N., Szucs, D., Goswami, U. (2011). Auditory sensory deficits in developmental dyslexia: a longitudinal ERP study. *Neuroimage, 57(3)*, 723-32.**

The core difficulty in developmental dyslexia across languages is a "phonological deficit", a specific difficulty with the neural representation of the sound structure of words. Recent data across languages suggest that this phonological deficit arises in part from inefficient auditory processing of the rate of change of the amplitude envelope at syllable onset (inefficient sensory processing of rise time). Rise time is a complex percept that also involves changes in duration and perceived intensity. Understanding the neural mechanisms that give rise to the phonological deficit in dyslexia is important for optimizing educational interventions. In a three-deviant passive 'oddball' paradigm and a corresponding blocked 'deviant-alone' control condition we recorded ERPs to tones varying in rise time, duration and intensity in children with dyslexia and typically developing children longitudinally. We report here results from test Phases 1 and 2, when participants were aged 8-10 years. We found an MMN to duration, but not to rise time nor intensity deviants, at both time points for both groups. For rise time, duration and intensity we found group effects in both the Oddball and Blocked conditions. There was a slower fronto-central P1 response in the dyslexic group compared to controls. The amplitude of the P1 fronto-centrally to tones with slower rise times and lower intensity was smaller compared to tones with sharper rise times and higher intensity in the Oddball condition, for children with dyslexia only. The latency of this ERP component for all three stimuli was shorter on the right compared to the left hemisphere, only for the dyslexic group in the Blocked condition. Furthermore, we found decreased N1c amplitude to tones with slower rise times compared to tones with sharper rise times for children with dyslexia, only in the Oddball condition. Several other effects of stimulus type, age and laterality were also observed. Our data suggest that neuronal responses underlying some aspects of auditory sensory processing may be impaired

in dyslexia.

**Little, L.M., Freuler, A.C., Houser, M.B., Guckian, L., Carbine, K., David, F.J., Baranek, G.T. Psychometric validation of the Sensory Experiences Questionnaire. *American Journal of Occupational Therapy,65(2),* 207-10.**

**Introduction**: We evaluated the psychometric properties of the Sensory Experiences Questionnaire (Version 1; Baranek, David, Poe, Stone, & Watson 2006), a brief caregiver questionnaire for young children with autism and developmental delays used to identify sensory processing patterns in the context of daily activities.

**Method:** Caregiver questionnaires (N=358) were analyzed to determine internal consistency. The test-retest subsample (n=24) completed two assessments within 2-4 wk. Internal consistency and test-retest reliability were analyzed using Cronbach's coefficient alpha and intraclass correlation coefficients, respectively.

**Results:** Internal consistency for the SEQ was alpha = .80. Test-retest reliability for the total score was excellent, with ICC = .92.

**Discussion:** The SEQ is an internally consistent and reliable caregiver report measure of young children's sensory processing patterns of hypo- and hyperresponsiveness. The SEQ can be used as an early tool for identifying sensory patterns in young children with autism and other developmental disabilities.

**Mailloux, Z., Mulligan, S., Roley, S.S., Blanche, E., Cermak, S., Coleman, G.G., Bodison, S., Lane, C.J. Verification and clarification of patterns of sensory integrative dysfunction. *American Journal of Occupational Therapy,65(2)*,143-151.**

Building on established relationships between the constructs of sensory

integration in typical and special needs populations, in this retrospective

study we examined patterns of sensory integrative dysfunction in 273 children ages 4-9 who had received occupational therapy evaluations in two private practice settings. Test results on the Sensory Integration and Praxis Tests, portions of the Sensory Processing Measure representing tactile over responsiveness, and parent report of attention and activity level were included in the analyses. Exploratory factor analysis identified patterns similar to those found in early studies by Ayres (1965, 1966a, 1966b, 1969, 1972b, 1977, & 1989), namely Visuodyspraxia and Somatodyspraxia, Vestibular and Proprioceptive Bilateral Integration and Sequencing, Tactile and Visual Discrimination, and Tactile Defensiveness and Attention. Findings reinforce associations between constructs of sensory integration and assist with understanding sensory integration disorders that may affect childhood occupation. Limitations include the potential for subjective interpretation in factor analysis and inability to adjust measures available in charts in a retrospective research.

**Schaaf RC, Toth-Cohen S, Johnson SL, Outten G, Benevides TW.**

**The everyday routines of families of children with autism: examining the impact of sensory processing difficulties on the family. Autism. 2011 May;15(3):373-389.**

The purpose of this qualitative study was to explore the lived experience of how sensory-related behaviors of children with autism affected family routines. In-depth semi-structured interviews were conducted with four primary caregivers regarding the meaning and impact of their child's sensory-related behaviors on family routines that occurred inside and outside the home. Findings indicated that sensory behaviors are one factor that limited family participation in work, family and leisure activities; and that parents employed specific strategies to manage individual and family routines in light of the child's sensory-related

behaviors. This information has important implications for professionals who work with families of children with autism to decrease caregiver stress and to increase life satisfaction for the child and family.

**Engel-Yeger, B., Ziv-On, D.(2011). The relationship between sensory processing difficulties and leisure activity preference of children with different types of ADHD. *Res Dev Disabil., 32(3):*1154-1162.**

Sensory processing difficulties (SPD) are prevalent among children with ADHD. Yet, the question whether different SPD characterize children with different types of ADHD has not received enough attention in the literature. The current study characterized sensory processing difficulties (SPD) of children with different types of ADHD and explored the relationship between SPD and leisure activity preference. Participants were 58 boys aged 6-10 years: 29 boys with ADHD: 15 with hyperactive-impulsive type and 14 characterized as inattentive. The controls were 29 typical peers. SPD were evaluated by The Short Sensory Profile (SSP) completed by the parents. Participants answered the preference for activities of children (PAC). According the results, SPD were manifested among children with both ADHD types. Children with both ADHD types showed significantly lower preference to participate in leisure activities than the controls. Their lower preference correlated with SPD. The findings suggest that children with different ADHD types may share common SPD, which may negatively impact their activity preference. In this study it seemed that children with ADD were more vulnerable to these impacts. SPD and participation should be considered in evaluation and intervention programs for children with ADHD in order to focus on child's abilities, needs and preferences, and enhance intervention success, child's relationships with peers and child's well-being.

**Symons, F.J. (2011). Self-injurious behavior in neurodevelopmental disorders: relevance of nociceptive and immune mechanisms. *Neurosci Biobehav Rev.5(5)*,1266-1274.**

Self-injurious behavior (SIB) among individuals with intellectual and related neurodevelopmental disorders (IDD) is a clinical challenge and scientific puzzle. The physiological mechanisms regulating the sensory components of SIB remain a mystery with no clear understanding of the underlying pathophysiology. The central dogma regarding sensory processing in general and pain in particular among individuals with IDD and chronic SIB is that sensory processing is reduced and pain is absent or blunted. In this paper, recent findings challenging some of the conventional wisdom regarding pain and sensory function among individuals with IDD and SIB are reviewed. It seems that at least a subgroup of individuals with IDD and chronic SIB may be in a physiological state similar to neuropathic pain in which hyperalgesia is mediated by plasticity mechanisms regulating inflammatory, immune, and nociceptive systems. In response to repeated tissue damage associated with chronic self-injury, innate immune cells may be producing pro-inflammatory and pro-nociceptive cytokines that act on the brain to cause sickness-like behavior and sensitize primary sensory nerve afferents contributing to pain hypersensitivity (i.e., hyperalgesia).

**Lane, A.E., Dennis, S.J., & Geraghty, M.E. (2011). Brief report: Further evidence of sensory subtypes in autism. J *Autism Dev Disord, 41(6):*826-831.**

Distinct sensory processing (SP) subtypes in autism have been reported

previously. This study sought to replicate the previous findings in an

independent sample of thirty children diagnosed with an Autism Spectrum Disorder. Model-based cluster analysis of parent-reported sensory functioning (measured using the Short Sensory Profile) confirmed the triad of sensory subtypes reported earlier. Subtypes were differentiated from each other based on degree of SP dysfunction, taste/smell sensitivity and vestibular/proprioceptive processing. Further elucidation of two of the subtypes was also achieved in this study. Children with a primary pattern of sensory-based inattention could be further described as sensory seekers or non-seekers. Children with a primary pattern of vestibular/proprioceptive dysfunction were also differentiated on movement and tactile sensitivity.

**Ebisch, S.J., Gallese, V., Willems, R.M., Mantini, D., Groen, W.B., Romani, G.L., Buitelaar, J.K., & Bekkering, H. (2011). Altered intrinsic functional connectivity of anterior and posterior insula regions in high-functioning participants with autism spectrum disorder. *Hum Brain Mapp.32(7)*1013-1028. doi:10.1002/hbm.21085.**

Impaired understanding of others' sensations and emotions as well as abnormal experience of their own emotions and sensations is frequently reported in individuals with Autism Spectrum Disorder (ASD). It is hypothesized that these abnormalities are based on altered connectivity within "shared" neural networks involved in emotional awareness of self and others. The insula is considered a central brain region in a network underlying these functions, being located at the transition of information about bodily arousal and the physiological state of the body to subjective feelings. The present study investigated the intrinsic functional connectivity properties of the insula in 14 high-functioning participants with ASD (HF-ASD) and 15 typically developing (TD) participants in the age range between 12 and 20 years by means of "resting state" or "non-task" functional magnetic resonance imaging. Essentially, a distinction was made between anterior and posterior regions of the insular cortex. The results show a reduced functional connectivity in the HF-ASD group, compared with the TD group, between anterior as well as posterior insula and specific brain regions involved in emotional and sensory processing. It is suggested that functional abnormalities in a network involved in emotional and interoceptive awareness might be at the basis of altered emotional experiences and impaired social abilities in ASD, and that these abnormalities are partly based on the intrinsic functional connectivity properties of such a network.

**Engel-Yeger, B., Mimouni, D., Rozenman, D., Shani-Adir, A. Sensory processing patterns of adults with atopic dermatitis. *J Eur Acad Dermatol Venereol.*,*25(2*),152-6. doi:10.1111/j.1468-3083.2010.03729.x**

**Background**: Atopic dermatitis (AD) has been associated with sensory

hypersensitivity in children.

**Objective**: To examine the sensory profile of adults with AD using standardized questionnaire that measures sensory processing and related behaviors in daily living.

**Methods:** Thirty-two patients aged 18-53 years with AD and 32 healthy, sex- and age-matched control subjects completed the Adolescent/Adult Sensory Profile (AASP). Severity of AD was assessed by the Severity Scoring of Atopic Dermatitis (SCORAD).

**Results**: Patients with AD showed higher sensory sensitivity and avoidance than the controls, mainly in the tactile, vestibular, visual and auditory modalities.

**Conclusions**: Adults with AD may suffer from sensory hypersensitivity. Additional studies should examine the influence of the peripheral and the central nervous system on sensory hypersensitivity. Better understanding of the sensory impairment of patients with AD may help improving treatment strategies for the disease.

**Goswami, U., Wang, H.L., Cruz, A., Fosker, T., Mead, N., & Huss, M. (2011). Language-universal sensory deficits in developmental dyslexia: English, Spanish, and Chinese. *J Cogn Neurosci., 23(2),* 325-337.**

Studies in sensory neuroscience reveal the critical importance of accurate

sensory perception for cognitive development. There is considerable debate concerning the possible sensory correlates of phonological processing, the primary cognitive risk factor for developmental dyslexia. Across languages, children with dyslexia have a specific difficulty with the neural representation of the phonological structure of speech. The identification of a robust sensory marker of phonological difficulties would enable early identification of risk for developmental dyslexia and early targeted intervention. Here, we explore whether phonological processing difficulties are associated with difficulties in processing acoustic cues to speech rhythm. Speech rhythm is used across languages by infants to segment the speech stream into words and syllables. Early difficulties in perceiving auditory sensory cues to speech rhythm and prosody could lead developmentally to impairments in phonology. We compared matched samples of children with and without dyslexia, learning three very different spoken and written languages, English, Spanish, and Chinese. The key sensory cue measured was rate of onset of the amplitude envelope (rise time), known to be critical for the rhythmic timing of speech. Despite phonological and orthographic differences, for each language, rise time sensitivity was a significant predictor of phonological awareness, and rise time was the only consistent predictor of reading acquisition. The data support a language-universal theory of the neural basis of developmental dyslexia on the basis of rhythmic perception and syllable segmentation. They also suggest that novel remediation strategies on the basis of rhythm and music may offer benefits for phonological and linguistic development.

**Nobile, M., Perego, P., Piccinini, L., Mani, E., Rossi, A., Bellina, M., & Molteni, M. (2011). Further evidence of complex motor dysfunction in drug naive children with autism using automatic motion analysis of gait. *Autism*,15(3),263-283.**

In order to increase the knowledge of locomotor disturbances in children with autism, and of the mechanism underlying them, the objective of this exploratory study was to reliably and quantitatively evaluate linear gait parameters (spatio-temporal and kinematic parameters), upper body kinematic parameters, walk orientation and smoothness using an automatic motion analyser (ELITE systems) in drug naïve children with Autistic Disorder (AD) and healthy controls. The children with AD showed a stiffer gait in which the usual fluidity of walking was lost, trunk postural abnormalities, highly significant difficulties to maintain a straight line and a marked loss of smoothness (increase of jerk index), compared to the healthy controls. As a whole, these data suggest a complex motor dysfunction involving both the cortical and the subcortical area or, maybe, a possible deficit in the integration of sensory-motor information within motor networks (i.e., anomalous connections within the fronto-cerebello-thalamo-frontal network). Although the underlying neural structures involved remain to be better defined, these data may contribute to highlighting the central role of motor impairment in autism and suggest the usefulness of taking into account motor difficulties when developing new diagnostic and rehabilitation programs.

**Goyen, T.A., Luim K., Hummell, J. (2011). Sensorimotor skills associated with motor dysfunction in children born extremely preterm. *Early Hum Dev.87(7)*:489-493. doi:10.1016/j.earlhumdev.2011.04.002.**

**Background**: Children born prematurely, despite being free of intellectual and sensorineural deficits, are at risk of motor dysfunction.

**Purpose**: To investigate the association of sensorimotor processing skills and Developmental Coordination Disorder (DCD) in "apparently normal" extreme preterm children.

**Design:**In a matched case-control study, 50 preterm children born less than 29 weeks or birthweight <1000 g, with an IQ>85 and no identified sensorineural disability, were assessed at 8 years of age along with 50 gender and birth date matched classroom controls born at full term. battery of sensorimotor tests was administered, which examined visual-motor, visual perception, tactile perception, kinaesthesia, and praxis.

**Results:** For preterm children with DCD (n=21), significantly lower scores were found for the visual processing and praxis tests, with the exception of verbal command, in comparison to those 29 preterm children without DCD and term controls (median visual perception scores were 92, 96 and 108 respectively; design copying was 0.07, 0.46 and 0.95; constructive praxis was 0.09, 0.27 and 0.63; and sequencing praxis was 0.14, 0.73 and 0.96). There were no difference on the tactile sensitivity and kinaesthetic processing tests.

**Conclusions:** Preterm children with DCD have difficulty with visual processing tasks. Praxis or motor planning poses a particular challenge for them. Motor dysfunction in extremely preterm children was related to poorer visual processing and motor planning and may relate to a cognitive processing problem.

**Jafari, Z., Asad, & Malayeri, S. (2011). The effect of saccular function on static balance ability of profound hearing-impaired children. *Int J Pediatr Otorhinolaryngol.75(7)*, 919-924.**

**Objective**: Researches have shown that in clinical practice, balance disorders in children with congenital or early acquired severe to profound hearing loss are probable. The purposes of present study were to specify the percentage of vestibular evoked myogenic potential (VEMP) and an acoustically evoked, short latency negative response (ASNR) recordings and the relation between their presence and static balance ability and postural control of children with profound sensorineural hearing loss (SNHL).

**Methods:** Thirty children with profound SNHL, with an average age of 6.93 years, underwent the VEMP and auditory brainstem response (ABR) tests. Both VEMP and ABR were recorded at the threshold level through air-conduction stimulation via an insert receiver. The static balance performance of the hearing-impaired children was tested with six exercises and compared with that of 30 age- and sex-matched

normal-hearing children as controls.

**Results**: VEMP was recorded in 53.3% of ears and ASNR in 40.0%. VEMP was revealed in all ears with ASNR, and a significant correlation was shown between their presence (p=0.005) and also between the ASNR wave latency and P1 (p=0.0001) and N1 (p=0.004) wave amplitude of VEMP. There was a significant correlation between the presence of VEMP and ASNR with the performance of the children in two static balance skills, namely standing on one leg with eyes open on a line and the same practice on the balance beam (p≤0.008).

**Conclusion:** There was a close relation between the presence of VEMP and ASNR. Additionally, when ASNR was present, the recording of VEMP could be expected. Successful performance in the static balance exercises with reduced vestibular and somatosensory inputs increased the possibility of the recording of ASNR and VEMP.

**Bair, W.N., Barela, J.A., Whitall, J., Jeka, J.J., & Clark, J.E. (2011). Children with developmental coordination disorder benefit from using vision in combination with touch information for quiet standing. *Gait Posture. 34(2)*,183-190.**

In two experiments, the ability to use multisensory information (haptic

information, provided by lightly touching a stationary surface, and vision) for quiet standing was examined in typically developing (TD) children, adults, and in seven-year-old children with Developmental Coordination Disorder (DCD). Four sensory conditions (no touch/no vision, with touch/no vision, no touch/with vision, and with touch/with vision) were employed. In experiment 1, we tested four-, six- and eight-year-old TD children and adults to provide a developmental landscape for performance on this task. In experiment 2, we tested a group of seven-year-old children with DCD and their age-matched TD peers. For all groups, touch robustly attenuated standing sway suggesting that children as young as four years old use touch information similarly to adults. Touch was less effective in children with DCD compared to their TD peers, especially in attenuating their sway velocity. Children with DCD, unlike their TD peers, also benefited from using vision to reduce sway. The present results suggest that children with DCD benefit from using vision in combination with touch information for standing control possibly due to their less well developed internal models of body orientation and self-motion. Internal model deficits, combined with other known

deficits such as postural muscles activation timing deficits, may exacerbate the balance impairment in children with DCD.

**De Jong, M., Punt, M., De Groot, E., Minderaa, R.B., & Hadders-Algra, M. (2011). Minor neurological dysfunction in children with autism spectrum disorder. D*ev Med Child Neurol.*, *53(7)*:641-646. doi:10.1111/j.1469-8749.2011.03971.x**

**Purpose:** The aim of this study was to improve the understanding of brain function in children with autism spectrum disorder (ASD) in relation to minor neurological dysfunctions (MNDs).

**Method:** We studied MNDs in 122 children (93 males, 29 females; mean age 8 y 1 mo, SD 2 y 6 mo) who, among a total cohort of 705 children (513 males, 192 females; mean age 9 y, SD 2 y 0.5 mo) referred to a regional outpatient non-academic psychiatric centre in the Netherlands, were diagnosed with ASD after an extensive multidisciplinary psychiatric assessment. Children with clear neurological abnormalities (e.g. cerebral palsy or spina bifida) were excluded from the study. MNDs were assessed in all 705 children using the Touwen examination method. Special attention was paid to the severity and type of MND. Data of the children with ASD were compared with neurological morbidity data of children with other psychiatric disorders and with children in the general population, who were born at Groningen University Hospital between 1975 and 1978.

**Results:** Seventy-four percent of the children with ASD showed complex MNDs compared with 52% of the children with other psychiatric disorders and 6% of the reference group (χ(2) =18.0, p<0.001; χ(2) =937.5, p<0.001 respectively). Specific dysfunctions frequently encountered in ASD were dysfunctional posture and muscle tone, fine manipulative disability, discoordination, and excessive associated movements.

**Conclusion:** These findings suggest a contribution of dysfunctional supraspinal networks involving multiple parts of the brain in the pathogenesis of ASD. This is consistent with findings from neuroimaging studies, and highlights the importance of neurological examinations in paediatric psychiatric assessments.

**Goyen, T.A., Lui, K., & Hummell, J. (2011). Sensorimotor skills associated with motor dysfunction in children born extremely preterm. *Early Hum Dev.87(7):* 489-493. doi:10.1016/j.earlhumdev.2011.04.002.**

**Background**: Children born prematurely, despite being free of intellectual and sensorineural deficits, are at risk of motor dysfunction.

**Purpose:** To investigate the association of sensorimotor processing skills and Developmental Coordination Disorder (DCD) in "apparently normal" extreme preterm children.

**Design:** a matched case-control study, 50 preterm children born less than

29 weeks or birthweight <1000 g, with an IQ>85 and no identified sensorineural disability, were assessed at 8 years of age along with 50 gender and birth date matched classroom controls born at full term. A battery of sensorimotor tests was administered, which examined visual-motor, visual perception, tactile perception, kinaesthesia, and praxis.

**Results:** For preterm children with DCD (n=21), significantly lower scores were found for the visual processing and praxis tests, with the exception of verbal command, in comparison to those 29 preterm children without DCD and term controls (median visual perception scores were 92, 96 and 108 respectively; design copying was 0.07, 0.46 and 0.95; constructive praxis was 0.09, 0.27 and 0.63; and sequencing praxis was 0.14, 0.73 and 0.96). There was no difference on the tactile sensitivity and kinaesthetic processing tests.

**Conclusions**: Preterm children with DCD have difficulty with visual processing tasks. Praxis or motor planning poses a particular challenge for them. Motor dysfunction in extremely preterm children was related to poorer visual processing and motor planning and may relate to a cognitive processing problem.

**Barela, J.A., Dias, J.L., Godoi, D., Viana, A.R., De Freitas, P.B. Postural control and automaticity in dyslexic children: the relationship between visual information and body sway. *Res Dev Disabil., 32(5)*,1814-1821.**

Difficulty with literacy acquisition is only one of the symptoms of developmental dyslexia. Dyslexic children also show poor motor coordination and postural control. Those problems could be associated with automaticity, i.e., difficulty in performing a task without dispending a fair amount of conscious efforts. If this is the case, dyslexic children would show difficulties in using "unperceived" sensory cues to control body sway. Therefore, the aim of the study was to examine postural control performance and the coupling between visual information and body sway in dyslexic children. Ten dyslexic children and 10 non-dyslexic children stood upright inside a moving room that remained stationary

or oscillated back and forward at frequencies of 0.2 or 0.5 Hz. Body sway

magnitude and the relationship between the room's movement and body sway were examined. The results indicated that dyslexic children oscillated more than non-dyslexic children in both stationary and oscillating conditions. Visual manipulation induced body sway in all children but the coupling between visual information and body sway was weaker and more variable in dyslexic children. Based upon these results, we can suggest that dyslexic children use visual information to postural control with the same underlying processes as non-dyslexic children; however, dyslexic children show poorer performance and more variability while relating visual information and motor action even in a task that does not require an active cognitive and conscious motor involvement, which may be a further evidence of automaticity problem.

**Quercia, P., Demougeot, L., Dos Santos, M., & Bonnetblanc, F. (2011). Integration of proprioceptive signals and attentional capacity during postural control are impaired but subject to improvement in dyslexic children. *Exp Brain Res.,209(4),* 599-608.**

Children with developmental dyslexia suffer from delayed reading capabilities and may also exhibit attentional and sensori-motor deficits. The objective of this study was twofold. First, we aimed at investigating whether integration of proprioceptive signals in balance control was more impaired in dyslexic children when the attentional demand was varied. Secondly, we checked whether this effect was reduced significantly by using a specific treatment to improve eye control deficits and certain postural signs that are often linked to dyslexia (Quercia et al. in J Fr Ophtalmol 28:713-723, 2005, J Fr Ophtalmol 30:380-89, 2007). Thirty dyslexic and 51 treated dyslexic children (> 3 months of treatment) were compared with 42 non-dyslexic children in several conditions (mean age: 136.2 ± 23.6, 132.2 ± 18.7 and 140.2 ± 25 months, respectively). Co-vibration of ankle muscles was affected in order to alter proprioceptive information originating from the ankle. In two vibration conditions, ankle muscles were either not vibrated or vibrated at 85 Hz without illusion of any movement. These two vibration conditions were combined with two attentional conditions. In the first such condition, children-maintained balance while merely fixing their gaze on a point

in front of them. In the second condition, they had to look for smaller or larger stars in a panel showing forty of each kind. Balance was assessed by means of a force plate. Results indicated that the mean velocity (i.e. the total length) of the center of pressure (CoP) displacement in the 85-Hz vibration condition increased significantly more (compared with no vibration) in the dyslexic and the treated dyslexic groups than in the control group, irrespective of the attention task. Interestingly, in the condition without vibration, the attentional performance of treated children was similar to that of the control group, whereas the attentional performance of the untreated dyslexic children was significantly impaired. Altogether, these results suggest that integration of proprioceptive signals in balance control and attentional capacity are impaired in dyslexic children. However, attention capacity during the control of stance could be improved significantly.

**Vaivre-Douret, L., Lalanne, C., Ingster-Moati, I., Boddaert, N., Cabrol, D., Dufier, J.L.,Golse, B., Falissard, B. (2011). Subtypes of developmental coordination disorder: research on their nature and etiology. *Dev Neuropsychology, 36(5)*:614-643.**

Children with Developmental Coordination Disorder (DCD) are a group embracing clumsiness and developmental dyspraxia. Our study provides a better understanding of the nature of DCD and its etiology and identifies subtypes of dyspraxia. Forty-three children with DCD (5-15 years) were enrolled on the Diagnostic and Statistical Manual of Mental Disorders (4th ed. [DSM-IV-TR]; American Psychiatric Association, 2000) criteria. Extensive standardized evaluations were conducted. We distinguished from two patterns of "pure" developmental dyspraxia: ideomotor and visual-spatial/visual-constructional and mix dyspraxia with more co-morbidities. Our study provides a better understanding of the nature of DCD, and sheds light on its etiology and brain dysfunction, so as to identify subtypes of developmental DCD/dyspraxia with specific clinical criteria.

**Goyen, T.A., Lui, K.,& Hummell, J. (2011). Sensorimotor skills associated with motor dysfunction in children born extremely pre-term. *Early Human Development*, 87(7),489-493. doi:10.1016/j.earlhumdev.2011.04.002.**

**Background**: Children born prematurely, despite being free of intellectual and sensorineural deficits, are at risk of motor dysfunction.

**Purpose**: To investigate the association of sensorimotor processing skills and Developmental Coordination Disorder (DCD) in "apparently normal" extreme preterm children.

**Design**: In a matched case-control study, 50 preterm children born less than 29 weeks or birthweight <1000 g, with an IQ>85 and no identified sensorineural disability, were assessed at 8 years of age along with 50 gender and birth date matched classroom controls born at full term. A battery of sensorimotor tests was administered, which examined visual-motor, visual perception, tactile perception, kinaesthesia, and praxis.

**Results:** For preterm children with DCD (n=21), significantly lower scores were found for the visual processing and praxis tests, with the exception of verbal command, in comparison to those 29 preterm children without DCD and term controls (median visual perception scores were 92, 96 and 108 respectively; design copying was 0.07, 0.46 and 0.95; constructive praxis was 0.09, 0.27 and 0.63; and sequencing praxis was 0.14, 0.73 and 0.96). There was no difference on the tactile sensitivity and kinaesthetic processing tests.

**Conclusions:** Preterm children with DCD have difficulty with visual processing tasks. Praxis or motor planning poses a particular challenge for them. Motor dysfunction in extremely preterm children was related to poorer visual processing and motor planning and may relate to a cognitive processing problem.

**Law, S.H., Lo, S.K., Chow, S., Cheing, G.L. (2011). Grip force control is dependent on task constraints in children with and without developmental coordination disorder. I*nt J Rehabil Res.* *34(2)*,93-99.**

Excessive grip force (GF) is often found in children with developmental

coordination disorder (DCD). However, their GF control may vary when task constraints are imposed upon their motor performance. This study aimed to investigate how their GF control changes in response to task demands, and to examine their tactile sensitivity. Twenty-one children with DCD and 17 controls participated in the study. The instrument used to measure GF was a cylindrical cup equipped with a load cell. The children were asked to hold and transport three cups with varying physical properties as quickly as possible. For tactile function, static and moving two-point discrimination senses were recorded. Data

were analyzed using repeated-measures analysis of covariance. Children with DCD displayed slower rate of GF generation, which might be related to their lower sensitivity of two-point dynamic discrimination. Given the slow rate of GF generation and time constraint, the peak GF for children with DCD was lower than that for the control children, but the peak GF of both the groups depended on the time allowed for the performance and the task demand. Both the groups of children cautiously modulated the grip when the cup was filled with water, and graded GF according to the physical property of the cup. We conclude that GF control in children with or without DCD was task dependent.

**Magalhães, L.C., Cardoso, A.A.,& Missiuna, C. (2011). Activities and participation in children with developmental coordination disorder: a systematic review. *Res Dev Disabil., 232(4)*,1309-1316.**

**Purpose:** To systematically review all literature published in peer reviewed journals from January 1995 to July 2008 in order to summarize and describe the activity limitations and participation restrictions of children with developmental coordination disorder (DCD).

**Methods:** Multiple databases were systematically searched for articles related to DCD; only descriptive, intervention or qualitative articles were retained. Articles were coded using the International Classification of Function, Disability and Health (ICF) and descriptions of the activity and participation issues of individuals with DCD were identified.

**Results:** Data analysis revealed that, from 371 articles that met inclusion

criteria, only 44 (14.4%) presented any data related to activity or participation issues. Information was inconsistent and only 18 articles used published measurement tools. Most frequently cited issues were poor handwriting, difficulties playing ball games, getting dressed and participating in organized sports.

**Conclusion:** Evidence concerning activity and participation issues for children with DCD is limited in both volume and scope. Improved understanding of participation and of activity limitations in children with DCD is essential for clarifying diagnostic criteria, guiding assessment, and making evidence-based decisions regarding intervention. Researchers working with this population should make every effort to measure and consistently report the impact of children's motor impairments on function.

**Biancotto, M., Skabar, A., Bulgheroni,** [**M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Bulgheroni%20M%22%5BAuthor%5D)**., Carrozzi, M., Zoia, S. (2011). Neuromotor deficits in developmental coordination disorder: evidence from a reach-to-grasp task.** [***Res Dev Disabil.***](http://www.ncbi.nlm.nih.gov/pubmed)***, 32(4)*,1293-1300.**

Developmental coordination disorder (DCD) has been classified as a specific learning disability, nonetheless the underlying cognitive mechanisms are still a matter of discussion. After a summary of the main hypotheses on the principal neuromotor causes of DCD, this study applies a causal model framework to describe the possible coexistence of more than one deficit in this disorder. For this purpose, kinematic analysis was applied to an ecological task, the reach-to-grasp action, introducing the manipulation of three variables: vision, distance and object size. After a thorough neurological and neuropsychological evaluation, 9 children with DCD (7-9 years old) were selected and compared to 27 age-matched control children. The results suggest that children with DCD have a normal neurological characterization of the reaching and grasping movements, in terms of proximal to distal action, but their grasping aperture (MGA) was always wider with respect to controls, particularly when vision was not allowed. In addition, the performance of children with DCD was always slower, more dependent on vision and more variable than that of controls. The MGA of children with DCD could be explained by a deficit in the internal construction of movement for a forward model, while slowness could be related to a control problem in the neuronal firing of the muscles. The idea of a possible coexistence of these two deficits is discussed in accordance to a causal model framework and also addressed considering recent neurophysiologic evidences.

[**Zwicker, J.G**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Zwicker%20JG%22%5BAuthor%5D)**.,** [**Missiuna, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Missiuna%20C%22%5BAuthor%5D)**.,** [**Harris, S.R**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Harris%20SR%22%5BAuthor%5D)**., Boyd, L.A. (2011).** [**Brain activation associated with motor skill practice in children with developmental coordination disorder: an fMRI study.**](http://www.ncbi.nlm.nih.gov/pubmed/21145385)[***Int J Dev Neurosci.***](http://www.ncbi.nlm.nih.gov/pubmed) ***29(2),145-152.***

Children with developmental coordination disorder (DCD) have difficulty in learning new motor skills. At present, it is not known whether these children employ a different set of brain regions than typically developing (TD) children during skilled motor practice. Using functional magnetic resonance imaging, we mapped brain activity associated with skilled motor practice of a trail-tracing task in 7 children with DCD and 7 age-matched controls (aged 8-12 years). We indexed change in motor performance as a reduction in tracing error from early practice to retention. Children with DCD showed less blood-oxygen-level-dependent signal as compared to TD children in a network of brain regions associated with skilled motor practice: bilateral inferior parietal lobules (Brodmann Area (BA) 40), right lingual gyrus (BA 18), right middle frontal gyrus (BA 9), left fusiform gyrus (BA 37), right cerebellar crus I, left cerebellar lobule VI, and left cerebellar lobule IX. While no statistically significant differences were detected, effect size testing revealed that children with DCD demonstrated poorer tracing accuracy than TD children at retention (d=0.48). Our results suggest that, compared to TD peers, children with DCD demonstrate under-activation in cerebellar-parietal and cerebellar-prefrontal networks and in brain regions associated with visual-spatial learning. These data suggest a neurobiological correlation with impaired learning of motor skills in children with DCD, which will need to be confirmed with a larger sample.

**Wuang, YP, & Su, C.Y. (2011). Correlations of sensory processing and visual organization ability with participation in school-aged children with Down syndrome, *Research in Developmental Disabilities,32(6)*,2398-2407.**

Previous work has highlighted delays and differences in cognitive, language, and sensorimotor functions in children diagnosed with Down syndrome (DS). However, sensory processing and visual organization abilities have not been well-examined in DS to date. This study aimed to investigate the developmental profile of sensory processing and visual organization abilities, body functions classified by the World Health Organization's ICF model, and their impacts on participation in DS to guide research and evidence-based practices. Two hundred and six children (101 boys, 105 girls) with DS (age range = 6 years 1 month to 12 years 10 months; mean age = 8 years 1 month) were assessed on measures of sensory processing (Sensory Profile), visual organization ability (Hooper Visual Organization Test), and activity participation (Vineland Adaptive Behavior Scale, School Function Assessment). Our findings characterized the developmental continuum of body functions (sensory processing and visual organization) of children with DS, and revealed their correlations with activity participation. Interventions focused on improving body functions is needed while stressing the acquisition of functional skills that increase participation in age-appropriate activities.

**2010**

[**Koenig, K.P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Koenig%20KP%22%5BAuthor%5D)**., & Rudney, S.G.(2010). Performance challenges for children and adolescents with difficulty processing and integrating sensory information: a systematic review. *Am J Occup Ther.64(3)*:430-442.**

A systematic review of the literature related to performance difficulties for children and adolescents with difficulty processing and integrating sensory information was completed as part of the Evidence-Based Literature Review Project of the American Occupational Therapy Association. The review focused on functional performance difficulties that these children may exhibit in areas of occupation including play and leisure, social participation, activities of daily living, instrumental activities of daily living, rest and sleep, education, and work. The results suggest that children and adolescents with difficulty processing and integrating sensory information do exhibit functional performance difficulties in key areas of occupation. However, further descriptive studies are needed to tie these difficulties to their specific sensory and motor issues. Researchers are encouraged to include functional performance measures and measures of social participation in their studies to further elucidate these relationships.

**Foss-Feig, J.H.,** [**Kwakye, L.D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Kwakye%20LD%22%5BAuthor%5D)**.,** [**Cascio, C.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Cascio%20CJ%22%5BAuthor%5D)**.,** [**Burnette, C.P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Burnette%20CP%22%5BAuthor%5D)**.,** [**Kadivar, H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Kadivar%20H%22%5BAuthor%5D)**.,** [**Stone, W.L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Stone%20WL%22%5BAuthor%5D)**., & Wallace, M.T. (2010). An extended multisensory temporal binding window in autism spectrum disorders. *Exp Brain Res., 203(2)*,381-389.**

Autism spectrum disorders (ASD) form a continuum of neurodevelopmental disorders, characterized by deficits in communication and reciprocal social interaction, as well as by repetitive behaviors and restricted interests. Sensory disturbances are also frequently reported in clinical and autobiographical accounts. However, surprisingly few empirical studies have characterized the fundamental features of sensory and multisensory processing in ASD. The current study is structured to test for potential differences in multisensory temporal function in ASD by making use of a temporally dependent, low-level multisensory illusion. In this illusion, the presentation of a single flash of light accompanied by multiple sounds often results in the illusory perception of multiple flashes. By systematically varying the temporal structure of the audiovisual stimuli, a "temporal window" within which these stimuli are likely to be bound into a single perceptual entity can be defined. The results of this study revealed that children with ASD report the flash-beep illusion over an extended range of stimulus onset asynchronies relative to children with typical development, suggesting that children with ASD have altered multisensory temporal function. These findings provide valuable new insights into our understanding of sensory processing in ASD and may hold promise for the development of more sensitive diagnostic measures and improved remediation strategies.

[**Belmonte, M.K**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Belmonte%20MK%22%5BAuthor%5D)**.,** [**Gomot, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Gomot%20M%22%5BAuthor%5D)**.,** [**Baron-Cohen, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Baron-Cohen%20S%22%5BAuthor%5D)**. (2010).** [**Visual attention in autism families: 'Unaffected' sibs share atypical frontal activation.**](http://www.ncbi.nlm.nih.gov/pubmed/19912448) ***J Child Psychol Psychiatry,*51(3),259-76.**

**Background:** In addition to their more clinically evident abnormalities of social cognition, people with autism spectrum conditions (ASC) manifest perturbations of attention and sensory perception which may offer insights into the underlying neural abnormalities. Similar autistic traits in ASC relatives without a diagnosis suggest a continuity between clinically affected and unaffected family members.

**Methods:** We applied fMRI in the context of a non-social task of visual attention in order to determine whether this continuity persists at the level of brain physiology.

**Results:** Both boys with ASC and clinically unaffected brothers of people with ASC were impaired at a visual divided-attention task demanding conjunction of attributes from rapidly and simultaneously presented, spatially disjoint stimuli and suppression of spatially intervening distractors. In addition, both groups in comparison to controls manifested atypical fronto-cerebellar activation as a function of distractor congruence, and the degree of this frontal atypicality correlated with psychometric measures of autistic traits in ASC and sibs. Despite these resemblances between the ASC and sib groups, an exploratory, hypothesis-generating analysis of correlations across brain regions revealed a decrease in overall functional correlation only in the ASC group and not in the sibs.

**Conclusions: T**hese results establish a neurophysiological correlate of familial susceptibility to ASC, and suggest that whilst abnormal time courses of frontal activation may reflect processes permissive of autistic brain development, abnormal patterns of functional correlation across a wider array of brain regions may relate more closely to autism's determinants.

[**John, A.E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22John%20AE%22%5BAuthor%5D)**.,&** [**Mervis, C.B**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mervis%20CB%22%5BAuthor%5D)**. (2010). Sensory modulation impairments in children with Williams syndrome. *Am J Med Genet C Semin Med Genet, 154C(2*),266-76.**

The ability to organize information detected by our senses ("sensory modulation") allows us to act or respond effectively to situations encountered, facilitating learning, social behavior, and day-to-day functioning. We hypothesized that children with Williams syndrome (WS) would demonstrate symptoms of poor sensory modulation and that these sensory modulation abnormalities contribute to the phenotype. Participants were 78 children with WS aged 4.00-10.95 years. Based on parent ratings on the Short Sensory Profile [SSP; Dunn, 1999], most children were classified as having definite sensory modulation issues. Cluster analysis identified the presence of two clusters varying in level of sensory modulation impairment. Children in the high impairment group demonstrated poorer adaptive functioning, executive functioning, more problem behaviors, and more difficult temperaments than children in the low impairment group.

**Moore, D.R., Ferguson, M.A.,** [**Edmondson-Jones A.M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Edmondson-Jones%20AM%22%5BAuthor%5D)**.,** [**Ratib, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Ratib%20S%22%5BAuthor%5D)**., & Riley, A. (2010). Nature of auditory processing disorder in children.** ***Pediatrics*****,*126(2)*,382-390.**

**Objective:** We tested the specific hypothesis that the presentation of auditory processing disorder (APD) is related to a sensory processing deficit.

**Methods:** Randomly chosen, 6- to 11-year-old children with normal hearing (N = 1469) were tested in schools in 4 regional centers across the United Kingdom. Caregivers completed questionnaires regarding their participating children's listening and communication skills. Children completed a battery of audiometric, auditory processing (AP), speech-in-noise, cognitive (IQ, memory, language, and literacy), and attention (auditory and visual) tests. AP measures separated the sensory and nonsensory contributions to spectral and temporal perception.

**Results:** AP improved with age. Poor-for-age AP was significantly related to poor cognitive, communication, and speech-in-noise performance (P < .001). However, sensory elements of perception were only weakly related to those performance measures (r < 0.1), and correlations between auditory perception and cognitive scores were generally low (r = 0.1-0.3). Multivariate regression analysis showed that response variability in the AP tests, reflecting attention, and cognitive scores were the best predictors of listening, communication, and speech-in-noise skills.

**Conclusions:** Presenting symptoms of APD were largely unrelated to auditory sensory processing. Response variability and cognitive performance were the best predictors of poor communication and listening. We suggest that APD is primarily an attention problem and that clinical diagnosis and management, as well as further research, should be based on that premise.

[**Brown, N.B**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Brown%20NB%22%5BAuthor%5D)**., &nDunn, W. (2010).** [**Relationship between context and sensory processing in children with autism.**](http://www.ncbi.nlm.nih.gov/pubmed/20608278)***American Journal of Occupational Therapy******, 64(3)*:474-483.**

**Objective:** The purpose of the study was to determine the relationship between sensory processing and context for children with autism. We examined home and school contexts using the Sensory Profile (Dunn, 1999) and the Sensory Profile School Companion (Dunn, 2006a) questionnaires.

**Methods:** Teachers of 49 students with autism completed the Sensory Profile School Companion, and parents completed the Sensory Profile. We conducted correlational analyses using the avoiding and seeking quadrant scores from the School Companion and corresponding avoiding and seeking quadrant scores from the Sensory Profile.

**Results:** The avoiding quadrant score coefficient (.59) and the seeking quadrant score coefficient (.45) were statistically significant (p = .01) with good and fair correlations, respectively, suggesting that sensory processing patterns have both universal qualities and context-specific qualities in children with autism.

**Conclusion:** Findings from this study provide initial evidence that sensory processing and context for children with autism are related.

[**Gal, E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Gal%20E%22%5BAuthor%5D)**.,** [**Dyck, M.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Dyck%20MJ%22%5BAuthor%5D)**., & Passmore, A. (2010).** [**Relationships between stereotyped movements and sensory processing disorders in children with and without developmental or sensory disorders.**](http://www.ncbi.nlm.nih.gov/pubmed/20608276)***American Journal of Occupational Therapy******, 64(3)*, 453-461.**

**Objective:** Stereotyped movements (SM) are a defining characteristic of autism but are also present in children with a range of sensory and developmental disorders. We examined whether the severity of sensory processing disorders (SPD) was associated with the severity of SM and whether SPD accounted for between-group differences in SM.

**Method:** The Short Sensory Profile and the Stereotyped and Self-Injurious Movements Interview were administered to children with autism, intellectual disability, visual impairment, and hearing impairment and to typically developing children.

**Results:** SPD predicted the severity of SM in all samples and accounted for differences in SM between the groups. Other differences in the severity of SM were the result of diagnosis and the interaction between diagnosis and an intellectual disability.

**Conclusion:** SPD may be a source of SM, but functional connections between these phenomena will need to be tested in future research. Implications for occupational performance are addressed.

**Su, C.T.,** [**Wu, M.Y**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Wu%20MY%22%5BAuthor%5D)**., Yang, A.L.,** [**Chen-Sea, M.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chen-Sea%20MJ%22%5BAuthor%5D)**.,& Hwang, I.S.(2010).** [**Impairment of stance control in children with sensory modulation disorder.**](http://www.ncbi.nlm.nih.gov/pubmed/20608275) ***American Journal of Occupational Therapy,*64(3), 443-52.**

**Objective:** To compare stance control between children with sensory modulation disorder (SMD) and typically developing children in various visual and somatosensory conditions.

**Method:** Thirty-one children participated in this study, including 17 children with SMD and 14 matched typically developing children. The Sensory Profile was used to screen for sensory modulation problems, which were further confirmed by measures of electrodermal response and the Evaluation of Sensory Processing. Stance parameters for an assessment of postural stability were obtained with a dual-axis accelerometer on the lumbar area.

**Results:** The children with SMD presented atypical sensory responses in terms of both electrophysiological and behavioral measures. The results for stance showed a greater body sway in the SMD group than in the control group (p < .05). However, the group difference was not always significant under the conditions of reliable somatosensory input and sway-referenced vision.

**Conclusion:** Our findings first confirmed impaired stance control in children with SMD.

**Carr,** [**J.L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Carr%20JL%22%5BAuthor%5D)**.,** [**Agnihotri, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Agnihotri%20S%22%5BAuthor%5D)**., Keightley, M. (2010). Sensory processing and adaptive behavior deficits of children across the fetal alcohol spectrum disorder continuum. *Alcohol Clin Exp Res*; *34(6),* 1022-1032.**

**Background:** Prenatal alcohol exposure can have detrimental effects on a child's development of adaptive behaviors necessary for success in the areas of academic achievement, socialization, and self-care. Sensory processing abilities have been found to affect a child's ability to successfully perform adaptive behaviors. The current study explored whether significant differences in sensory processing abilities, adaptive behavior, and neurocognitive functioning are observed between children diagnosed with partial Fetal Alcohol Syndrome (pFAS), Alcohol-Related Neurodevelopmental Disorder (ARND), or children who were prenatally exposed to alcohol (PEA), but did not meet criteria for an FASD diagnosis. The influence of IQ on adaptive behavior as well as further exploration of the relationship between sensory processing and adaptive behavior deficits among these children was also examined.

**Methods:** A secondary analysis was conducted on some of the Short Sensory Profile (SSP) scores, Adaptive Behavior Assessment System--Second Edition (ABAS-II) scores, and Wechsler Intelligence Scale--Fourth Edition/Wechsler Preschool and Primary Scale of Intelligence--Third Edition (WISC- IV/WPPSI-III) scores of 46 children between 3 and 14 years of age with pFAS, ARND, or who were PEA.

**Results:** Greater sensory processing deficits were found in children with a diagnosis of pFAS and ARND compared to those in the PEA group. Children with an ARND diagnosis scored significantly worse on measures of adaptive behavior than the PEA group. Children with pFAS scored significantly lower than children with ARND or PEA on perceptual/performance IQ. No correlation was found between IQ scores and adaptive behaviors across the FASD diagnostic categories. A significant positive correlation was found between SSP and ABAS-II scores.

**Conclusion:** Regardless of the diagnosis received under the FASD umbrella, functional difficulties that could not be observed using traditional measures of intelligence were found, supporting guidelines that a broad range of standardized assessments be included when screening children for FASD.

[**Cermak, S.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Cermak%20SA%22%5BAuthor%5D)**.,** [**Curtin, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Curtin%20C%22%5BAuthor%5D)**., & Bandini, L.G. (2010). Food selectivity and sensory sensitivity in children with autism spectrum disorders. *Journal American Diet Association,110(2),* 238-246.**

Autism spectrum disorders comprise a complex set of related developmental disorders that are characterized by impairments in communication, social interaction, and repetitive behaviors. Impairments in sensory processing are also extremely common. The prevalence of autism spectrum disorders is increasing and is currently estimated to affect 1 in 150 children. Autism spectrum disorders are considered to be a major health and educational problem, affecting many areas of daily living, including eating. Children with autism spectrum disorders are often described as picky or selective eaters. This article provides a comprehensive narrative review of the empirical literature over the last 25 years on food selectivity and nutritional adequacy in children with autism spectrum disorders. The possible contributions of sensory factors, such as sensory sensitivity, to food selectivity are discussed. The need for an interdisciplinary approach to managing atypical eating patterns in children with autism spectrum disorders is highlighted.

[**Brett-Green, B.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Brett-Green%20BA%22%5BAuthor%5D)**.,** [**Miller, L.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Miller%20LJ%22%5BAuthor%5D)**., Schoen, S.A., & Nielsen, D.M. (2010).** [**An exploratory event-related potential study of multisensory integration in sensory over-responsive children.**](http://www.ncbi.nlm.nih.gov/pubmed/20097181)***Brain Res*****,*1321*,67-77.**

Children who are over-responsive to sensation have defensive and "fight or flight" reactions to ordinary levels of sensory stimulation in the environment. Based on clinical observations, sensory over-responsivity is hypothesized to reflect atypical neural integration of sensory input. To examine a possible underlying neural mechanism of the disorder, integration of simultaneous multisensory auditory and somatosensory stimulation was studied in twenty children with sensory over-responsivity (SOR) using event-related potentials (ERPs). Three types of sensory stimuli were presented and ERPs were recorded from thirty-two scalp electrodes while participants watched a silent cartoon: bilateral auditory clicks, right somatosensory median nerve electrical pulses, or both simultaneously. The paradigm was passive; no behavioral responses were required. To examine integration, responses to simultaneous multisensory auditory-somatosensory stimulation were compared to the sum of unisensory auditory plus unisensory somatosensory responses in four time-windows: (60-80 ms, 80-110 ms, 110-150 ms, and 180-220 ms). Specific midline and lateral electrode sites were examined over scalp regions where auditory-somatosensory integration was expected based on previous studies. Midline electrode sites (Fz, Cz, and Pz) showed significant integration during two time-windows: 60-80 ms and 180-220 ms. Significant integration was also found at contralateral electrode site (C3) for the time-window between 180 and 220 ms. At ipsilateral electrode sites (C4 and CP6), no significant integration was found during any of the time-windows (i.e. the multisensory ERP was not significantly different from the summed unisensory ERP). These results demonstrate that MSI can be reliably measured in children with SOR and provide evidence that multisensory auditory-somatosensory input is integrated during both early and later stages of sensory information processing, mainly over fronto-central scalp regions.

[**Su, C.T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Su%20CT%22%5BAuthor%5D)**.,** [**Wu, M.Y**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Wu%20MY%22%5BAuthor%5D)**.,** [**Yang, A.L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Yang%20AL%22%5BAuthor%5D)**.,** [**Chen-Sea, M.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chen-Sea%20MJ%22%5BAuthor%5D)**.,** [**Hwang, I.S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hwang%20IS%22%5BAuthor%5D)**. (2010). Impairment of stance control in children with sensory modulation disorder. *American Journal of Occupational Therapy, 64(3)*, 443-452.**

**Objective:** To compare stance control between children with sensory modulation disorder (SMD) and typically developing children in various visual and somatosensory conditions.

**Methods:** Thirty-one children participated in this study, including 17 children with SMD and 14 matched typically developing children. The Sensory Profile was used to screen for sensory modulation problems, which were further confirmed by measures of electrodermal response and the Evaluation of Sensory Processing. Stance parameters for an assessment of postural stability were obtained with a dual-axis accelerometer on the lumbar area.

**Results:** The children with SMD presented atypical sensory responses in terms of both electrophysiological and behavioral measures. The results for stance showed a greater body sway in the SMD group than in the control group (p < .05). However, the group difference was not always significant under the conditions of reliable somatosensory input and sway-referenced vision.

**Conclusion:** Our findings first confirmed impaired stance control in children with SMD.

[**Humphriss, R**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Humphriss%20R%22%5BAuthor%5D)**.,** [**Hall, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hall%20A%22%5BAuthor%5D)**., & Macleod, J. (2010). Prenatal alcohol exposure and childhood balance: a systematic review.** ***Paediatric Perinatal Epidemiology*****,*4(2)*,156-165.**

Balance problems in childhood have known adverse psychosocial associations such as poorer quality of life and lower educational achievement. Previous longitudinal studies have documented an adverse effect of prenatal alcohol exposure on a variety of neurodevelopmental outcomes and so an effect on balance would seem plausible. This is supported by a previous laboratory study that found that rats exposed to ethanol in utero have dysfunctional balance and gait. The present study is a systematic review of the current evidence on the effects of maternal alcohol use during pregnancy on offspring balance in childhood. A search strategy was devised and applied in the CENTRAL database (Cochrane Collaboration). Prospective longitudinal studies were then sought using databases including Medline, EMBASE, PsychInfo, CINAHL and AMED. In addition, citations in relevant published papers and books were followed up and experts in the field were contacted. No relevant human experimental studies were found. Four longitudinal studies were found to have assessed balance in preschool children. Only one of these studies suggested strong or substantial effects of alcohol exposure on balance-related outcomes. However, this study appeared the most methodologically robust. In conclusion, at present, there is limited evidence on the possible effects of alcohol exposure on childhood balance.

[**Fournier, K.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Fournier%20KA%22%5BAuthor%5D)**.,** [**Kimberg, C.I**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Kimberg%20CI%22%5BAuthor%5D)**.,** [**Radonovich, K.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Radonovich%20KJ%22%5BAuthor%5D)**.,** [**Tillman, M.D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Tillman%20MD%22%5BAuthor%5D)**.,** [**Chow, J.W**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chow%20JW%22%5BAuthor%5D)**., Lewis, M.H.,** [**Bodfish, J.W**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Bodfish%20JW%22%5BAuthor%5D)**., & Hass, C.J.(2010). Decreased static and dynamic postural control in children with autism spectrum disorders.** ***Gait Posture*****, *32(1*), 6-9.**

The purpose of this study was to investigate postural control in children with Autism Spectrum Disorders (ASD) during static and dynamic postural challenges. We evaluated postural sway during quiet stance and the center of pressure (COP) shift mechanism during gait initiation for 13 children with ASD and 12 age-matched typically developing (TD) children. Children with ASD produced 438% greater normalized mediolateral sway (p<0.05) and 104% greater normalized anteroposterior sway (p<0.05) than TD children. Consequently, normalized sway area was also significantly greater (p<0.05) in the group with ASD. Similarly, the maximum separation between the COP and center of mass (COM) during quiet stance was 100% greater in the anteroposterior direction (p<0.05) and 146% greater in the resultant direction (p<0.05) for children with ASD. No significant difference was observed in the mediolateral direction, in spite of the 123% greater separation detected in children with ASD. During gait initiation, no group differences were detected in the posterior COP shift mechanism, suggesting the mechanism for generating forward momentum is intact. However, significantly smaller lateral COP shifts (p<0.05) were observed in children with ASD, suggesting instability or an alternative strategy for generating momentum in the mediolateral direction. These results help to clarify some discrepancies in the literature, suggesting an impaired or immature control of posture, even under the most basic conditions when no afferent or sensory information have been removed or modified. Additionally, these findings provide new insight into dynamic balance in children with ASD.

[**Riquelme, I**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Riquelme%20I%22%5BAuthor%5D)**,,** [**Montoya, P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Montoya%20P%22%5BAuthor%5D)**. (2010). Developmental changes in somatosensory processing in cerebral palsy and healthy individuals. *Clinical Neurophysiology*,*121(8)*,1314-1320.**

**Objective:** Cerebral palsy (CP) is a motor disorder that causes physical disability in human development. Recent work has shown that somatosensory deficits are a serious problem for people with CP. There is however no information about the influence of age on brain correlates of tactile sensitivity.

**Methods:** Proprioception, touch and pain pressure thresholds, as well as somatosensory evoked potentials (SEP) elicited by tactile stimulation in lips and thumbs were examined in 15 children with CP (range 5-14y), 14 adults with CP (range 22-55y), 15 healthy children (range 5-14y), and 15 healthy adults (range 22-42y).

**Results:** Children with CP as compared to healthy controls showed more reduced sensitivity for non-painful stimuli, but enhanced sensitivity for painful stimuli. Early SEP amplitudes (P50 and P100) were more enhanced in children and adults with CP than in healthy participants. A functional hemispheric asymmetry was observed in CP when left- and right-side body parts were stimulated.

**Conclusions:** Data suggest the possibility that altered somatosensory brain processing in CP might be reflecting an enhanced excitability of the somatosensory cortex.

**Significance:** Assessment of somatosensory functions may have implications for future neuromodulatory treatment of pain complaints and motor rehabilitation programs in children and adults with cerebral palsy.

**Jacobs, E.,** [**Miller, L.C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Miller%20LC%22%5BAuthor%5D)**., & Tirella, L.G. (2010). Developmental and behavioral performance of internationally adopted preschoolers: a pilot study. *Child Psychiatry* *Human Development,41(1)*,15-29.**

Most international adoptees (IA) have rapid catch-up of the delays common at arrival. However, it is not known whether development at arrival predicts later abilities or school readiness. Therefore, we comprehensively evaluated language, fine motor, visual reception (VR), executive function (EF), attention (ATT), and sensory skills (SS) in IA preschoolers. We hypothesized that pre-adoptive risk factors, development at arrival, and the post-adoptive environment (time in day care) would predict developmental and behavioral outcomes and school readiness. 37 IA (12M:25F), currently age 4-5 years and previously seen in our clinic (mean arrival age 12 months), were evaluated with standardized tests of development, language, EF, ATT, and SS, along with demographic information, parent interview, and review of arrival clinic records. Fine motor and VR skills at arrival ranged from average to very below average. At follow-up, most IA were average or above average in fine motor, VR, and language skills, but many had concerning scores for ATT (42%), EF (11%) and SS (48%). Arrival expressive language T scores (Mullen) predicted follow-up scores for expressive language (PLS-4, r = .44, p = .005). Arrival fine motor scores (Mullen) correlated with follow-up auditory comprehension scores (PLS-4, r = .47, p = .002) and inversely with inattention scores (Conners', r = -.48, p = .003). Arrival visual reception scores correlated inversely with global measures of attention (Conners' opposition r = -.45, p = .005, ADHD scores r = -.49, p = .002, and to a lesser extent hyperactivity r = -.35, p = .03). Age at arrival was a very strong predictor of many of the outcome measures tested, including language performance, attention regulation, executive function, and sensory processing. Children who spent more time in daycare had significantly more difficulty with emotional control (p = .005). Although IA have good catch-up in specific areas of development, difficulties with ATT regulation, EF, and sensory processing may increase the risk of later school problems.

**Lane, A.E.,** [**Young, R.L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Young%20RL%22%5BAuthor%5D)**.,** [**Baker, A.E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Baker%20AE%22%5BAuthor%5D)**.,& Angley, M.T. (2010).** [**Sensory processing subtypes in autism: association with adaptive behavior.**](http://www.ncbi.nlm.nih.gov/pubmed/19644746) ***Journal of Autism and Developmental Disorders*,*40(1),*112-122.**

Children with autism are frequently observed to experience difficulties in sensory processing. This study examined specific patterns of sensory processing in 54 children with autistic disorder and their association with adaptive behavior. Model-based cluster analysis revealed three distinct sensory processing subtypes in autism. These subtypes were differentiated by taste and smell sensitivity and movement-related sensory behavior. Further, sensory processing subtypes predicted communication competence and maladaptive behavior. The findings of this study lay the foundation for the generation of more specific hypotheses regarding the mechanisms of sensory processing dysfunction in autism, and support the continued use of sensory-based interventions in the remediation of communication and behavioral difficulties in autism.

[**Davies, P.L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Davies%20PL%22%5BAuthor%5D)**., &** [**Tucker, R**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Tucker%20R%22%5BAuthor%5D)**. (2010). Evidence review to investigate the support for subtypes of children with difficulty processing and integrating sensory information.** ***American Journal of Occupational Therapy******, 2010, 64(3)*, 391-402.**

We investigated the evidence for subtypes in children with difficulty processing and integrating sensory information. Fifty-seven articles were incorporated into a systematic literature review; only 4 articles provided direct evidence for subtypes. These studies did not provide a comprehensive assessment of all sensory functions and sensory-based motor functions (i.e., praxis) and included different diagnostic groups. Therefore, generalized conclusions about subtypes could not be drawn. The other 53 studies reviewed provided meaningful information about strengths and challenges that children with difficulty processing and integrating sensory information demonstrate, but these studies were limited in scope. A principal theme was the importance of conducting comprehensive assessments of sensory-based functions, including multiple measures of sensory integrative functions such as praxis, sensory modulation, and sensory discrimination in children and adolescents with various clinical disorders. In addition, more consistency in the use of specific assessment tools will allow for synthesis of data across studies.

[**Chang, S.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chang%20SH%22%5BAuthor%5D)**., & Yu, N.Y. (2010).** [**Characterization of motor control in handwriting difficulties in children with or without developmental coordination disorder*.***](http://www.ncbi.nlm.nih.gov/pubmed/20002122) ***Dev Med Child Neurol*, *52(3)*, 244-250.**

**Purpose:** The purpose of this study was to characterize handwriting deficits in children with developmental coordination disorder (DCD) using computerized movement analyses.

**Method:** Seventy-two children (40 females, 32 males; mean age 7 y, SD 7 mo; range 6 y 2 mo to 7 y 11 mo) with handwriting deficits (33 with DCD, 39 without DCD); and 22 age- and sex-matched children without handwriting deficits were asked to perform handwriting tasks on a digital tablet for the collection of kinematic and kinetic data. Practice times required to achieve automation of movement when writing an unfamiliar character were used to assess the motor learning of handwriting. The children were asked to copy three simple and three complex characters, and the velocity and axial pen force used for corresponding strokes were compared.

**Results:** The attainment of automated handwriting was markedly slower in children with handwriting deficits and DCD, who used a faster stroke velocity to write simple characters (1.22 times those without handwriting deficits), but when writing complex characters, their stroke velocity and pen force were lower (0.85 and 0.89 times those without handwriting deficits, respectively).

**Interpretation:** By linking the results with neuromotor control theories, it was determined that children with DCD have difficulties performing the open-loop and closed-loop movements required for fluent handwriting.

[**Elder**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Elders%20V%22%5BAuthor%5D)**s,** [**V**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Elders%20V%22%5BAuthor%5D)**.,** [**Sheehan, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Sheehan%20S%22%5BAuthor%5D)**.,** [**Wilson, A.D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Wilson%20AD%22%5BAuthor%5D)**.,** [**Levesley, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Levesley%20M%22%5BAuthor%5D)**.,** [**Bhakta, B**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Bhakta%20B%22%5BAuthor%5D)**., & Mon-Williams, M. (2010).** [**Head-torso-hand coordination in children with and without developmental coordination disorder.**](http://www.ncbi.nlm.nih.gov/pubmed/19549191) ***Dev Med Child Neurol*, *52(3)*, 238-43.**

**Purpose:** This study investigated the nature of coordination and control problems in children with developmental coordination disorder (DCD).

**Method:** Seven adults (two males, five females, age range 20-28 y; mean 23 y, SD 2 y 8 mo) and eight children with DCD (six males, two females, age range 7-9 y; mean 8 y, SD 8 mo), and 10 without DCD (seven males, three females, age range 7-9 y; mean 8 y, SD 7 mo) sat in a swivel chair and looked at or pointed to targets. Optoelectronic apparatus recorded head, torso, and hand movements, and the spatial and temporal characteristics of the movements were computed.

**Results:** Head movement times were longer (p<0.05) in children with DCD than in the comparison group, even in the looking task, suggesting that these children experience problems at the lowest level of coordination (the coupling of synergistic muscle groups within a single degree of freedom). Increasing the task demands with the pointing condition affected the performance of children with DCD to a much greater extent than the other groups, most noticeably in key feedforward kinematic landmarks. Temporal coordination data indicated that all three groups attempted to produce similar movement patterns to each other, but that the children with DCD were much less successful than age-matched children in the comparison group.

**Interpretation:** Children with DCD have difficulty coordinating and controlling single degree-of-freedom movements; this problem makes more complex tasks disproportionately difficult for them. Quantitative analysis of kinematics provides key insights into the nature of the problems faced by children with DCD.

**Riquelme, I.,&** [**Montoya, P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Montoya%20P%22%5BAuthor%5D)**. (2010).** [**Developmental changes in somatosensory processing in cerebral palsy and healthy individuals.**](http://www.ncbi.nlm.nih.gov/pubmed/20363181) ***Clinical Neurophysiol*ogy,*121(8)*,1314-1320.**

**Objective:** Cerebral palsy (CP) is a motor disorder that causes physical disability in human development. Recent work has shown that somatosensory deficits are a serious problem for people with CP. There is however no information about the influence of age on brain correlates of tactile sensitivity.

**Methods:** Proprioception, touch and pain pressure thresholds, as well as somatosensory evoked potentials (SEP) elicited by tactile stimulation in lips and thumbs were examined in 15 children with CP (range 5-14y), 14 adults with CP (range 22-55y), 15 healthy children (range 5-14y), and 15 healthy adults (range 22-42y).

**Results:** Children with CP as compared to healthy controls showed more reduced sensitivity for non-painful stimuli, but enhanced sensitivity for painful stimuli. Early SEP amplitudes (P50 and P100) were more enhanced in children and adults with CP than in healthy participants. A functional hemispheric asymmetry was observed in CP when left- and right-side body parts were stimulated.

**Conclusions:** Data suggest the possibility that altered somatosensory brain processing in CP might be reflecting an enhanced excitability of the somatosensory cortex.

**Significance:** Assessment of somatosensory functions may have implications for future neuromodulatory treatment of pain complaints and motor rehabilitation programs in children and adults with cerebral palsy.

**Van Roon, D.,** [**Caeyenberghs, K**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Caeyenberghs%20K%22%5BAuthor%5D)**.,** [**Swinnen, S.P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Swinnen%20SP%22%5BAuthor%5D)**., & Smits-Engelsman, B.C. (2010). Children with a learning disorder show prospective control impairments during visuomanual tracking. *Res Dev Disability, 31(1)*,195-202.**

To examine whether children with a learning disorder (LD) are able to use prospective motor control, 30 children with LD (mean age 8 years and 11 months) and an age- and gender-matched control group were asked to smoothly track an accelerating dot presented on a monitor by moving an electronic pen on a digitizer. Children with LD performed worse than controls: the number of drawn circles was smaller, the maximum target velocity lower, and the number of submovements was higher. It is suggested that a decreased ability to predict the movement of the target leads to impaired visuomanual tracking in children with LD. Furthermore, children with LD did not improve from the 1st to the 2nd trial, possibly as a result of slower visuomotor adaptation processes.

[**Semrud-Clikeman, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Semrud-Clikeman%20M%22%5BAuthor%5D)**.,** [**Walkowiak, J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Walkowiak%20J%22%5BAuthor%5D)**.,** [**Wilkinson, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Wilkinson%20A%22%5BAuthor%5D)**., & Christopher, G. (2010). Neuropsychological differences among children with Asperger syndrome, nonverbal learning disabilities, attention deficit disorder, and controls. *Developmental Neuropsychology,35(5)*,582-600.**

Confusion is present as to possible diagnostic differences between Asperger syndrome (AS) and Nonverbal learning disabilities (NLD) and the relation of these disorders to attentional difficulties. Three-hundred and forty-five children participated in this study in 5 groups; NLD, AS, attention deficit hyperactivity disorder (ADHD): Combined type, ADHD: Inattentive type, and controls. The NLD group showed particular difficulty on visual-spatial, visual-motor, and fluid reasoning measures compared to the other groups. There was also a significant verbal-performance IQ split in this group related to difficulty in social functioning. This study extends the findings from previous studies and extends these findings to differences between AS and NLD groups.

**Zwicker, J.G.,** [**Missiuna, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Missiuna%20C%22%5BAuthor%5D)**., Harris, S.R., &** [**Boyd, L.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Boyd%20LA%22%5BAuthor%5D)**. (2010). Brain activation of children with developmental coordination disorder is different than peers. *Pediatrics,126(3)*,678-686.**

**Objectives:** Children with developmental coordination disorder (DCD)struggle to learn new motor skills, demonstrating more variable performance than typically developing (TD) children. The purpose of this study was to determine whether patterns of brain activity differed between children with and without DCD while performing a motor task.

**Methods:** Using functional MRI, we measured brain activation patterns in 7 children with DCD and 7 age-matched peers (aged 8-12 years) during a fine-motor, trail-tracing task.

**Results:** Despite similar levels of behavioral motor performance, different patterns of brain activity were noted between the 2 groups. The group with DCD showed significantly more activation than control subjects in left inferior parietal lobule, right middle frontal gyrus, right supramarginal gyrus, right lingual gyrus, right parahippocampal gyrus, right posterior cingulate gyrus, right precentral gyrus, right superior temporal gyrus, and right cerebellar lobule VI. These results suggest that the group with DCD relied on visuospatial processing to complete the task. The TD group demonstrated significantly more activation than the group with DCD in left precuneus, left superior frontal gyrus, right superior temporal gyrus/insula, left inferior frontal gyrus, and left postcentral gyrus; these regions have been associated with spatial processing, motor control and learning, and error processing.

**Conclusions:** Children with DCD activate different brain regions from typical children when performing the same trail-tracing task. Despite the small sample size, our results contribute to a growing body of literature suggesting that children with DCD exhibit differences in neural networks and patterns of brain activation relative to same-age peers.

[**Mosconi, M.W**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mosconi%20MW%22%5BAuthor%5D)**.,** [**Kay, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Kay%20M%22%5BAuthor%5D)**.,** [**D'Cruz, A.M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22D'Cruz%20AM%22%5BAuthor%5D)**.,** [**Guter, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Guter%20S%22%5BAuthor%5D)**.,** [**Kapur, K**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Kapur%20K%22%5BAuthor%5D)**.,** [**Macmillan, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Macmillan%20C%22%5BAuthor%5D)**.,** [**Stanford, L.D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Stanford%20LD%22%5BAuthor%5D)**., &** [**Sweeney, J.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Sweeney%20JA%22%5BAuthor%5D)**. (2010).** [**Neurobehavioral abnormalities in first-degree relatives of individuals with autism.**](http://www.ncbi.nlm.nih.gov/pubmed/20679591) ***Arch Gen Psychiatry, 67(8)*,830-840.**

**Context:** Studying sensorimotor and neurocognitive impairments in unaffected family members of individuals with autism may help identify familial pathophysiological mechanisms associated with the disorder.

**Objective:** To determine whether atypical sensorimotor or neurocognitive characteristics associated with autism are present in first-degree relatives of individuals with autism.

**Design:** Case-control comparison of neurobehavioral functions.

**Setting:** University medical center.

**Participants:** Fifty-seven first-degree relatives of individuals with autism and 40 age-, sex-, and IQ-matched healthy control participants (aged 8-54 years).

**Main outcome measures:** Oculomotor tests of sensorimotor responses (saccades and smooth pursuit); procedural learning and response inhibition; neuropsychological tests of motor, memory, and executive functions; and psychological measures of social behavior, communication skills, and obsessive-compulsive behaviors.

**Results:** On eye movement testing, family members demonstrated saccadic hypometria, reduced steady-state pursuit gain, and a higher rate of voluntary response inhibition errors relative to controls. They also showed lateralized deficits in procedural learning and open-loop pursuit gain (initial 100 milliseconds of pursuit) and increased variability in the accuracy of large-amplitude saccades that were confined to rightward movements. In neuropsychological studies, only executive functions were impaired relative to those of controls. Family members reported more communication abnormalities and obsessive-compulsive behaviors than controls. Deficits across oculomotor, neuropsychological, and psychological domains were relatively independent from one another.

**Conclusions:** Family members of individuals with autism demonstrate oculomotor abnormalities implicating pontocerebellar and frontostriatal circuits and left-lateralized alterations of frontotemporal circuitry and striatum. The left-lateralized alterations have not been identified in other neuropsychiatric disorders and are of interest given atypical brain lateralization and language development associated with the disorder. Similar oculomotor deficits have been reported in individuals with autism, suggesting that they may be familial and useful for studies of neurophysiological and genetic mechanisms in autism.

[**Bédard, A.C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22B%C3%A9dard%20AC%22%5BAuthor%5D)**.,** [**Trampush, J.W**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Trampush%20JW%22%5BAuthor%5D)**.,** [**Newcorn, J.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Newcorn%20JH%22%5BAuthor%5D)**., &** [**Halperin, J.M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Halperin%20JM%22%5BAuthor%5D)**. (2010).** [**Perceptual and motor inhibition in adolescents/young adults with childhood-diagnosed ADHD.**](http://www.ncbi.nlm.nih.gov/pubmed/20604617)***Neuropsychology******, 24(4),* 424-434.**

**Objective:** This study examined perceptual and motor inhibition in a longitudinal sample of adolescents/young adults who were diagnosed with ADHD in childhood, and as a function of the relative persistence of ADHD.

**Method:** Ninety-eight participants diagnosed with ADHD in childhood were re-evaluated approximately 10 years later. Eighty-five never-ADHD controls similar in age, IQ, sociodemographic background, and gender distribution served as a comparison group. Participants were administered a psychiatric interview and the Stimulus and Response Conflict Tasks (Nassauer & Halperin, 2003).

**Results:** Participants with childhood ADHD demonstrated slower and less accurate responses to both control and conflict conditions relative to the comparison group, as well as more variable responses in both conditions of the motor inhibition task; there was no specific effect of childhood ADHD on perceptual or motor inhibition. ADHD persisters and partial remitters did not differ in overall accuracy, speed or variability in responding, but relative to partial remitters, persisters demonstrated greater slowing in response to perceptual conflict.

**Conclusions:** These findings are consistent with theories positing state regulation, but not inhibitory control deficits in the etiology of ADHD, and suggest that improved perceptual inhibition may be associated with better outcome for ADHD.

**Hartman, E.,** [**Houwen, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Houwen%20S%22%5BAuthor%5D)**.,** [**Scherder, E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Scherder%20E%22%5BAuthor%5D)**.,&** [**Visscher, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Visscher%20C%22%5BAuthor%5D)**. (2010).** [**On the relationship between motor performance and executive functioning in children with intellectual disabilities.**](http://www.ncbi.nlm.nih.gov/pubmed/20537052)***J Intellect Disabil Res.*****,*54(5)*,468-477.**

**BACKGROUND:** It has been suggested that children with intellectual disabilities (ID) have motor problems and higher-order cognitive deficits. The aim of this study was to examine the motor skills and executive functions in school-age children with borderline and mild ID. The second aim was to investigate the relationship between the two performance domains.

**Methods** Sixty-one children aged between 7 and 12 years diagnosed with borderline ID (33 boys and 28 girls; 71 < IQ < 79) and 36 age peers with mild ID (24 boys and 12 girls; 54 < IQ < 70) were assessed. Their abilities were compared with those of 97 age- and gender-matched typically developing children. Qualitative motor skills, i.e. locomotor ability and object control, were evaluated with the Test of Gross Motor Development (TGMD-2). Executive functioning (EF), in terms of planning ability, strategic decision-making and problem solving, was gauged with the Tower of London (TOL) task.

**Results:** Compared with the reference group, the full ID cohort scored significantly lower on all assessments. For the locomotor skills, the children with mild ID scored significantly lower than the children with borderline ID, but for the object control skills and the TOL score, no significant differences between the two groups were found. Motor performance and EF correlated positively. At the most complex level, the TOL showed decision time to be a mediator between motor performance and EF: the children with the lower motor scores had significantly shorter decision times and lower EF scores. Analogously, the children with the lower object control scores had longer execution times and lower EF scores.

**Conclusions:** The current results support the notion that besides being impaired in qualitative motor skills intellectually challenged children are also impaired in higher-order executive functions. The deficits in the two domains are interrelated, so early interventions boosting their motor and cognitive development are recommended.

[**Cairney J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Cairney%20J%22%5BAuthor%5D)**,** [**Veldhuizen S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Veldhuizen%20S%22%5BAuthor%5D)**,** [**Szatmari P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Szatmari%20P%22%5BAuthor%5D)**. Motor coordination and emotional-behavioral problems in children.** ***Curr Opin Psychiatry*****(4),324-329.**

**Purpose:** To summarize recent research on developmental coordination disorder (DCD), with particular attention to comorbidity and related questions of etiology.

**Results:** Although a general consensus on the disorder definition exists, case identification in research studies remains problematic. Despite this, recent research has reported high levels of attention deficit/hyperactivity disorder and internalizing disorders among children with poor motor coordination. These findings offer some support for the longstanding view that DCD may be one facet of a broader syndrome that includes learning difficulties and deficits in attention. 'Pure' cases are common, however, and other work suggests that DCD and attention deficit/hyperactivity disorder have distinct causes. There is also some evidence that internalizing disorder may be a consequence of DCD.

**Summary:** Measurement issues in DCD persist, whereas findings on comorbidity have both illuminated the nature of the disorder and heightened debate on its usefulness as a distinct diagnostic entity.

[**Travers BG**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Travers%20BG%22%5BAuthor%5D)**,** [**Klinger MR**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Klinger%20MR%22%5BAuthor%5D)**,** [**Mussey JL**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mussey%20JL%22%5BAuthor%5D)**,** [**Klinger LG**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Klinger%20LG%22%5BAuthor%5D)**.** [**Motor-linked implicit learning in persons with autism spectrum disorders.**](http://www.ncbi.nlm.nih.gov/pubmed/20437602)**Autism Res.** **2010 Apr;3(2)68-77.**

Fifteen adolescents and young adults with high-functioning autism spectrum disorders (ASD) and 18 age- and IQ-matched adults with typical development (TD) completed a serial reaction time task (SRT) to examine possible motor-linked implicit learning impairments in persons with ASD. Measures were taken to decrease the role of explicit learning in the SRT. Results showed that participants with ASD demonstrated intact motor-linked implicit learning. Furthermore, the motor-linked implicit learning appeared to take place at a similar rate across trials in the group with ASD compared to the group with TD. These results suggest that persons with ASD are successful in implicit learning of motor-linked behavior. The results of this study, coupled with past findings, suggest that people with ASD may be able to learn motor movements without conscious awareness, especially if the individual is older and is learning fine motor sequences.

[**Martin, R**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Martin%20R%22%5BAuthor%5D)**.,** [**Tigera, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Tigera%20C%22%5BAuthor%5D)**.,** [**Denckla, M.B**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Denckla%20MB%22%5BAuthor%5D)**., &** [**Mahone, E.M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mahone%20EM%22%5BAuthor%5D)**. (2010).** [**Factor structure of paediatric timed motor examination and its relationship with IQ.**](http://www.ncbi.nlm.nih.gov/pubmed/20412260)***Develop Med Child Neurol*****, *52(8)*, 188-194.**

**Aim**: Brain systems supporting higher cognitive and motor control develop in a parallel manner, dependent on functional integrity and maturation of related regions, suggesting neighbouring neural circuitry. Concurrent examination of motor and cognitive control can provide a window into neurological development. However, identification of performance-based measures that do not correlate with IQ has been a challenge.

**Methods**: Timed motor performance from the Physical and Neurological Examination of Subtle Signs and IQ were analysed in 136 children aged 6 to 16 (mean age 10y 2.6mo, SD 2y 6.4mo; 98 female, 38 male) attending an outpatient neuropsychology clinic and 136 right-handed comparison individuals aged 6 to 16 (mean age 10y 3.1mo, SD 2y 6.1mo; 98 female, 38 male). Timed activities--three repetitive movements (toe tapping, hand patting, finger tapping) and three sequenced movements (heel-toe tap, hand pronate/supinate, finger sequencing) each performed on the right and left--were included in exploratory factor analyses.

**Results**: Among comparison individuals, factor analysis yielded two factors--repetitive and sequenced movements--with the sequenced factor significantly predictive of Verbal IQ (VIQ) (DeltaR(2)=0.018, p=0.019), but not the repetitive factor (DeltaR(2)=0.004, p=0.39). Factor analysis within the clinical group yielded two similar factors (repetitive and sequenced), both significantly predictive of VIQ, (DeltaR(2)=0.028, p=0.015; DeltaR(2)=0.046, p=0.002 respectively).

**Interpretation**: Among typical children, repetitive timed tasks may be independent of IQ; however, sequenced tasks share more variance, implying shared neural substrates. Among neurologically vulnerable populations, however, both sequenced and repetitive movements covary with IQ, suggesting that repetitive speed is more indicative of underlying neurological integrity.

[**Watanabe, K**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Watanabe%20K%22%5BAuthor%5D)**.,** [**Ikeda, H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Ikeda%20H%22%5BAuthor%5D)**., &** [**Miyao, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Miyao%20M%22%5BAuthor%5D)**. (2010).Learning efficacy of explicit visuomotor sequences in children with attention-deficit/hyperactivity disorder and Asperger syndrome.** ***Exp Brain Res*****, *203(1)*,233-239.**

Developmental disorders such as attention-deficit/hyperactivity disorder (ADHD) and Asperger syndrome (AS) are often associated with learning disabilities. This study investigated the explicit learning of visuomotor sequences in 17 ADHD children (mean age 12.1), 21 AS children (mean age 12.7), and 15 typically developing children (mean age: 12.3). The participants were required to explore a hidden sequence of button presses by trial and error and elaborate the learned sequence (2 x 10 task: Hikosaka et al. 1996). The results indicated that although ADHD and AS children had a tendency of repeating the same errors and took longer to complete a sequence, both showed a degree and pattern of improvement in accuracy and speed similar to that of typically developing children. These results suggest that the explicit learning of visuomotor sequence in ADHD and AS patients is largely unimpaired.

**Fernell, E.,** [**Hedvallm, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hedvall%20A%22%5BAuthor%5D)**.,** [**Norrelgen, F**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Norrelgen%20F%22%5BAuthor%5D)**.,** [**Eriksson, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Eriksson%20M%22%5BAuthor%5D)**.,** [**Höglund-Carlsson, L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22H%C3%B6glund-Carlsson%20L%22%5BAuthor%5D)**.,** [**Barnevik-Olsson, M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Barnevik-Olsson%20M%22%5BAuthor%5D)**.,** [**Svensson, L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Svensson%20L%22%5BAuthor%5D)**.,** [**Holm, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Holm%20A%22%5BAuthor%5D)**.,** [**Westerlund, J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Westerlund%20J%22%5BAuthor%5D)**., &** [**Gillberg, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Gillberg%20C%22%5BAuthor%5D)**. (2010).** [**Developmental profiles in preschool children with autism spectrum disorders referred for intervention.**](http://www.ncbi.nlm.nih.gov/pubmed/20207104) ***Res Dev Disabil,31(3),*790-799.**

The aim was to characterize the panorama of developmental disorders in 208 preschool children with a clinical diagnosis of autism spectrum disorder (ASD), referred to a specialized centre, the Autism Centre for Young Children (ACYC), for intervention. At the centre, a research team examined all children according to structured protocols and interviews. All available test data from their assessments prior to referral were scrutinized. The boy:girl ratio was 5.5:1. In 22% of the total group a period of regression, including speech and language, had occurred. Epilepsy had been diagnosed in 6% of the children. In 38% of the children there was a definite or highly suspected learning disability/mental retardation according to cognitive test results. About the same proportion had a developmental delay that at the time of assessment could not be definitely classified and in 23% there were clear indications of a normal intellectual function. About 40% of the group exhibited hyperactivity. Differences in expressive vocabulary and adaptive functioning were strongly related to cognitive level. About 20% of the group had AD as the dominating developmental disorder, i.e., they represented a clinical picture of "classic" autism. The majority in this group also had learning disability. Another 20%, had ASD combined with a normal intellectual level, some of these conformed to the clinical picture of Asperger syndrome. In a relatively large group (more than half) learning disability or a general developmental delay was as evident as the ASD. In a smaller group (8%) ASD criteria were questionably met. In this group attention deficits in connection with speech and language problems were prominent. The highly individual developmental profiles seen in children with ASDs have to be taken into account when planning intervention and follow-up. The children's medical characteristics also vary considerably and will be detailed in a further report.

[**Chang, S.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chang%20SH%22%5BAuthor%5D)**., &** [**Yu, N.Y**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Yu%20NY%22%5BAuthor%5D)**. (2010).** [**Characterization of motor control in handwriting difficulties in children with or without developmental coordination disorder.**](http://www.ncbi.nlm.nih.gov/pubmed/20002122)***Dev Med Child Neurol*.** ***52(3)*, 244-250.**

**Aim:** The purpose of this study was to characterize handwriting deficits in children with developmental coordination disorder (DCD) using computerized movement analyses.

**Method:** Seventy-two children (40 females, 32 males; mean age 7 y, SD 7 mo; range 6 y 2 mo to 7 y 11 mo) with handwriting deficits (33 with DCD, 39 without DCD); and 22 age- and sex-matched children without handwriting deficits were asked to perform handwriting tasks on a digital tablet for the collection of kinematic and kinetic data. Practice times required to achieve automation of movement when writing an unfamiliar character were used to assess the motor learning of handwriting. The children were asked to copy three simple and three complex characters, and the velocity and axial pen force used for corresponding strokes were compared.

**Results:** The attainment of automated handwriting was markedly slower in children with handwriting deficits and DCD, who used a faster stroke velocity to write simple characters (1.22 times those without handwriting deficits), but when writing complex characters, their stroke velocity and pen force were lower (0.85 and 0.89 times those without handwriting deficits, respectively).

**Interpretation:** By linking the results with neuromotor control theories, it was determined that children with DCD have difficulties performing the open-loop and closed-loop movements required for fluent handwriting.

**Uysal, S.A.,** [**Erden, Z**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Erden%20Z%22%5BAuthor%5D)**.,** [**Akbayrak, T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Akbayrak%20T%22%5BAuthor%5D)**., &** [**Demirtürk, F**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Demirt%C3%BCrk%20F%22%5BAuthor%5D)**. (2010). Comparison of balance and gait in visually or hearing impaired children.** ***Perceptual Motor Skills******,111(1),* 71-80.**

The study was planned to evaluate the effect of loss of hearing and vision on balance and gait in 60 children, 20 of whom had hearing loss (M age = 9.3 yr., SD = 0.9), 20 who were visually impaired (M age = 12.2 yr., SD = 2.5), and 20 controls with no disability (M age = 9.4 yr., SD = 0.6). Standing Balance subtests of the Southern California Sensory Integration Tests were used. Gait analysis was conducted on a powdered surface. When the gait analysis results of the three groups of children were compared, statistically significant differences were noted. Scores for the hearing impaired group were more like those of the control group than those of the visually impaired group. Results show that children with visual impairment had more problems with balance and gait than controls.

[**Nazari, M.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Nazari%20MA%22%5BAuthor%5D)**.,** [**Berquin, P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Berquin%20P%22%5BAuthor%5D)**.,** [**Missonnier, P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Missonnier%20P%22%5BAuthor%5D)**.,** [**Aarabi, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Aarabi%20A%22%5BAuthor%5D)**.,** [**Debatisse, D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Debatisse%20D%22%5BAuthor%5D)**.,** [**De Broca, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22De%20Broca%20A%22%5BAuthor%5D)**., & Wallois F. (2010).** [**Visual sensory processing deficit in the occipital region in children with attention-deficit / hyperactivity disorder as revealed by event-related potentials during cued continuous performance test.**](http://www.ncbi.nlm.nih.gov/pubmed/20513613) ***Neurophysiol Clin. 40(3)*,137-149.**

**Aim:** Recent studies described several changes of attention-related components of late frontal event-related potentials (ERPs) during Go/NoGo paradigm in children with attention-deficit/hyperactivity disorder (ADHD). We aimed to determine whether ERP components corresponding to earlier encoding of visual incoming information are also modulated by attentional disorders.

**Methods:** We recorded high-resolution EEG in 15 children meeting DSM-IV criteria for ADHD, comprising 15 age-matched control groups during an equiprobable Go/NoGo task in a cued continuous performance test (CPT-AX) paradigm. Both P100 and N200 ERP components were measured in response to both Go and NoGo stimuli. We analyzed both components with SwLORETA in order to localize their brain sources.

**Results:** A low rate of Go correct response and high rate of omission errors were observed in ADHD children. When compared to controls, these displayed delayed P100 and N200 latency, and lower P100-NoGo amplitude. In addition, the P100 latency was delayed for NoGo compared to Go condition. The source of P100 was located in occipital area. A sizable decrease in early electrical activity was found in ADHD, especially in the NoGo condition.

**Conclusion:** Our results suggest an early deficit in visual sensory integration within the occipital cortex in children with ADHD.

**2009**

**Ben-Sasson, A. Carter, A.S. & Briggs-Gowan, M.J. (2009). Sensory over-responsivity in elementary school: Prevalence and social-emotional correlates. *Journal of Abnormal Child Psychology*, 37(5).**

Sensory over-responsivity (SOR) towards tactile and auditory input can impact children’s participation in academic and social activities; however the prevalence of SOR behaviors and their relation to social-emotional problems and competence has not been rigorously studied. This study investigated SOR in a representative sample of elementary school-aged children (*n*= 925, 50% boys, ages 7–11 years) who were followed from infancy. Sixteen percent of parents reported that at least four tactile or auditory sensations bothered their children. Being bothered by certain sensations was common while others were relatively rare. Parents of children with versus without elevated SOR in school-age reported higher frequencies of early and co-occurring internalizing, externalizing, and dysregulation problems, and lower levels of concurrent adaptive social behaviors. Early identification of elevated SOR and assessment of concurrent social-emotional status are important to minimize their impact on social adaptive behaviors at school age.

**Schoen,S.A. , Miller,L.J., Brett-Green,B. A., & Nielsen, D.M. (2009). Physiological and Behavioral Differences in Sensory Processing: A Comparison of Children with Autism Spectrum Disorder and Sensory Modulation Disorder. *Front Integr Neurosci.; 3 (29).***

A high incidence of sensory processing difficulties exists in children with Autism Spectrum Disorder (ASD) and children with Sensory Modulation Disorder (SMD). This is the first study to directly compare and contrast these clinical disorders. Sympathetic nervous system markers of arousal and reactivity were utilized in a laboratory paradigm that administered a series of sensory challenges across five sensory domains. The Short Sensory Profile, a standardized parent-report measure, provided a measure of sensory-related behaviors. Physiological arousal and sensory reactivity were lower in children with ASD whereas reactivity after each sensory stimulus was higher in SMD, particularly to the first stimulus in each sensory domain. Both clinical groups had significantly more sensory-related behaviors than typically developing children, with contrasting profiles. The ASD group had more taste/smell sensitivity and sensory under-responsivity while the SMD group had more atypical sensory seeking behavior. This study provides preliminary evidence distinguishing sympathetic nervous system functions and sensory-related behaviors in Autism Spectrum Disorder and Sensory Modulation Disorder. Differentiating the physiology and sensory symptoms in clinical groups is essential to the provision of appropriate interventions.

## Emmanuelle Jasmin, Mélanie Couture, Patricia McKinley, Greg Reid, Eric Fombonne & Erika Gisel. (2009). Sensori-motor and Daily Living Skills of Preschool Children with Autism Spectrum Disorders. Journal of Autism and Developmental Disorders, 39, 231-41.

Sensorimotor development and performance of daily living skills (DLS) remain little explored in children with autism spectrum disorders (ASD). The objective of this study was to determine the impact of sensorimotor skills on the performance of DLS in preschool children with ASD. Thirty-five children, 3–4 years of age, were recruited and assessed with a battery of diagnostic and clinical tests. Children showed atypical sensory responses, very poor motor and DLS. Sensory avoiding, an excessive reaction to sensory stimuli, and fine motor skills were highly correlated with DLS, even when cognitive performance was taken into account. Sensorimotor deficits have an impact on the autonomy of children with ASD and interventions should aim at improving and supporting the development of sensorimotor skills.

**Oti, R.S. (2009). Atypical sensory behaviors in young children with Autism Spectrum Disorders. Dissertation.**

Previous research has established that individuals with autism spectrum disorders (ASD) have higher rates of unusual responses to sensory stimuli than the typical population. Differences in these behaviors between children with autism compared to children with other clinical populations have not been as consistent. Research in this area is limited by inconsistencies in definitions of what constitutes sensory behavior, differences in how behaviors are assessed, and how styles of responding are defined (e.g. hyper-responsivity versus sensory sensitivity). The three studies included in this dissertation examined unusual sensory responses in children between the ages of 12 and 36 months who were at higher risk for having ASD. The first study examined the validity of using the Toddler Sensory Profile Questionnaire (TSP) to measure sensory behaviors in children with ASD by identifying items in the TSP that overlap with autism-specific behaviors and comparing performance on the TSP to other measures of sensory behavior. The goal of the second study was to compare the sensory behaviors of children with ASD to typically developing children and children with nonspectrum developmental disorders. In addition, the effect of individual characteristics, such as NVIQ, age, risk status and diagnosis, was examined. The third study examined the relationship between atypical sensory behavior and impairments in socialization by examining the relationship between scores on the TSP and socialization as measured by the Autism Diagnostic Observation Schedule (ADOS), The Autism Diagnostic Interview-Revised (ADI-R), and the Vineland Adaptive Behavior Interview (VABS). Results support previous research that children with autism have higher rates of unusual sensory responses than typically developing peers. However, caution should be used when interpreting findings from studies that use the TSP as several TSP items were identified as autism-specific behaviors. NVIQ, age, and diagnosis were found to have an effect on sensory behavior, but the effect differed based on the sensory modality or style being addressed. Results of Study 3 indicated a relationship between sensory behaviors and socialization, specifically when socialization is measured by the ADI-R and the VABS. Implications of these findings and limitations of the studies and other research regarding sensory behaviors in children are discussed

##  Joosten, A., Bundy, A., & Einfeld, S.(2009). Intrinsic and extrinsic motivation for stereotypic and repetitive Behavior. Journal of Autism and Developmental Disorders, 39, 521-531.

This study provides evidence for intrinsic and extrinsic motivators for stereotypical and repetitive behavior in children with autism and intellectual disability and children with intellectual disability alone. We modified the Motivation Assessment Scale (MAS) (1988b); dividing it into intrinsic and extrinsic measures and adding items to assess anxiety as an intrinsic motivator. Rasch analysis of data from 279 MASs (74 children) revealed that the items formed two unidimensional scales. Anxiety was a more likely intrinsic motivator than sensory seeking for children with dual diagnoses; the reverse was true for children with intellectual disability only. Escape and gaining a tangible object were the most common extrinsic motivators for those with dual diagnoses and attention and escape for children with intellectual disability.

**Chen,Y.H., Rodgers,J., & McConachie, H. (2009). Restricted and Repetitive Behaviours, Sensory processing and cognitive style in children with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, 39, 635-642.**

Many individuals with autism tend to focus on details. It has been suggested that this cognitive style may underlie the presence of stereotyped routines, repetitive interests and behaviours, and both relate in some way to sensory abnormalities. Twenty-nine children with diagnosis of high functioning autism or Asperger syndrome completed the Embedded Figures Test (EFT), and their parents the Short Sensory Profile and Childhood Routines Inventory. Significant correlations were found between degree of sensory abnormalities and amount of restricted and repetitive behaviours reported. Repetitive behaviours, age and IQ significantly predicted completion time on the EFT. The results suggest a cognitive link between an individual’s detail-focused cognitive style and their repetitiveness. No such relationship was found with sensory processing abnormalities, which may arise at a more peripheral level of functioning.

**Cheung, P. & Siu, A. (2009). A comparison of patterns of sensory processing in children with and without developmental disabilities.** [***Research in Developmental Disabilities***](http://www.sciencedirect.com/science/journal/08914222), [**30(6**](http://www.sciencedirect.com/science?_ob=PublicationURL&_tockey=%23TOC%235987%232009%23999699993%231474073%23FLA%23&_cdi=5987&_pubType=J&view=c&_auth=y&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=505296a614df29499e730670080fa1be)**), 1468-1480.**

This study compared the patterns of sensory processing among children with autism spectrum disorder (ASD), attention deficit and hyperactivity disorder (ADHD), and children without disabilities. Parents reported on the frequency of sensory processing issues by completing the Chinese Sensory Profile (CSP). Children with disabilities (ASD or ADHD) exhibited significantly more sensory processing issues than children without disabilities. The results of GLM and discriminant analyses showed that the CSP effectively differentiated between children with and without developmental disabilities. But it failed to identify major differences in sensory processing issues between children with either ASD or ADHD. Sensory processing issues could be one of many criteria that characterize and differentiate the features of children with different developmental disabilities. Although no significant gender differences in sensory processing issues appeared, age was a significant cofounding factor in evaluating sensory processing. Children without disabilities showed some small decreases in sensory processing issues as they aged from 6 to 12 years old. Children with ASD showed some decrease in sensory processing issues over the span of their childhood, while children with ADHD showed a significant increase in auditory processing issues as well as small increases in many aspects of sensory processing.

**Newmeyer, A., Aylward, C., Akers, R., Ishikawa, K., Grether, S., DeGrauw, T., Grasha, C., & White, J. (2009). Results of the Sensory Profile in children with suspected childhood apraxia of speech.*Physical & Occupational Therapy in Pediatrics,* 29(2), 203-218.**

Speech-sound disorders are common in preschool-age children, and are characterized by difficulty in the planning and production of speech sounds and their combination into words and sentences. The objective of this study was to review and compare the results of the *Sensory Profile* (Dunn, 1999) in children with a specific type of speech-sound disorder, childhood apraxia of speech (CAS), and to explore the relationship between sensory processing and sound-production deficits. Participants were identified prospectively through an interdisciplinary apraxia clinic at a tertiary care pediatric hospital, and results of the Sensory Profile were compiled and reviewed. Thirty-eight children aged 3 to 10 years with suspected CAS were evaluated from July 2003 to July 2005. The results of the Sensory Profile indicated a difference for these children in several factor clusters when compared to typical peers from the normative population of the Sensory Profile. These findings imply that children with suspected CAS may present with differences in sensory processing in addition to speech impairment. When present, these differences in sensory processing could be addressed with specific therapeutic approaches through occupational therapy or consultation with an occupational therapist.

[**Chang S.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chang%20SH%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Yu, N.Y**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Yu%20NY%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.**[**Characterization of motor control in handwriting difficulties in children with or without developmental coordination disorder*.***](http://www.ncbi.nlm.nih.gov/pubmed/20002122)***Dev Med Child Neurol*.****. [Epub ahead of print]**

**Aim:** The purpose of this study was to characterize handwriting deficits in children with developmental coordination disorder (DCD) using computerized movement analyses.

**Method:** Seventy-two children (40 females, 32 males; mean age 7y, SD 7mo; range 6y 2mo to 7y 11mo) with handwriting deficits (33 with DCD, 39 without DCD); and 22 age- and sex-matched children without handwriting deficits were asked to perform handwriting tasks on a digital tablet for the collection of kinematic and kinetic data. Practice times required to achieve automation of movement when writing an unfamiliar character were used to assess the motor learning of handwriting. The children were asked to copy three simple and three complex characters, and the velocity and axial pen force used for corresponding strokes were compared.

**Results:** The attainment of automated handwriting was markedly slower in children with handwriting deficits and DCD, who used a faster stroke velocity to write simple characters (1.22 times those without handwriting deficits), but when writing complex characters, their stroke velocity and pen force were lower (0.85 and 0.89 times those without handwriting deficits, respectively).

**Interpretation**: By linking the results with neuromotor control theories, it was determined that children with DCD have difficulties performing the open-loop and closed-loop movements required for fluent handwriting.

[**Glazebrook, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Glazebrook%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Gonzalez, D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Gonzalez%20D%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Hansen, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hansen%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Elliott, D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Elliott%20D%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.(2009).** [**The role of vision for online control of manual aiming movements in persons with autism spectrum disorders.**](http://www.ncbi.nlm.nih.gov/pubmed/19535469)***Autism,******13(4)*,411-33.**

Recent studies suggest motor skills are not entirely spared in individuals with an autism spectrum disorder (ASD). Previous reports demonstrated that young adults with ASD were able to land accurately on a target despite increased temporal and spatial variability during their movement. This study explored how a group of adolescents and young adults with an ASD used vision and proprioception to land successfully on one of two targets. Participants performed eye movements and/or manual reaching movements, either with or without vision. Although eye movements were executed in a similar timeframe, participants with ASD took longer to plan and execute manual reaching movements. They also exhibited significantly greater variability during eye and hand movements, but were able to land on the target regardless of the vision condition. In general, individuals with autism used vision and proprioception. However, they took considerably more time to perform movements that required greater visual-proprioceptive integration.

[**Wang, T.N**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Wang%20TN%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Tseng, M.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Tseng%20MH%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Wilson, B.N**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Wilson%20BN%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Hu, F.C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hu%20FC%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.(2009).** [**Functional performance of children with developmental coordination disorder at home and at school.**](http://www.ncbi.nlm.nih.gov/pubmed/19416344)***Dev Med Child Neurol******,* *51(10),* 817-25.**

This study investigated the functional performance of daily activities at home and at school in a population-based sample of children with different degrees of motor coordination impairment and competence. Sixteen children (seven males, nine females; mean age 8 y, SD 9 mo) with developmental coordination disorder (DCD), 25 with suspected DCD ([sDCD] 17 males, eight females; mean age 7 y 6 mo, SD 8 mo), and 63 children without motor problems (39 males, 24 females; mean age 7 y 9 mo, SD 7 mo) were recruited from public schools (Grades 1-3, age 6 y 4 mo-9 y 10 mo) using the Chinese version of the Developmental Coordination Disorder Questionnaire, the Movement Assessment Battery for Children, and the Bruininks-Oseretsky Test of Motor Proficiency. Functional performance was assessed using the Chinese versions of the Vineland Adaptive Behavior Scales and the School Function Assessment-Chinese version. The functional performance of children with DCD and sDCD was statistically significantly lower than those without DCD (p's<0.05). chi(2) and logistic regression analyses showed significant differences among all groups in the proportion of children scoring at the 'inadequate' adaptive level of home performance (p's<0.05). There were also significant differences among the groups in the proportion of children scoring below the cut-off in school performance (p's<0.05). The findings show the pervasive impact of DCD on children's functional performance in daily activities at home and at school.

**Green, D.,** [**Charman, T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Charman%20T%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Pickles, A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Pickles%20A%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Chandler, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chandler%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Loucas, T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Loucas%20T%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., Simonoff, E., &** [**Baird, G**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Baird%20G%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.(2009). Impairment in movement skills of children with autistic spectrum disorders.** **Dev Med Child Neurol.** **51(4):311-6.**

**Aim:** We undertook this study to explore the degree of impairment in movement skills in children with autistic spectrum disorders (ASD) and a wide IQ range. METHOD: Movement skills were measured using the Movement Assessment Battery for Children (M-ABC) in a large, well defined, population-derived group of children (n=101: 89 males,12 females; mean age 11y 4mo, SD 10mo; range 10y-14y 3mo) with childhood autism and broader ASD and a wide range of IQ scores. Additionally, we tested whether a parent-completed questionnaire, the Developmental Coordination Disorder Questionnaire (DCDQ), was useful in identifying children who met criteria for movement impairments after assessment (n=97 with complete M-ABCs and DCDQs).

**Results**: Of the children with ASD, 79% had definite movement impairments on the M-ABC; a further 10% had borderline problems. Children with childhood autism were more impaired than children with broader ASD, and children with an IQ less than 70 were more impaired than those with IQ more than 70. This is consistent with the view that movement impairments may arise from a more severe neurological impairment that also contributes to intellectual disability and more severe autism. Movement impairment was not associated with everyday adaptive behaviour once the effect of IQ was controlled for. The DCDQ performed moderately well as a screen for possible motor difficulties. INTERPRETATION: Movement impairments are common in children with ASD. Systematic assessment of movement abilities should be considered a routine investigation.

[**Klein, V.C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Klein%20VC%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Gaspardo, C.M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Gaspardo%20CM%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Martinez, F.E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Martinez%20FE%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Grunau, R.E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Grunau%20RE%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Linhares, MB**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Linhares%20MB%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Pain and distress reactivity and recovery as early predictors of temperament in toddlers born preterm.**](http://www.ncbi.nlm.nih.gov/pubmed/19560293)***Early Hum Dev.******, 85(9)*,569-576.**

**Background:** Pain reactivity may reflect underlying mechanisms of constitutional aspects of temperament. AIM: To examine whether the neonatal biobehavioral reactivity and recovery responses from pain and distress, as well as the gestational age, the illness severity and the amount of painful procedures undergone the Neonatal Intensive Care Unit (NICU) stay, predict temperament later in toddlerhood, in vulnerable children born preterm.

**Study Design:** Prospective-longitudinal study.

**Subjects:** Twenty-six preterm and very low birth weight infants followed from birth to toddlerhood.

**Outcome Measures**: Illness severity was assessed with the Clinical Risk Index for Babies (CRIB) score. The medical charts were reviewed prospectively for obtaining the amount of pain exposure in NICU. For assessing the behavioral and cardiac reactivity and recovery from pain and distress, the neonates were evaluated during routine blood collection in the NICU in the first 10 days of life. Pain and distress reactivity and recovery was measured using the Neonatal Facial Coding System score, the duration of crying, and the magnitude of average heart rate. At toddlerhood, mothers answered the Early Childhood Behavior Questionnaire.

**Results:** Higher biobehavioral reactivity to pain and distress predicted higher temperamental Negative Affect, above and beyond gestational age, illness severity and amount of pain exposure in NICU. However, we did not find a predictive relation between gestational age, CRIB score and number of painful procedures undergone NICU and toddler's temperament.

**Conclusions:** The findings highlight the relevance of the neonatal individual characteristics of reactivity for identifying more vulnerable infants for future problems in biobehavioral regulation.

[**Fuentes, C.T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Fuentes%20CT%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Mostofsky, S.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mostofsky%20SH%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Bastian, A.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Bastian%20AJ%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Children with autism show specific handwriting impairments.**](http://www.ncbi.nlm.nih.gov/pubmed/19901244)***Neurology*****, *73(19)*,1532-1537.**

**Background:** Handwriting skills, which are crucial for success in school, communication, and building children's self-esteem, have been observed to be poor in individuals with autism. Little information exists on the handwriting of children with autism, without delineation of specific features that can contribute to impairments. As a result, the specific aspects of handwriting in which individuals with autism demonstrate difficulty remain unknown.

**Methods:** A case-control study of handwriting samples from children with and without autism spectrum disorders (ASD) was performed using the Minnesota Handwriting Assessment. Samples were scored on an individual letter basis in 5 categories: legibility, form, alignment, size, and spacing. Subjects were also tested on the Wechsler Intelligence Scale for Children-IV and the Physical and Neurological Examination for Subtle (Motor) Signs.

**Results**: We found that children with ASD do indeed show overall worse performance on a handwriting task than do age- and intelligence-matched controls. More specifically, children with ASD show worse quality of forming letters but do not show differences in their ability to correctly size, align, and space their letters. Within the ASD group, motor skills were significantly predictive of handwriting performance, whereas age, gender, IQ, and visuospatial abilities were not.

**Conclusions**: We addressed how different elements of handwriting contribute to impairments observed in children with autism. Our results suggest that training targeting letter formation, in combination with general training of fine motor control, may be the best direction for improving handwriting performance in children with autism.

[**Pan, C.Y**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Pan%20CY%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Tsai, C.L**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Tsai%20CL%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., & Chu, C.H. (2009).** [**Fundamental Movement Skills in Children Diagnosed with Autism Spectrum Disorders and Attention Deficit Hyperactivity Disorder.**](http://www.ncbi.nlm.nih.gov/pubmed/19588236) ***J Autism Dev Disorders.***

The purpose of this study was to compare the movement skills of children with autism spectrum disorders (ASD), attention deficit hyperactivity disorder (ADHD), and those without disabilities. Ninety-one children (ASD, n = 28; ADHD, n = 29; control, n = 34), ages 6-10 years, were of average IQ participated. After controlling for age, both ASD and ADHD groups scored significantly lower than controls (p's < .05) on overall gross motor development as well as locomotor and object control subtests, and the ASD group performed more poorly than the ADHD group (p's < .01) on both subtests. Of the children with ASD and ADHD, only 16% had clinical levels of impairment. Potential underlying factors are discussed, with suggestions for future research.

**Cairney, J.,** [**Hay, J.A**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hay%20JA%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Veldhuizen, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Veldhuizen%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Missiuna, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Missiuna%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Faught, B.E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Faught%20BE%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Developmental coordination disorder, sex, and activity deficit over time: a longitudinal analysis of participation trajectories in children with and without coordination difficulties.**](http://www.ncbi.nlm.nih.gov/pubmed/20015253)***Dev Med Child Neurol.***

**Aim**: Children with developmental coordination disorder (DCD) are known to participate in active play less than typically developing children. However, it is not known whether the activity deficit between children with and without DCD widens or diminishes over time.

**Method**: Data were obtained from a large, prospective cohort study of children (baseline n=2278, total n=2470). Motor coordination was assessed for 2083 students using the short form of the Bruininks-Oseretsky Test of Motor Proficiency. Participation in organized and free-play activities was assessed using a participation questionnaire on five occasions over 3 years. Mixed-effects modelling was used to examine differences in participation over time between children with probable DCD (pDCD, n=111, 46 males, 65 females) and their typically developing peers (n=1972, 1016 males, 956 females). The mean age for the whole sample was 9 years 11 months (SD 5mo) at assessment 1, 10 years 5 months (SD 5mo) at assessment 2, 10 years 11 months (SD 5mo) at assessment 3, 11 years 4 months (SD 4mo) at assessment 4, and 11 years 11 months (SD 4mo) at assessment 5.

**Results**: Children with pDCD reported less participation in organized and free-play activities than their typically developing peers, and these differences persisted over time. Among males, the gap in participation in free-play activities between those with DCD and typically developing children diminished substantially over time; among females, it increased slightly. Interpretation DCD is associated with a persistent activity deficit in children. Its effect on participation appears to be particularly serious among females but may diminish with time among males.

**Gerrard, S.*, &*** [**Rugg, G**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Rugg%20G%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)***. (2009).*** [**Sensory impairments and autism: a re-examination of causal modelling.**](http://www.ncbi.nlm.nih.gov/pubmed/19488845)***J Autism Dev Disord*.** ***39(10),*1449-1463.**

Sensory impairments are widely reported in autism, but remain largely unexplained by existing models. This article examines Kanner's causal reasoning and identifies unsupported assumptions implicit in later empirical work. Our analysis supports a heterogeneous causal model for autistic characteristics. We propose that the development of a standardised framework for analysing autistic characteristics would facilitate the identification of sub-groups and the location of biological markers for genetic variation. We also support a neuroconstructivist model proposing that peripheral sensory abnormalities disrupt compilation of complex skills; impact on synaptogenesis, synaptic pruning and myelination; and subsequently manifest themselves as autistic behaviours. This model explains some of the structural and functional brain abnormalities and many of the perceptual, cognitive and attentional features found in autism.

[**Vieira, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Vieira%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Quercia, P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Quercia%20P%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Michel, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Michel%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Pozzo, T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Pozzo%20T%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,&** [**Bonnetblanc, F**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Bonnetblanc%20F%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Cognitive demands impair postural control in developmental dyslexia: a negative effect that can be compensated.**](http://www.ncbi.nlm.nih.gov/pubmed/19576954)***Neurosci Lett*.** **462(2),125-129.**

Children with developmental dyslexia exhibit delayed reading abilities and various sensori-motor deficits. The way these various symptoms interact remain poorly understood. The objective of this study was twofold. First, we aimed to investigate whether postural control was impaired in dyslexic children when cognitive demands are increased. Second, we checked whether this effect could be reduced significantly by a treatment aiming to recalibrate ocular proprioception. Twelve dyslexic and fifteen treated dyslexic children (>3 months of treatment) were compared with twelve non-dyslexic children in two conditions (mean age: 11.6+/-2.1, 12.5+/-1.5 and 10.6+/-1.7 years respectively). In a first condition they maintained balance while fixating a point in front of them. In the second condition the postural task was combined with a silently reading one. Balance was assessed by means of a force plate. Results demonstrated that the mean velocity (i.e. the total length) of the center of pressure (CoP) displacement was increased in the reading task only for the dyslexic group. Interestingly, for the treated children, an inverse tendency was observed: the mean velocity (i.e. the total length) and the surface of the 90% confidence ellipse of the CoP displacement decreased for 13/15 patients and for 12/15 patients respectively, while performing the reading task. Values remained similar to those observed for the control children. Altogether, these results strongly suggest that cognitive demands can impair postural control in developmental dyslexia but this interaction could be normalized. These results sustain the hypothesis of a cerebellar origin for dyslexia.

[**Marton, K**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Marton%20K%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Imitation of body postures and hand movements in children with specific language impairment.**](http://www.ncbi.nlm.nih.gov/pubmed/18823904)***J Exp Child Psychol.*** ***102(1)*,1-13.**

Within the domain-general theory of language impairment, this study examined body posture and hand movement imitation in children with specific language impairment (SLI) and in their age-matched peers. Participants included 40 children with SLI (5 years 3 months to 6 years 10 months of age) and 40 children with typical language development (5 years 3 months to 6 years 7 months of age). Five tests were used to examine imitation and its underlying cognitive and motor skills such as kinesthesia, working memory, and gross motor coordination. It was hypothesized that children with SLI show a weakness in imitation of body postures and that this deficit is not equally influenced by the underlying cognitive and motor skills. There was a group effect in each cognitive and motor task, but only gross motor coordination proved to be a strong predictor of imitation in children with SLI. In contrast, hand movement imitation was strongly predicted by performance in the Kinesthesia task in typically developing children. Thus, the findings show not only that children with SLI performed more poorly on the imitation tasks than their typically developing peers but also that the groups' performances showed qualitative differences. The results of the current study provide additional support to the view that the weaknesses in children with SLI are not limited to the verbal domain.

[**Shum, S.B**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Shum%20SB%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Pang, M.Y**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Pang%20MY%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.(2009).** [**Children with attention deficit hyperactivity disorder have impaired balance function: involvement of somatosensory, visual, and vestibular systems.**](http://www.ncbi.nlm.nih.gov/pubmed/19446843)***J Pediatr.*** ***155(2),* 245-249.**

**Objectives**: To compare standing balance performance and sensory organization of balance control in children with attention deficit hyperactivity disorder (combined type) (ADHD-C) and typically developing children.

**Study Design:** School-aged children (n = 43) with ADHD-C and 50 age- and sex-matched typically developing children participated in the study. Sensory organization of standing balance was evaluated using the Sensory Organization Test (SOT). In addition to the composite equilibrium score, somatosensory, vestibular, and visual ratios, which were indicators of the ability of the child to use information from the respective sensory systems to maintain balance, were computed. Multivariate analysis of covariance (MANCOVA) was used to compare the outcome variables between the 2 groups while controlling for physical activity level.

**Results**: MANCOVA revealed that children with ADHD-C had significantly lower composite equilibrium scores (P < .001) and somatosensory (P = .029), vestibular (P = .037), and visual ratios (P = .001) than control children, by 10.3%, 2.1%, 15.6%, and 16.0%, respectively.

**Conclusions**: Children with ADHD-C had significant deficits in standing balance performance in all conditions that included a disruption of sensory signals. The visual system tends to be more involved in contributing to the balance deficits in children with ADHD-C than the somatosensory and vestibular systems.

[**Baron-Cohen, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Baron-Cohen%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Ashwin, E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Ashwin%20E%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Ashwin, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Ashwin%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Tavassoli, T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Tavassoli%20T%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Chakrabarti, B**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Chakrabarti%20B%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.(2009). Talent in autism: hyper-systemizing, hyper-attention to detail and sensory hypersensitivity.** ***Philos Trans R Soc Lond B Biol Sci.******, 364(1522)*:1377-1383.**

We argue that hyper-systemizing predisposes individuals to show talent, and review evidence that hyper-systemizing is part of the cognitive style of people with autism spectrum conditions (ASC). We then clarify the hyper-systemizing theory, contrasting it to the weak central coherence (WCC) and executive dysfunction (ED) theories. The ED theory has difficulty explaining the existence of talent in ASC. While both hyper-systemizing and WCC theories postulate excellent attention to detail, by itself excellent attention to detail will not produce talent. By contrast, the hyper-systemizing theory argues that the excellent attention to detail is directed towards detecting 'if p, then q' rules (or [input-operation-output] reasoning). Such law-based pattern recognition systems can produce talent in systemizable domains. Finally, we argue that the excellent attention to detail in ASC is itself a consequence of sensory hypersensitivity. We review an experiment from our laboratory demonstrating sensory hypersensitivity detection thresholds in vision. We conclude that the origins of the association between autism and talent begin at the sensory level, include excellent attention to detail and end with hyper-systemizing.

**Rieke, E.F., & Anderson, D. (2009). Adolescent/adult sensory profile and obsessive-compulsive disorder. American Journal of *Occupational Therapy,*63(2),138–145.**

We sought to describe how the sensory processing of adults with obsessive-compulsive disorder (OCD) differs from that of the general population within the context of Dunn’s (1997) model of sensory processing and to evaluate the discriminant validity of the Adolescent/Adult Sensory Profile (AASP). Using unequal variance t tests, the AASP results of 51 adults with OCD were compared with the means of the AASP standardization study’s adult age group. Adults with OCD scored higher than the means of the AASP standardization study’s adult age group on sensory sensitivity and sensation avoiding, consistent with predictions based on the OCD literature. Adults with OCD also scored higher on low registration and lower on sensation seeking. The results provide a preliminary description of how the sensory processing of adults with OCD differs from that of the general population and preliminary support for the AASP’s discriminant validity.

[**Rogers, S.J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Rogers%20SJ%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**What are infant siblings teaching us about autism in infancy?**](http://www.ncbi.nlm.nih.gov/pubmed/19582867)***Autism Res.*** **2(3),125-137.**

International research to understand infant patterns of development in autism spectrum disorders (ASDs) has recently focused on a research paradigm involving prospective longitudinal studies of infant siblings of children with autism. Such designs use a comparison group of infant siblings without any familial risks (the low-risk group) to gather longitudinal information about developmental skills across the first 3 years of life, followed by clinical diagnosis of ASD at 36 months. This review focuses on five topics: presence of ASD in the infant sibling groups, patterns and characteristics of motor development, patterns and characteristics of social and emotional development, patterns and characteristics of intentional communication, both verbal and nonverbal, and patterns that mark the onset of behaviors pathognomonic for ASD. Symptoms in all these areas typically begin to be detected during the age period of 12-24 months in infants who will develop autism. Onset of the symptoms occurs at varying ages and in varying patterns, but the pattern of frank loss of skills and marked regression reported from previous retrospective studies in 20-30% of children is seldom reported in these infant sibling prospective studies. Two surprises involve the very early onset of repetitive and unusual sensory behaviors, and the lack of predictive symptoms at the age of 6 months. Contrary to current views that autism is a disorder that profoundly affects social development from the earliest months of life, the data from these studies presents a picture of autism as a disorder involving symptoms across multiple domains with a gradual onset that changes both ongoing developmental rate and established behavioral patterns across the first 2-3 years of life.

**Andrea Faber Taylor & Frances E. Kuo (2009). Children With attention deficits concentrate better after walk in the park. *Journal of Attention Disorders,12(5)*, 402-409.**

**Objective:** In the general population, attention is reliably enhanced after exposure to certain physical environments, particularly natural environments. This study examined the impacts of environments on attention in children with ADHD.

**Method:** In this within subjects design, each participant experienced each of three treatments (environments) in single blind controlled trials. Seventeen children 7 to 12 years old professionally diagnosed with ADHD experienced each of three environments—a city park and two other well-kept urban settings—via individually guided 20-minute walks. Environments were experienced 1 week apart, with randomized assignment to treatment order. After each walk, concentration was measured using Digit Span Backwards. **Results:** Children with ADHD concentrated better after the walk in the park than after the

downtown walk (p .0229) or the neighborhood walk (p .0072). Effect sizes were substantial (Cohen’s d .52 and .77, respectively) and comparable to those reported for recent formulations of methylphenidate.

**Conclusion:** Twenty minutes in a park setting was sufficient to elevate attention performance relative to the same amount of time in other settings. These findings indicate that environments can enhance attention not only in the general population but also in ADHD populations. “Doses of nature” might serve as a safe, inexpensive, widely accessible new tool in the tool kit for managing ADHD symptoms.

[**Kopp, S**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Kopp%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Beckung, E**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Beckung%20E%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., & Gillberg C. (2009).** [**Developmental coordination disorder and other motor control problems in girls with autism spectrum disorder and/or attention-deficit/hyperactivity disorder.**](http://www.ncbi.nlm.nih.gov/pubmed/19910158) ***Res Dev Disabil*.**

Examine the rate, predictors, and effect on daily life skills of developmental coordination disorder (DCD) and other motor control difficulties in school age girls with autism spectrum disorder (ASD) and/or attention-deficit/hyperactivity disorder (ADHD), in preschool age girls with ASD referred to a neuropsychiatric clinic, and in a community sample of school age girls. The girls (131 in total) were examined with standardised test of motor function and parent interviews and questionnaires. The school girls were compared with 57 age-and IQ-matched girls from the community. DCD was diagnosed in 25% of clinic school girls with ASD, in 32% of those with ADHD, and in 80% of the clinic preschool girls with ASD. Parents reported more motor problems in the school age clinic group. Agreement between a brief motor screening test and a full comprehensive motor examination was moderate to good in the clinic group. Young age, autistic symptomatology, and low performance IQ predicted more motor coordination problems. Motor coordination problems were related to lower ability in daily life skills even when the effect of PIQ was controlled for. A large minority of school girls with ASD and/or ADHD, and a majority of preschool girls with ASD meet full diagnostic criteria for DCD. Their motor problems contribute to reduced activity in daily life even when the effects of IQ have been partialled out.

**Martin, N.C.,** [**Piek, J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Piek%20J%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Baynam, G**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Baynam%20G%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Levy, F**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Levy%20F%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Hay D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Hay%20D%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**An examination of the relationship between movement problems and four common developmental disorders.**](http://www.ncbi.nlm.nih.gov/pubmed/19944472)***Hum Mov Sci.***

It has been well recognized since the days of "minimal brain dysfunction" (Clements, 1966) that various developmental disorders have a shared aetiology. Poor motor coordination has been implicated as one of the factors in these relationships. This study examines the different patterns in symptomatology of five developmental disorders, namely developmental coordination disorder (DCD), attention-deficit/hyperactivity disorder (ADHD), reading disorder (RD), oppositional defiant disorder (ODD), and conduct disorder (CD) in order to build on the genetic work from Martin, Levy, Piek, and Hay (2006) and Martin, Piek, and Hay (2006) examining the overlap of these disorders. Latent class analysis was used on questionnaire data from 1304 families from the Australian twin ADHD project (ATAP) to examine the patterns of comorbidity of the five disorders. We confirmed and added detail to the shared symptoms between DCD, ADHD, RD, and ODD, but found no links between CD symptoms and any other disorders. Despite the close link previously identified with ODD and CD, this finding suggests a different aetiology for CD.

[**Dockstader, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Dockstader%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**,,** [**Gaetz, W**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Gaetz%20W%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Cheyne, D**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Cheyne%20D%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., & Tannock, R. (2009).** [**Abnormal neural reactivity to unpredictable sensory events in attention-deficit/hyperactivity disorder.**](http://www.ncbi.nlm.nih.gov/pubmed/19482264)***Biol Psychiatry.*****66(4), 376-383.**

**Background**: Cortical oscillations in the sensorimotor region in the 8-12-Hz range ("mu rhythms") are associated with basic somatosensory and motor processes as well as top-down processes such as learning, attention, expectancy, and inhibition. Recent studies suggest that reactivity of these rhythms to sensory input reflects a link between perception and action and that abnormalities in this reactivity might reflect impairment in perception-to-action mechanisms. Individuals with attention-deficit/hyperactivity disorder (ADHD) are impaired in tasks requiring sensorimotor function, attention, expectancy, and inhibition, yet their sensorimotor responses are unknown. Thus, we investigated mu reactivity in a group of adults with ADHD.

**Methods**: Sixteen adults with ADHD and 16 matched control subjects received median nerve stimulation in predictable patterns (trains of four stimuli followed by 4-sec gap) or unpredictable patterns (randomly presented trains of two, four, or six stimuli followed by 4-sec gap). With magnetoencephalography, we examined the effects of stimulus patterning (predictable, unpredictable) on reactivity to somatosensory stimuli. **Results**: Compared with control subjects, the ADHD group showed lower mu reactivity overall and no modulation by unpredictable somatosensory input. By contrast, the control group showed robust mu reactivity to stimuli presented in unpredictable but not predictable patterns. These changes were stronger in the contralateral hemisphere compared with the ADHD group.

**Conclusions**: Cortical mu rhythms are modulated by stimulus predictability and might be involved in attentional alerting (awareness of when an unexpected stimulus occurs). Diminished mu modulation in adult ADHD suggests a possible underlying deficit in the perception-to-action system.

**Newmeyer, A.J.,** [**Aylward, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Aylward%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Akers, R**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Akers%20R%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Ishikawa, K**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Ishikawa%20K%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., Grether, S.,** [**deGrauw,T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22deGrauw%20T%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Grasha, C**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Grasha%20C%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**White, J**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22White%20J%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Results of the Sensory Profile in children with suspected childhood apraxia of speech.**](http://www.ncbi.nlm.nih.gov/pubmed/19401932)***Phys Occup Ther Pediatr.*** ***29(2),*205-20.**

Speech-sound disorders are common in preschool-age children, and are characterized by difficulty in the planning and production of speech sounds and their combination into words and sentences. The objective of this study was to review and compare the results of the Sensory Profile (Dunn, 1999) in children with a specific type of speech-sound disorder, childhood apraxia of speech (CAS), and to explore the relationship between sensory processing and sound-production deficits. Participants were identified prospectively through an interdisciplinary apraxia clinic at a tertiary care pediatric hospital, and results of the Sensory Profile were compiled and reviewed. Thirty-eight children aged 3 to 10 years with suspected CAS were evaluated from July 2003 to July 2005. The results of the Sensory Profile indicated a difference for these children in several factor clusters when compared to typical peers from the normative population of the Sensory Profile. These findings imply that children with suspected CAS may present with differences in sensory processing in addition to speech impairment. When present, these differences in sensory processing could be addressed with specific therapeutic approaches through occupational therapy or consultation with an occupational therapist.

**Dowell, L.R.,** [**Mahone, E.M**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mahone%20EM%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Mostofsky, S.H**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Mostofsky%20SH%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Associations of postural knowledge and basic motor skill with dyspraxia in autism: implication for abnormalities in distributed connectivity and motor learning.**](http://www.ncbi.nlm.nih.gov/pubmed/19702410)***Neuropsychology.*** ***23(5)*, 563-570.**

Children with autism often have difficulty performing skilled movements. Praxis performance requires basic motor skill, knowledge of representations of the movement (mediated by parietal regions), and transcoding of these representations into movement plans (mediated by premotor circuits). The goals of this study were (a) to determine whether dyspraxia in autism is associated with impaired representational ("postural") knowledge and (b) to examine the contributions of postural knowledge and basic motor skill to dyspraxia in autism. Thirty-seven children with autism spectrum disorder (ASD) and 50 typically developing (TD) children, ages 8-13, completed (a) an examination of basic motor skills, (b) a postural knowledge test assessing praxis discrimination, and (c) a praxis examination. Children with ASD showed worse basic motor skill and postural knowledge than did controls. The ASD group continued to show significantly poorer praxis than did controls after accounting for age, IQ, basic motor skill, and postural knowledge. Dyspraxia in autism appears to be associated with impaired formation of spatial representations, as well as transcoding and execution. Distributed abnormality across parietal, premotor, and motor circuitry, as well as anomalous connectivity, may be implicated.

**Emck, C.,** [**Bosscher, R**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Bosscher%20R%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**.,** [**Beek, P**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Beek%20P%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**., &** [**Doreleijers, T**](http://www.ncbi.nlm.nih.gov/pubmed?term=%22Doreleijers%20T%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract)**. (2009).** [**Gross motor performance and self-perceived motor competence in children with emotional, behavioural, and pervasive developmental disorders: a review.**](http://www.ncbi.nlm.nih.gov/pubmed/19538424) ***Dev Med Child Neurol. 51(7)*,501-517.**

**Aims**: Motor performance and self-perceived motor competence have a great impact on the psychosocial development of children in general. In this review, empirical studies of gross motor performance and self-perception of motor competence in children with emotional (depression and anxiety), behavioural, and pervasive developmental disorders are scrutinized, with the objective of identifying specific motor characteristics that may be relevant to clinical practice.

**Method**: A systematic search of studies published between 1997 and 2007 was performed using nine search engines.

**Results**: Children in all three categories (emotional, behavioural, and pervasive developmental disorders) exhibit poor gross motor performance and problematic self-perception of motor competence, with certain indications of disorder-specific characteristics. In particular, children with emotional disorders have balance problems and self-perceived motor incompetence; children with behavioural disorders show poor ball skills and tend to overestimate their motor performance; children with pervasive developmental disorders demonstrate poor gross motor performance and self-perceived motor incompetence. As a result, children with developmental and emotional disorders are restricted in participating in games and play, which may lead to inactive lifestyles and further disruption of their psychosocial and physical development. **Interpretation**: Motor problems need more, to some extent disorder-specific, attention in clinical practice than has been provided to date.

**Prior to 2009**

**S. Parush, H. Sohmer , A. Steinberg, & M. Kaitz (2007). Somatosensory function in boys with ADHD and tactile defensiveness. *Physiology & Behavior 90*, 553–558.**

In this study, we tested for deficits in somatosensory function in boys with Attention Deficit Hyperactivity Disorder (ADHD) and tactile

defensiveness (TD). The subjects were 67 boys with ADHD, sub-typed as TD (ADHD+TD+) or non TD (ADHD+TD−), matched with 60 “typical”

children in the control group. Sixty nine percent of the boys with ADHD were categorized as TD. The groups were compared on three measures: (a)performance scores on subtests of the Sensory Integration and Praxis Test, (b) measurements of the Somatosensory Evoked Potential (SEP) and (c)ratings of the children's affective responses during tactile stimulation. Both ADHD groups differed from the control group on most study measures. No significant differences were found between the two ADHD subgroups on threshold and perceptual tests scores, except for Finger Identification. However, the TD+ group demonstrated significantly higher central SEP amplitudes than did the TD− group. Together, the results support claims that TD is related to central processing of somatosensory information, but not to anomalous tactile perception, with the exception of Finger Identification.

**Piek, J.L., & Dyck, M.J. (2004). Sensory-motor deficits in children with developmental coordination disorder, attention deficit hyperactivity disorder and autistic disorder. *Human Movement Science*, *23*, 475-488.**

This article was a critical discussion of relevant literature and the authors’ recent research studies in regards to the authors’ postulate that deficient sensory-motor functioning in children can aid in detecting the presence or absence of comorbid developmental disorders. The authors investigated the developmental disorders of developmental coordination disorder (DCD), attention deficit hyperactivity disorder (ADHD) and autistic disorder in children. The authors found support for the association of DCD with deficits in visual-spatial processing, kinesthetic perception (particularly related to active movement), and cross-modal integration of kinesthetic information with other sensory information. Research findings on the degree of competency of kinesthetic perception and visual-motor skills in children with ADHD have not been consistent, possibly due to the failure of most researchers to separate the research population of children with ADHD into groups with and without ADHD. Children with ADHD do frequently demonstrate slower processing speed. The motor skill deficiencies in children with ADHD have often been attributed to their distractibility and impulsiveness. These authors investigated this postulate. They found that only children who had comorbid diagnoses of DCD and ADHD had significantly poorer results on a test of fine motor ability than the control subjects and children with only the diagnosis of ADHD. In another study by these authors, they found that children with both diagnoses of DCD and ADHD performed more poorly to a significant degree on measures of visual spatial organization than the children with ADHD alone or the control group. A meta-analysis done by Pennington and Ozonoff (1996) was stated to indicate that children with ADHD tend to have adequate visual-spatial perception, but have difficulty with executive functioning (e.g., working memory, response inhibition, and planning action sequences). The findings of research studies on children with autism indicate that if both motor coordination and perceptual abilities are markedly deficient, more severe symptoms are manifested. There has been an association established between difficulties in motor coordination and empathic abilities. Children

with DCD may have poor social skills partially due to their inadequate

visual-spatial integration contributing to problems in perceiving non-verbal, emotional cues. These authors propose that the presence of a comorbid condition of DCD in some children with autism may be contributing to the severity of impairment in those children.

**SIGN note**: This article supports the Ayres’ SI principles of deficits in

sensory integration contributing to problems in motor coordination, deficits in visual-spatial perception and kinesthetic perception being associated with poor motor skills, and difficulties with sensory processing and motor coordination contributing to problems in social interaction. The article indirectly supports the possible appropriateness of the sensory integrative treatment approach with children having DCD and those having a comorbid diagnosis of autism or ADHD. There was a report of a research finding that children with ADHD tend to have significant difficulty with planning action sequences. This finding also indirectly supports the use of the SI treatment approach with some children with ADHD. Reviewed by Katherine Inamura, 10/28/2005

**Molloy, C. A., Kietrich, K. N., & Bhattacharya, A. (2003). Postural stability in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *33(6)*, 643-652.**

Eight boys identified as having Autism Spectrum Disorder (ASD) and eight

controls matched for age, race, and gender took part in this study of postural stability. The subjects with ASD were recruited from children diagnosed or receiving speech therapy at the Kelly O’Leary Center for Pervasive Developmental Disorder of the Children’s Hospital Medical Center of Cincinnati, Ohio. They all had a receptive language age of at least 4 years and ranged in age from 7 years to 12 years old. After selection for the study, the boys with ASD were rated on a parent questionnaire concerning their general performance for typical childhood motor activities. Their composite scores for running, climbing, and stair climbing did not vary significantly from the scores given to the controls. Measurements of the postural sway of the subjects were taken using force platform technology under conditions that removed or changed visual and somatosensory input. In comparison with the neurologically typical controls, the boys with ASD had greater postural sway when vision was occluded and somatosensory information was altered. The subjects with ASD had more difficulty maintaining their upright balance than the controls when vision cues were eliminated, whether or not the somatosensory input was altered or not. The researchers concluded that the study results supported the postulates that children with ASD tend to over-rely on visual information and that they have a deficit in sensory integration rather than a deficit in a particular afferent sensory system.

**SIGN note:** The study findings seem to support the Ayres’ SI postulate that children with ASD have deficits in sensory integration contributing to

balance difficulties. However, the study does not provide a link between

difficulties in balance and sensory integration to problems in functional

activities. It does provide evidence that some children with ASD are over-dependent on visual cues for maintaining their balance. The study is limited by the small number of subjects and the use of an apparently non-standardized questionnaire to assess the presence of motor deficits.

Reviewed by Katherine Inamura, 10/28/2005

**Gillberg, C., & Kadesjo, B. (2003). Why bother about clumsiness? The implications of having developmental coordination disorder (DCD). *Neural Plasticity, 10, 59-68.***

This article consists of a review of several research studies focusing on a

common motor problem currently affecting many school-aged children,

called Developmental Coordination Disorder (DCD). More specifically, the

authors use past research to create a link between DCD and behavior

problems such as ADHD and autism. According to the DSM IV, children

with DCD are well below their chronological age or measured intelligence

when performing daily activities that require motor coordination, such as

handwriting or sports. Researchers trying to uncover the etiology of DCD

have pointed at theories of “processing deficits,” which may cause a

reduction in the rate of information processing or create difficulty in

handling spatial information that is related to the control of movement.More specifically, researchers have found a greater frequency of visuospatial discrimination impairments and dysfunction of kinesthetic perceptions in children with DCD. In addition, research has shown a high rate of DCD as a comorbid condition in children with ADHD and autism spectrum disorders. In fact, in about fifty percent of all cases ADHD is associated with DCD. Therefore, the authors of this article suggest the need to further study the correlation between these diagnoses. For instance they point to the need to investigate how the treatment of one deficit, e.g. attention, may help alleviate several other problems, e.g. motor control.

**Astill, S., & Utley, A. (2006). Two-handed catching in children with**

**developmental coordination disorder. Motor Control, 10(2), 109-**

**124.**

This study investigated the nature and extent of inter and intralimb coupling of the upper limbs in children with developmental coordination disorder (DCD) and their age-matched controls (AMC) when catching a ball two-handed. Sixteen children (8 DCD, 8 AMC) volunteered for the study; parental consent was gained for each child. Using standard video analysis and 3D kinematic analysis, all children were examined performing 30 two-handed catches. Video analysis showed that the AMC children caught more balls than the DCD children (p< .005). Analyses of the kinematic data showed DCD participants exhibit a greater degree of linkage both between and within limb than the AMC participants (p < .01), but the AMC participants demonstrate more intra individual variability in these linkages (p < .01). The data shows that both DCD and AMC children couple their limbs to exert control over redundant degrees of freedom when catching a ball two-handed. However, DCD children show little capacity to vary their motor behavior exhibiting a less adaptable movement system, which in turn affects their success at the task.