Original Research

# COMPARISON OF ADOLESCENTS LIVING WITH SENSORY INTEGRATION DIFFERENCES. A PILOT STUDY

Tania Allan-Ross

School of Design, Otago Polytechnic, Dunedin, New Zealand.

## INTRODUCTION

The purpose of this pilot study was to begin to ascertain whether adolescents with Autism Spectrum Disorder (ASD) and/or Sensory Integration Disorder (SID) report different sensory processing styles as they mature, in comparison to age matched typically developing individuals. This research inquiry stems from observations made by the author of individuals with sensory integration differences, in particular the use of self-regulating sensory strategies that are adopted as they mature.

### Sensory Integration

The concept of sensory integration developed during the 1960s from a body of work by occupational therapist A. Jean Ayres. The way in which sensory processing and motor planning disorders interfere with learning and daily life interested Dr Ayres (Cribbin et al., 2003). Since then sensory integration theory has evolved into one of the most studied and developed theoretical frameworks in occupational theory (Cermak, 1994). Sensory integration is defined by Ayres (1979) as:

> The organization of sensory input for use. The 'use' may be a perception of the body or the world, or an adaptive response, or a learning process, or the development of some neural function. Through sensory integration, the many parts of the nervous system work together so that a person can interact with the environment effectively and experience appropriate satisfaction (p.184).

All the information we receive from our body and surroundings comes to us through our sensory systems. Our seven senses; touch (tactile), movement (vestibular), body position (proprioception), sight (vision), sound (auditory), smell (olfactory) and taste (gustatory), gather information which then enters central processing networks within our brain where it is organised and interpreted (Cribbin et al., 2003). As information from multiple sensory systems is processed reactions to sensory input are graded in an adaptive manner, known as sensory modulation (Miller, 2014). In everyday life, we are not often aware of any one sense as they usually work together and integrate in an automatic way providing us with a sense of who we are, where we are, an understanding of our surroundings and happenings around us and how we should respond.

When sensory information from one's body and the environment does not integrate in the brain as it should, or the brain cannot sort out, filter, analyse or organise sensory messages, this is known as a sensory integration dysfunction (Ayres, 1979). Differing terminology is used within the literature to describe and label sensory integration differences, such as sensory processing disorder, sensory modulation disorder and sensory integration disorder. A person experiencing this disability is unable to respond to sensory information in order to behave in a consistent and meaningful way, this can lead to an adaptive response, which may not be beneficial in the circumstances (Cribbin et al., 2003).

Sensory processing difficulties exist on a continuum of increasing severity, three distinct levels are portrayed, mild, moderate and severe. Depending on how the person is feeling at the time, individuals may be more easily (or not) aroused and then distressed by sensory stimuli (Heller, 2003).

There are many signs of SID including over or under-sensitivity and reactivity to touch, movement, sight and sounds. There are also co-ordination difficulties, in relation to whole body and/or fine hand movements, as well as complications in organisation of behaviour, such as planning and carrying out everyday activities (Cribbin, et al., 2003). Individuals living with SID often have other issues such as impaired motor development, a learning disability or nervous system or brain disorders such as autism (Fisher & Murray,1991).

### Sensory processing and ASD

Autism characteristics as described by high functioning individuals with ASD, such as Temple Grandin and Donna Williams widely report impairments with modulating sensory input; experiences of hyper- and hyposensitivity, visual distortion, sensory overload and sensory shutdown (Williams,1992. Grandin, 1995. Tomchek & Dunn, 2007). Scott Tomchek in his 2005 Doctoral Dissertation 'Characterizing Sensory Processing in Autism Spectrum Disorder' notes:

> The neuroscience literature generally presents material at the level of processes and neural mechanisms, whereas the occupational therapy literature generally conveys information at the level of experience or behaviour. Given the overlap in terminology, both fields describe and provide evidence of impaired sensory processing in autism (p.17).

Visual response in the form of avoidance of eye contact, is described as an early behaviour demonstrated in social settings by many individuals with ASD, It has been theorised, this particular behaviour is self-regulatory in nature, a means of compensating for visual input modulation difficulties (Tomchek & Dunn, 2007). Miller (2014) also makes comments of co-occurrence of the two distinct conditions ASD and SID within individuals. Miller, a practicing occupational therapist and active researcher, concludes that most (perhaps all) children with ASD have sensory issues.

### Sensory Profiling

Sensory profiling measures an individual's responses to sensory events in daily life. When sensory integration differences are suspected, occupational therapists administer sensory profiles as part of an assessment process. Together with direct observations, the competition of a sensory profile assists identification of sensory processing patterns, which guide diagnosis and intervention decisions. There are a number of tools available to occupational therapists which evaluate sensory histories to build a sensory profile. Individual profiling tools are often standardised for specific age groups. Profiling responses are generally gathered through tick-list questionnaires made up of statements describing specific sensory events. Profiles which question sensory histories yield information about the person's sensory processing skills and record how they change over the life span (Kientz & Dunn, 1997).

### Relevant Prior Research

A study published in 2009 by Cane,Goddard and Pring did include the examination of adult participants with and without ASD by means of a sensory profiling tool. A total of 36 adult participants were assessed for levels of sensory processing during their every-day lives, participants completed a self-report questionnaire survey, the Adult/ Adolescent Sensory Profile (AASP). Half of the participants had diagnosed ASD, the other half without a diagnosis were comparison participants. The study results suggest '… that levels of unusual sensory processing do not dissipate across the lifespan' (p 222).

A more recent study undertaken during 2012 by Hungarian academics Marietta Kekes-Szabo and Anges Szokolszky. Explored and compared how typically developing children and children with ASD perceive the world and select information. The sampled 30 children aged between two & seven, and 17 children aged between two & seven and a half who did not have an ASD diagnosis. Kekes-Szabo and Szokolszky selected the SPCR questionnaire as their evaluative tool, based on research undertaken by Robinson and Johnson in 2010, which described the SPCR as a useful and valid tool to evaluate the sensory and perceptual experiences of individuals on the ASD spectrum. On evaluation of the completed questionnaires Kekes-Szabo and Szokolszky concluded they found '…children with ASD displayed increased sensitivity compared to typically developing children in most of the seven sensory modalities'. Also that '… parents of children with ASD indicated a higher frequency of sensory-related unusual behaviour in general, and unusual behaviour specially linked to hyper- and hyposensitivity, compared to the healthy control group'. (p 390)

## METHOD

This study compares the current sensory profiles of adolescents with ASD and/or SID alongside age matched typically developing individuals. Participants were asked to complete Olga Bogdashina's Sensory Profile Checklist-Revised (SPCR). Data obtained from the SPCR responses was presented for analysis as illustrative graphs. Of particular interest was whether or not participants were able to identify at what age they became aware of their individual sensory difference. Also, if they are able to classify what contributed to any change in behavioural reactions to sensory stimuli.

Five adolescents with ASD and/or SID (age 16-17) completed and returned the checklist, the support of their families/ caregivers was used if required. Five similarly age matched typically developing individuals (age 14-17) independently completed and returned the SPCR.

The SPCR is a screening tool designed to compile a sensory profile for children on the autism spectrum. The question-based tool requires response to listed descriptors of behavioural reactions to sensory stimuli (Kekes-Szabo & Szokolszky, 2012).

All seven sensory systems are measured by 20 categories summarising possible sensory experiences in ASD. These 20 categories are; 1. Gestalt perception (inability to filter, screen, distinguish, coordinate sensory stimuli) 2. Inability to stop feeling the change (prolonged perception). 3. Fragmented perception (uneven 'in-bits' experiences) 4. Distorted perception. 5. Delayed perception. 6. Intensity with which the senses work (hyper-, hypo). 7. Sensitivity to disturbance by some stimuli. 8. Fascination with certain stimuli. 9. Inconsistency of perception (fluctuation between hyper- and hypo-) 10. Vulnerability to sensory overload. 11. Systems shutdowns ('tuneouts') 12. 'Sensory agnosia' (difficulty interpreting a sense). 13. Mono-processing (one sensory channel working at a time). 14. Peripheral perception (avoidance of direct perception). 15.

Compensating for unreliable sense by other senses. 16. 'Losing oneself' in stimuli, resonance. 17. Daydreaming (e.g. 'seeing' or 'hearing' thoughts, 'feeling' events, 'hallucinations' relating to smell and taste, experiencing movement while still). 18. Synaesthesia (e.g. smelling sounds, tasting colours, involuntary body postures and movements as a response to stimuli). 19. Perceptual memory, associative ('serial') memory (e.g. memory triggered by sensory stimuli). 20. Perceptual thinking (e.g. visual thinking 'thinking in pictures', proprioception thinking through body 'movement images') (Bogdashina, 2016).

Each category is broken down into statements that cover possible patterns of sensory experiences for participant response. For example; behaviour relating to vision statements include "Constantly looks at minute particles, picks up smallest pieces of fluff", "Covers, closes or squints eyes at bright light" and "Looks down most of the time".

The SPCR instructions direct the selection of an appropriate answer to the statement(s) described by 'ticking' any of four given options.

These options are listed with instruction;

- WT- Was true in any time in the past: in brackets, specify the age of the child when the statement was true.
- T- True now (if it was true and is true now, tick both answers).
- F- False (if the statement is not true).
- NS- Not sure or don't know.

Bogdashina describes the tool as an 'inside-out' approach to sensory profiling, maintaining it does not focus only on dysfunctional sensory experiences, as it includes the profiling of sensory strengths as well as deficits (Bogdashina, 2016).

A licence application was applied for and granted by Jessica Kingsley Publishers (facilitated by PLSclear) to reproduce and use Bogdashina's Sensory Profile Checklist- Revised (SPCR) as published in *Sensory Perceptual Issues in Autism and Asperger Syndrome. Different Sensory Experiences- Different Perceptual Worlds.* (2nd ed) London: Jessica Kingsley Publishers.

Minor changes were made to profile instructions for the purpose of this study, these included:

Additional instructions for completing the checklist, clarifying participants could either complete the checklist themselves by questioning 'Do I….?' for each statement or a parent or caregiver could report on their behalf. Explanation of WT (Was true) & T (True) responses were requested, in particular if the participant (or caregiver) completing the questionnaire had the ability to identify what contributed to the change. (e.g. self-initiated responses result of professional therapy and guidance, family support). No personally identifiable information was collected. A coversheet including two questions was added to the SPCR;

- What is your age? __ years
- Please circle

  Do you have a diagnosis of Autism Spectrum Disorder (ASD)? Yes No

  Do you have a diagnosis of Sensory Integration Disorder (SID)? Yes No

Definition statements for both proprioception and vestibular systems were added prior to these category sections of the checklist. Three behaviour statements were removed as they were considered inappropriate and superfluous for adolescent participants. Two from the olfaction section which directly related to toileting problems. One from the proprioception section, which questioned Echoemotica (the copying of others' emotions).

Ethical approval to conduct the study was gained from Otago Polytechnic Research Ethics Committee during 2017. Recruitment of participants was from the Autism New Zealand community and local secondary school aged students. Requests for participation took place through electronic Bcc emailing and messaging via closed group newsletters, and as a 'pick-up' document package, from the Otago region transition from school to life and careers: Transition Expo 2017. The study documents, including informed consent paperwork, were distributed independently of the author, with return addressed envelopes. Participants completed the SPCR at their own convenience. Inclusion criteria for responses was the first five completed SPCR responses from adolescents who identified as having an ASD and/or SID diagnosis, and the first five adolescents who did not identify with either diagnosis.

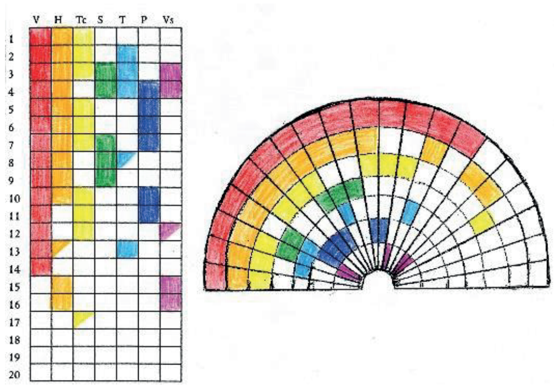

Figure 1. Sample table and Rainbow

The data obtained from the ten returned SPCR responses was presented for analysis as individually complied illustrative graphs. Then in graphic 'rainbows' as prescribed by Bogdashina (Figure 1). Each coloured box in the graphs represents specific sensory features experienced by the individual. The numbers (1-20) in the table correspond with the 20 categories listing the sensory experience statements for participant response, the top axis listed abbreviations of the seven sensory channels (V, H, Tc, S, T, P, Vs). Differing colours were used as instructed by Bogdashina to represent each sensory channel: for example, red signifies vision (V), orange-hearing (H), yellow-tactility (Tc), green-smell (S), blue-taste (T), indigo-proprioception (P) and violet for the vestibular sense (Vs). Bogdashina (2016) ascertains once a graph is 'coloured' it is fitting to display the sensory profile as a rainbow prism, she states

> …seems appropriate to show the sensory profile of an autistic individual in the form of curved lines rather than a straight line, as not all sensory differences are deficits; some are better described as superabilities (or gifts) that can be successfully used in the treatment of autistic people. (p.213)

For the purposes of this study T (True now) responses were recorded as a full block of colour, WT (Was true) responses were recorded as a half-coloured block.

## FINDINGS

Visual analysis of illustrative SPCR graphs for each participant, alongside additional accompanying comments, revealed a strong distinction between participants who identified a diagnosis alongside the comparison group, of those who do not have a clinical diagnosis (Figures 2-11).

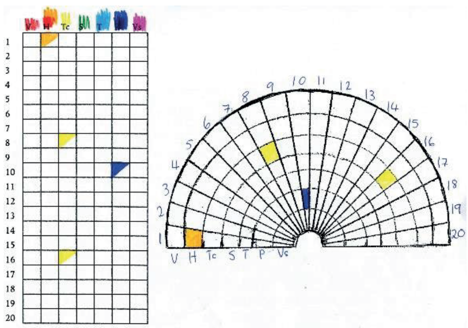

Figure 2. Participant 1: No Diagnosis

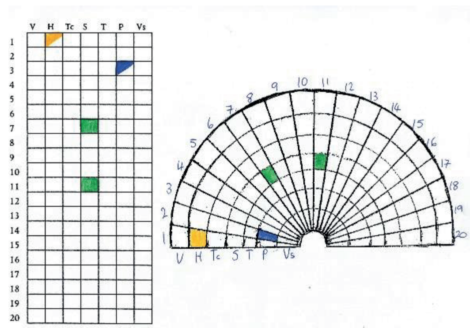

Figure 3. Participant 2: No Diagnosis

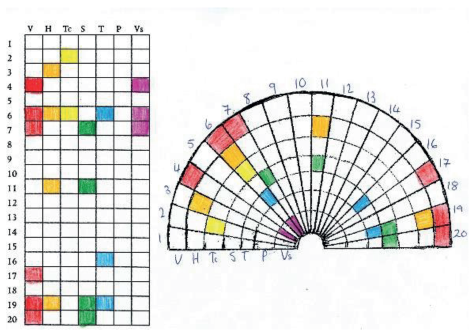

Figure 4. Participant 3: No Diagnosis

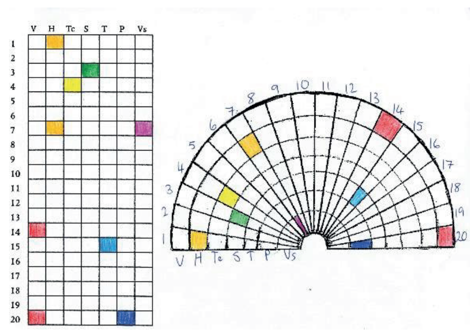

Figure 5. Participant 4: No Diagnosis

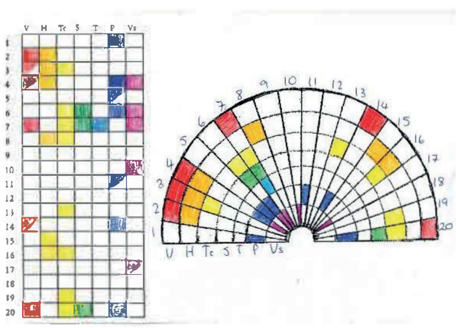

Figure 6. Participant 5: No Diagnosis

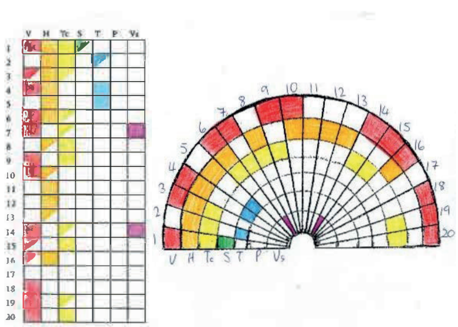

Figure 7. Participant 6: ASD Diagnosis

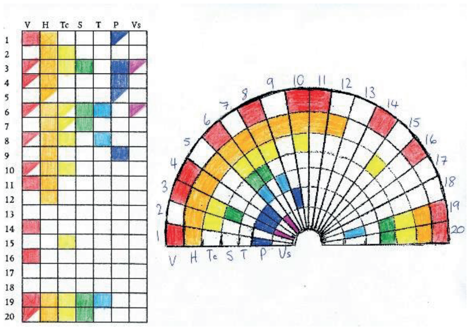

Figure 8. Participant 7: ASD Diagnosis

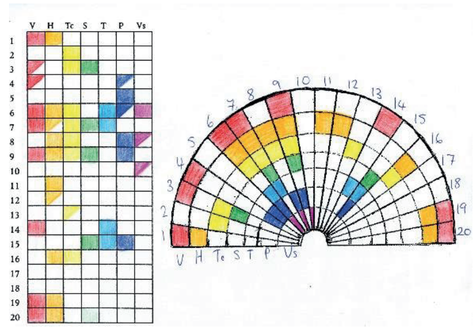

Figure 9. Participant 8: ASD Diagnosis

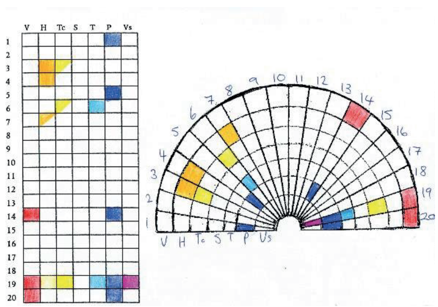

Figure 10. Participant 9: ASD (Comorbid) Diagnosis

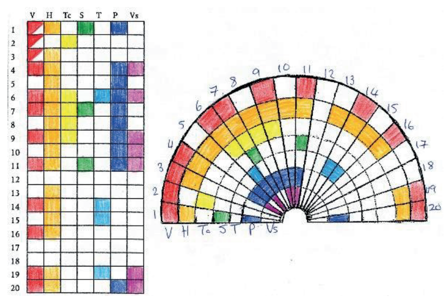

Figure 11. Participant 9: ASD & SID Diagnosis

The varying density of the T and WT coloured responses across all ten participants, clearly demonstrates the least recorded sensitivities by four of the five participants who did not 'circle' an ASD or SID diagnosis (Figures 2-5). These four profiles indicate limited sensory experiences as identified in ASD by the SPCR screening tool. Participant one recorded all four responses as WT (Figure 2). Of the five who did not identify with a clinical diagnosis, participant five responded with the highest rate of behavioural reactions to sensory stimuli, across all seven sensory systems as a mix of both T and WT responses (Figure 6). Only one participant without a diagnosis added a 'one word' comment to identify their response to a statement they considered T; specifying 'scarping' as a sound that frustrates them.

All five of the questionnaire profiles completed by participants who are on the autism spectrum were able to identify specific responses to sensory experiences. Adding additional explanatory comments beside a good number of the statements. This supplementary information included a number of examples of noted changes in their processing of sensory information throughout their life span to date. Listed below are a selection of the commentaries added:

> *"Was fascinated with certain sounds in particular the clicking of light switches, this behaviour stopped at age seven"*
>
> *"Until recently being in crowds would often result in a meltdown"*
>
> *"Fascinated with water movement, flicking"*

*"Stopped smelling all new objects. 11-12"*

*"Same Hair Dresser for 9 years so he tolerates having a haircut"*

*"Hates certain songs"*

*"He is very aware that people are happy or sad but often not sure how to deal with it"*

*"Age 14 - still can't tie shoe laces"*

*"Slept with head hard against headboard age 8 started use of weighted blanket which helps"*

*"Little bit distressed by clothes rubbing on skin up to 10yrs ish"*

*"Changed to gluten free at 5yrs, much improved eye contact & awareness in the world"*

*"Spinning on office chair, riding on ski biscuits seem to settle and relax him, especially if wound up about something"*

*"We struggle at the end of each season with clothing"*

*"Disliked brushing teeth this took a long time 1-11"*

*"Only eats crunchy food"*

*"Has played with dough since preschool, still daily models with plasticine"*

*"Stopped eating erasers and pencils at 17"*

*"Climb under things if I need to calm down"*

The majority of these comments imply they have been written by either a parent or caregiver. During a diagnostic period often caregivers are asked by an occupational therapist to undertake a sensory profile, when dysfunction is identified therapeutic sensory practices are prescribed. This experience encourages caregivers to take particular notice of sensory modulations, both current and retrospective.

A small number of self-regulating sensory strategies are identified and discussed, alongside age ranges of when sensory changes have been experienced. For example, use of therapeutic weighted blanket to aid sleep, self-regulation through body movement by spinning on a chair and hand modelling of a dough medium. Specific classification of what did or may have contributed to the adaptive strategies was limited.

Alongside the explanatory comments, all five participants with ASD recorded WT responses within their profiles, whereas the typically developing adolescents record less on average WT responses, two profiles did not record any identifiable changes in their range of sensitivities. This result suggests the typically developing individuals have experienced less change in their sensory systems, or they are less aware of sensory integration in comparison to those with ASD.

The five sensory profiles of the clinically diagnosed participants demonstrate a trend across all seven sensory systems, of recognised sensory experiences. Vision and hearing are predominately the sensory channels recording the greatest T and WT responses (Figures 7-11). These results suggest that sensory processing experiences of individuals with ASD and/or SID are significantly heightened in comparison to those of typically developing peers across all of the seven sensory modalities. Of interest is the one participant who identified a comorbid diagnosis (not SID) together with ASD (Figure 10). Their sensory profile has the least 'colour' of the five profiles with ASD, their sensory experiences could be less specific to ASD due to additional clinical impact.

Several trends have been observed in this small set of data. The limited reporting of sensory awareness or differences by the typically developing individuals in comparison to the group with an ASD diagnosis. The prevalence of sensory processing differences and self-regulating behaviours recorded across their life span by the ASD individuals, this experience was not shared by the typically developing adolescents. These findings present useful avenues for further, increased sample size research into sensory processing patterns of adolescent individuals with sensory integration differences.

## CONCLUSIONS

It is difficult to consider this study's findings alongside similar studies which also aim to gain better understanding of sensory integration as the majority of research cited in the area of sensory integration and ASD has focused on children, rather than adolescents and adults. Differentiation of sensory processing differences have been recognised in comparison studies of children across the autism spectrum, also ASD subjects alongside others with varied learning disabilities, as well as children who are typically developing (Cane,Goddard & Pring, 2009). Interestingly, only one participant identified a dual diagnosis, an explanation for this could lie with the current small number of health professional specialising in sensory integration in New Zealand.

This pilot study contributes to a growing awareness and understanding of both ASD and SID, it highlights the prevalence of sensory difference within the ASD population.


## ACKNOWLEDGEMENTS

Thanks go to Autism New Zealand for showing an interest and supporting this project; through sharing a 'call for participants' with their community. The studies participants and their families, who were willing to share their experiences of how best they live with sensory differences.



## AUTHOR CORRESPONDENCE

Tania Allen-Ross: Otago Polytechnic; Email: tania.allan-ross@op.ac.nz, Tel: 021 125 5223.


## REFRERENCES


Ayres, A.J. (1979). *Sensory Integration and the Child.* Los Angeles: Western Psychological Services.

Bogdashina, O. (2016). *Sensory Perceptual Issues in Autism and Asperger Syndrome. Different Sensory Experiences- Different Perceptual Worlds.* (2nd ed) London: Jessica Kingsley Publishers.

Cermak, S. A. (1994). Foreword. In J. Daems (Ed.). *Reviews of Research in Sensory Integration.* (pp. ix-x). California: Sensory Integration International.

Crane, L., Goddard, L., & Pring, L. (2009). Sensory Processing in Adults with Autism Spectrum Disorder. Autism. *The National Autistic Society,* 13(3), 215-228.

Cribbin, V., Lynch, H., Bagshawe, B., & Chadwick, K. (2003). *Sensory Integration Information Booklet.* Dublin: The Sensory Integration Network.

Fisher, A. G., & Murray, E. A. (1991). Introduction to Sensory Integration. In A. G., Fisher, E. A., Murray & A. C. Bundy (Eds.), *Sensory Integration Theory and Practice* (pp. 3-25). Philadelphia: F. A. Davis Company.

Grandin, T. (1995). *Thinking In Pictures* (2nd ed.). New York: Vintage Books.

Heller, S. (2003). *Too Loud, Too Bright, Too Fast, Too Tight. What to Do If You Are Sensory Defensive in an Overstimulating World.* New York: Quill.

Kekes-Szabo, M., & Szokolsky, A. (2012). Sensory- Perceptual Deficiencies and Possible Consequences in Autism. *Practice and Theory in Systems of Education,* 7(4) 377-394.

Kientz, M.A., & Dunn, W. (1997). A Comparison of the Performance of Children with and Without Autism on the Sensory Profile. *The American Journal of Occupational Therapy*, 51 (7), 530-537.

Miller, L. J. (2014). *Sensational Kids: Hope and Help for Children with Sensory Processing Disorder (SPD).* New York: Perigee.

Tomchek, S. D. (2005) *Characterizing Sensory Processing in Autism Spectrum Disorders*: University of Kentucky Doctoral Dissertations. Paper 455. Retrieved 3/2/16 from http://uknowledge.uk.edu/gradschool-diss/455

Tomchek, S.D., & Dunn, W. (2007). Sensory Processing in children With and Without Autism: A Comparative Study Using the Short Sensory Profile. *The American Journal of Occupational Therapy*, 61(5), 190-200.

Williams, D. (1992). Nobody Nowhere: The Extraordinary Autobiography of an Autistic Girl. New York, NY: Pergamon.