THE ASSOCIATION BETWEEN CHILD BEHAVIOR PROBLEMS, PARENTING PRACTICES, AND SENSORY INTEGRATION DYSFUNCTION

A Dissertation Presented

by

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ABSTRACT

THE ASSOCIATION BETWEEN CHILD BEHAVIOR PROBLEMS, PARENTING PRACTICES, AND SENSORY INTEGRATION DYSFUNCTION

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This study examined the association between child behavior problems, parenting practices, and sensory integration dysfunction (DSI) in 49 children (13 girls and 36 boys) ages 4 to 9 who were being evaluated for sensory integration issues at a clinic for occupational therapy. Ayres (1964), who originated the concept of DSI, speculated that three areas of DSI (tactile defensiveness, gravitational insecurity and dyspraxia) would most likely be associated with child behavior problems because they might lead to negative emotional reactions and noncompliance especially when paired with parenting behaviors and attitudes that do not reflect an appreciation of the child's difficulties. The purpose of this study was to examine this speculation. Child behavior problems were measured with the Child Behavior Checklist (Achenbach, 1991). Parenting practices were measured with the Alabama Parenting Questionnaire (Frick, 1991). Sensory integration dysfunction was measured with the Sensory Integration and Praxis

Tests (Ayres, 1989), the Short Sensory Profile (Dunn, 1999) and the Evaluation Completion Form, which is a summary of clinical findings completed at the end of sensory integration evaluations. Results from this study supported the hypothesis that increased child behavior problems were significantly associated with greater tactile sensitivity but were not significantly associated with gravitational insecurity or dyspraxia. As hypothesized, child behavior problems were also significantly associated with lack of parental involvement. However, regression analyses were inconclusive regarding the hypothesized interaction of DSI and parenting practices in predicting child behavior problems.

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Finally, I dedicate this dissertation to the children with whom I have worked, whose lives I have touched and who have touched my own.

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CHAPTER 1

INTRODUCTION

Disruptive child behavior problems, which are characterized by under-controlled, noncompliant, defiant, socially disruptive, and aggressive behavior, are a major reason why elementary school-age children are referred for professional mental health services and account for 35 to 50% of clinic referrals in this population (Robins, 1981; cited in Breen & Altepeter, 1990). Two of the most proximal contributors to child behavior problems in elementary school-age children are parenting practices and child characteristics (Barron & Earls, 1984; Belsky, 1984; Earl & Jung, 1987; Greenberg, Speltz, & DeKlyen, 1993; Greene & Doyle, 1999; Greenspan, 1989; Greenspan & Porges, 1984; Kochanska, 1993; Kopp, 1982; Patterson & Sanson, 1999; Sameroff, 1975; Stifter, Spinrad, & Braumgart-Rieker, 1999). One of the child characteristics that clinicians (Ayres, 1989; Greene, 1998; Greenspan, 1989, 1995) have speculated might be associated with behavior problems in young children is sensory integration dysfunction (DSI[1]; Ayres, 1972, 1979), which refers to a mild to moderate disorder of learning and behavior characterized by difficulty in processing and integrating sensory information from any and all modes of perception and subsequently producing an appropriate behavioral response. However, this speculation has received scant empirical attention or support. Therefore, this

[1] As recommended by Lane, Miller, and Hanft (2000), DSI is used as the acronym for sensory integration dysfunction instead of SDI to avoid overlap with sudden infant death syndrome.

study was undertaken to empirically examine the association between child behavior problems, parenting practices and DSI.

The following sections provide overviews of child behavior problems, parenting and DSI and the rationale for hypothesizing an association between them.

Overview of Child Behavior Problems

In research, child behavior problems have been discussed and measured through two approaches: the diagnostic and the psychometric approaches. In the diagnostic approach, child behavior problems have been classified into theoretically-derived, nosological categories, which can be found in the Diagnostic and Statistical Manual of Mental Disorders-4th edition (DSM-IV; American Psychiatric Association, 1994) and The International Statistical Classification of Diseases and Related Health Problems-10th edition (World Health Organization, 1992). They are Attention-Deficit/Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD). When used in research, subjects are typically classified into these diagnostic categories through structured clinical interviews. In the psychometric approach, child behavior problems have been classified and characterized through extensive factor analyses of questionnaire items related to various problem behaviors. This approach is typified by the Child Behavior Checklist (CBCL; Achenbach, 1991, 1993), which has been a widely-used measure of child behavior problems and was also used in this study.

Achenbach (1991a) used the term Externalizing Behavior Problems (EXT) to label one of his psychometrically-derived constructs of child behavior problems. EXT consists of two subscales: Aggressive Behavior Problems and Delinquent Behavior Problems. Aggressive behavior problems refer to excessive physical aggression without violation of any major societal norms or laws (Johnson & Fennel, 1983; cited in Breen & Altepeter, 1990). Delinquent behavior problems refer to ongoing behavior patterns that fail to follow major societal norms or laws. In relation to the diagnostic categories, Aggressive Behavior Problems generally overlap with ODD and Delinquent Behavior Problems generally overlap with CD (Achenbach & McConaughy, 1996), though Achenbach (1993) cautions that the overlap is not exact.[2]

Contributors to Child Behavior Problems

As mentioned earlier, two of the most proximal contributors to child behavior problems in elementary school-age children are parenting practices and child deficits, which will be reviewed individually next (Barron & Earls, 1984; Belsky, 1984; Earl & Jung, 1987; Greenberg, Speltz, & DeKlyen, 1993; Greene & Doyle, 1999; Greenspan, 1989; Greenspan & Porges, 1984; Kochanska, 1993; Kopp, 1982; Patterson & Sanson, 1999; Sameroff, 1975; Stifter, Spinrad, & Braumgart-Rieker, 1999). But, before beginning this review it is worth noting that many theorists subscribe to a transactional effects model (Sameroff, 1975) to

[2] Furthermore, with regards to ADHD, Achenbach also identified an Inattentive factor, but unlike the diagnostic approach, he did not group it with Delinquent and Aggressive Behavior problems

describe how parenting practices and child characteristics interact to contribute to the development of child behavior problems. In this model, parent and child characteristics are not static variables that contribute to child behavior problems in the same way across time. Rather, the qualities of parent and child variables are thought to reciprocally influence each other and have the potential to change (or remain the same) through the course of successive transactions that unfold over time. Child behavior problems are seen as malleable by-products of these transactions that might be sustained through continuous malfunction in parent-child transactions and poor fit between parent and child characteristics. Concrete examples of this model will be presented as necessary throughout the remainder of this chapter.

Parenting Practices that Contribute to Child Behavior Problems

The parenting practices most often associated with behavior problems in elementary school age children are lack of parent involvement in the child's activities and interests, poor parental monitoring and supervision, parental rejection, inconsistent discipline, and greater reliance on negative reinforcement, especially excessive use of corporal punishment (Loeber & Stouthamer-Loeber, 1986; Wells & Rankin, 1988). Curiously, many of the reviews of parenting and child behavior problems during the school-age years (e.g., Belsky, 1984; Frick, 1994; Loeber & Stouthamer-Loeber, 1996) neglect the possibility that parenting

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because of its weaker factor loading with Externalizing Behavior Problems and because he believed that attention problems resulted from different etiological sources.

practices differ according to the child's age. For example, Wauchope and Straus (1990) reported that use of physical punishment decreased with the child's age. Frick, Christian, and Wootton (1999), whose measure of parenting practices was used in this study, also reported developmental differences in the key parenting practices associated with child behavior problems. They divided their sample of children into three age groups: young (age 6 to 8), middle (age 9 to 12), and adolescent (age 13 to 17). They found that overall parenting practices were most strongly associated with behavior problems in the adolescent age group. More specifically, lack of parental involvement and inconsistent discipline were most strongly associated with adolescent behavior problems. For the middle age group, corporal punishment was strongly associated with behavior problems. For the young group, which is the age group that captures most of the children in this current study, parental involvement and inconsistent discipline were moderately related to behavior problems (R^2s = .15, $p < .05$), whereas poor monitoring/supervision, positive parenting, and corporal punishment were not significantly associated with behavior problems (R^2s ranging from .02 to .09).

How do parenting practices lead to child behavior problems? One widely cited cognitive-behavioral answer to this question is Patterson's (1982) "coercive" learning model. In this model, children learn to behave disruptively through standard behavioral reinforcement and social learning (i.e., social modeling). From the reinforcement perspective, children learn to use disruptive behaviors because these behaviors lead to desired outcomes. For example, a child may

whine, cry or yell, which is noxious to a parent, so the parent may concede to the child's wishes to stop the noxious behavior. This process then reinforces and increases the likelihood that the child will use similar strategies to get what he or she wants in the future. From the social learning perspective, children learn to use disruptive behaviors by observing their parents use these behaviors effectively to get what they might want from another person. An example of this might be the parent who threatens, nags, or scolds a child to force compliance or concession. This parental behavior models the use of noxious behaviors as a means of getting what one wants from another person and, if the noxious behaviors are effective in achieving their goals, then the lesson from this modeling is more strongly reinforced. When both parent and child begin to use these methods to get what they want from the other and they each begin to habituate to the noxious quality of these behaviors, then both parties will need to escalate the degree of noxiousness to produce the desired effect, which lead to vicious cycles of more and more intensely disruptive and coercive strategies.

This social learning model underlies the most widely-used and empirically validated (Brestan & Eyberg, 1998; cited in Greene & Doyle, 1999) contingency management therapies used to treat disruptive behavior problems (e.g., Barkley, 1997; Clark, 1996; Webster-Stratton & Hancock, 1998). These therapies focus on changing the patterns of parental discipline which are thought to contribute to child behavior problems (McMahon & Wells, 1998). They generally help parents understand how their parenting behaviors might reinforce child behavior

problems and then teach parents to (a) extinguish negative behaviors through withdrawal of rewards and (b) reinforce desirable behaviors through schedules of positive reinforcement.

Though these treatment approaches are widely-used in clinical practice and enjoy empirical support of their efficacy, some research has challenged the efficacy of these treatments for every type of child behavior problem. In discussing the studies and reviews examining the efficacy of these treatments, Greene and Doyle (1999) state that (a) many of the treatment efficacy studies did not sample clinic-referred youth, (b) many parents receiving these treatments did not fully comply with the implementation of these treatments or dropped out of treatment altogether, (c) results were often presented for only those families who stayed in the treatment, and (d) most results demonstrated statistically significant changes in child behavior problems but not clinically significant changes. Greene and Doyle thus conclude that these treatments, though generally considered to be the most effective treatments for disruptive behavior problems, may not benefit every family.

From a theoretical perspective, one possible reason why these treatment approaches might not be effective for all children with behavior problems may lie in the fact that these approaches assume that child behavior problems can be most directly, effectively and consistently reduced by changing the environmental contingencies that sustain their continued use. However, Greene and Doyle (1999) have argued that this assumption may not hold for some children because

of cognitive and/or emotional deficits (e.g., executive deficits, language processing impairments, cognitive distortions, and deficits in emotion regulation) which may undermine a child's ability to respond to contingencies. For example, children with executive deficits may have difficulty inhibiting negative behaviors even if they so desired. Children with language processing impairments may not understand what it is their parents are asking them to do or may not be able to articulately discuss and negotiate compromises or solutions to problems at hand. Children with emotion regulation problems may routinely become so frustrated, angry, or upset that they no longer care about contingencies, whether punitive or rewarding, so act against their own best interests in ways they might regret once they have regained their emotional composure.

For these children, Greene and Doyle suggest that an alternate treatment approach that directly addresses the child deficits contributing to behavior problems might be more appropriate. One such treatment approach is Greene's (1998) Collaborative Problem Solving approach, which is based on the premise that disruptive, explosive, and oppositional behaviors result primarily from an incompatibility between parent practices and child deficits, which broadly produce deficits in frustration tolerance and cognitive or behavioral flexibility. The goals of this treatment are to help parents (a) understand the specific adult and child characteristics contributing to their child's behavior problems, (b) become aware of three basic strategies for handling situations that lead to explosive behaviors (imposition of adult will, collaborative problem-solving, and removal of parental

expectations or will) and recognizing their impact on parent-child interactions, and (c) along with their children, becoming skilled at collaborative problem-solving, which defuses many situations that may lead to explosive behavior, often redresses many of the child deficits underlying the behavior problem, and ultimately improves parent-child compatibility.

In comparison to the contingency management approach, Greene's treatment approach appears to be more consistent with the transactional effects model mentioned above in that (a) it focuses on improving the transactions between parent and child by highlighting the importance of collaboration in problem-solving and (b) it places equal importance on parent and child characteristics as contributors to child behavior problems by teaching parents about the numerous child deficits which may lead to the development of disruptive behavior problems. An overview of these child deficits are presented next.

Child Deficits that Contribute to Child Behavior Problems

In the large body of research on child behavior problems, numerous child deficits have been identified that might potentially contribute to the development of child behavior problems. A sample of the most common child characteristics associated with child behavior problems are executive function problems (Biederman, Faraone, Milberger, & Jetton, 1996; Campbell, 1990; Johnston & Ohan, 1999), which have also been documented neurophysiologically in terms of

reduced frontal lobe activation (Baving, Laucht, & Schmidt, 2000; Krynicki, 1978); language processing impairments (Cohen, Davine, Horodezky, Lipsett, & Isaacson, 1993; Speltz, DeKlyen, Calderon, Greenberg, & Fisher, 1999); deficits in social problem-solving skills (Matthys, Cuperus, & van Engeland, 1999); and deficits in social information processing (Crick & Dodge, 1994; Webster-Stratton & Lindsay, 1999). There is also a growing body of empirical research documenting an association between child behavior problems and dysregulation of the autonomic nervous system, as evidenced by physiological differences in levels of serotonin and cortisol (van Goozen, Matthys, Cohen-Kettenis, Westenberg, & van Engeland, 1999; van Goozen, Cohen-Kettenis, Gispen de Wied, Wiegant, & van Engeland, 1998) and poor vagal tone (Calkin & Dedmon, 2000; DeGangi, DiPietro, Greenspan, & Porges, 1991; Porges, 1991; Raine & Jones, 1987). Researchers in infant temperament view these dysregulations of the nervous system to be physiologic correlates of the behaviorally observed dysregulations of affect and arousal in infancy that have been associated behavior problems in early childhood (Bates, Pettit, Dodge, & Ridge, 1998; Buss, Block, & Block, 1980; cited in Rubin, Burgess, Dwyer, & Hastings, 2003; Stifter, Spinrad, & Braungart-Rieker, 1999).

How might child deficits lead to the development of child behavior problems? Kopp (1982) articulated a developmental model of self-regulation during infancy and early childhood that eloquently proposes an answer to this question. In this model, self-regulation is defined as “the ability to comply with a

request, to initiate and cease activities according to situational demands, to modulate the intensity, frequency, and duration of verbal and motor acts in social and educational settings, to postpone acting upon a desired object or goal, and to generate socially approved behavior in the absence of external monitors" (p. 199).

Kopp posits four developmental phases through which self-regulation develops. The neurophysiological modulation phase (birth to 2-3 months) involves the regulation of arousal states and production of reflex movements. At this stage, caregivers primarily serve an assistive role in helping to modulate arousal states. The sensorimotor modulation phase (3 to 9-12 months) marks the infant's ability to engage in voluntary motor acts that are initiated as a response to external stimuli. Sensorimotor modulation does not involve consciousness, prior intention, or cognitive meaning-making. Caregivers facilitate development in this phase by serving as the external stimulus that responsively activates sensorimotor activities, which helps to consolidate the infant's growing awareness of their own actions as differentiated from the action of others. The control phase (9-12 to 18+ months), which coincides with the emergence of upright locomotion, marks the infant's emerging ability to initiate, modulate or cease physical acts, communications or emotional signals according to external social or task demands. This development reflects the emergence of intentionality, goal-directedness, use of means, budding conscious awareness and budding awareness of what behaviors are or are not acceptable to

caregivers. Because conscious recall of events has not yet developed, control is dependent on key signals from caregivers. The final phase refers to the emergence of self-control and the progression to self-regulation (24+ months). Self-control refers to the ability to comply with parental requests, delay action, and behave in accordance to parental or social expectations in the absence of external monitors. It differs from control in the fact that it is associated with the appearance of representational memory, language, fantasy play, delayed imitation, and a conscious sense of self. Self-regulation differs from self-control by degree and reflects greater capacity to delay and wait, to flexibly adapt behaviors to meet new situational demands, to use more contingency rules to guide behavior, and to maintain self-monitoring for longer periods of time and in more situations. Caregivers at this stage facilitate development through the use of language to communicate expectations for appropriate behavior and reasons for these expectations to enhance internalization of these regulations.

One might use Kopp's model to extrapolate how child deficits might lead to the development of child behavior problems. For instance, executive function deficits might reflect deficits in behavioral inhibition and delay and flexible adaptation of behavior to new situations, which are central components of self-regulation. Language processing impairments might interfere with parent-child communication and the internalization of parental and social expectations. Deficits in social problem-solving skills and social information processing might reflect or lead to impaired ability to accurately perceive social situations and

develop flexible and adaptive behaviors for different social situations. Finally, physiologic dysregulation of affect and arousal states might lead to child behavior problems to the extent that the development of self-regulation involves continuous experiences of frustration and negative emotionality and appropriate expression of these types of emotions becomes part of what is expected as part of socially appropriate self-regulation (Kopp, 1989).

Interestingly, sensory integration dysfunction (DSI; Ayres, 1979) is a child deficit that can be readily fit into Kopp's model to suggest that it might also be associated with child behavior problems, though this possibility has received much less empirical investigation, compared to other child characteristics. An overview of this deficit along with how it might be associated with child behavior problems according to Kopp's model is discussed next.

Overview of Sensory Integration Dysfunction

As a theoretical construct, sensory integration dysfunction (DSI) was originally formulated by Ayres (1972, 1979) to potentially explain mild to moderate problems in learning and behavior. Ayres (1989) defined sensory integration as "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment" (p. 11).

In the broadest sense, sensory integration involves two primary processes. The first process involves the proper encoding of sensory information from all sensory pathways (auditory, visual, tactile, olfactory, gustatory,

vestibular, and proprioceptive). This encoding involves sensory discrimination, the ability to accurately identify and distinguish various sensory stimuli, and sensory modulation, the ability to regulate the intensity of incoming sensory stimulation and its impact on arousal. Sensory defensiveness is sometimes used to describe extreme hypersensitivity that causes some children to react to sensory stimuli as if the stimulus were extremely noxious or painful. The second process is praxis and refers either to the planning and coordination of a behavioral response that is appropriate to the perceived situation or to the effortful learning of a new motor skill.

Ayres (1979) theorized that sensory integration played a crucial role in nearly all fundamental areas of development throughout infancy and early childhood. She proposed that sensory integration developed over four “levels” of integration loosely organized along an overlapping developmental spectrum. In the primary level of infant development sensory integration was thought to be important to feeding, coordinated eye movement, posture, balance, muscle tone, gravitational security, caregiver-infant bond, and the capacity to the soothed by caregivers. During the second level of development, sensory integration was thought to be crucial for accurate perception of one’s own body, bilateral coordination, praxis, modulated activity level, attention span, and emotional stability. During the third level of development, sensory integration was thought to be involved in receptive and expressive language, eye-hand coordination, visual perception, and purposive activity. Finally, in the elementary school-age years,

Ayres believed that sensory integration was important to those skills most directly necessary for academic success: concentration, organization, self-esteem, self-control, self-confidence, ability to learn, capacity for abstract thought and reasoning, and specialization of each side of the body and the brain.

In the field of psychology, DSI has generally been overlooked, disregarded, and sometimes actively questioned in terms of its theoretical validity and its treatment efficacy (occupational therapy). For example, Hoehn and Baumeister (1994) critically questioned the series of factor analytic studies originally used to formulate sensory integration theory, challenged the reliability of tests measuring sensory integration function and their ability to differentiate children with and without learning disorders, and challenged the efficacy of sensory integration treatment in improving academic achievement. Nevertheless, DSI and its treatment are quite central in the field of occupational therapy, and DSI has recently been receiving growing recognition by some psychologists and pediatricians as a clinically relevant concern and potential contributor to child behavior problems (Greene, 1998; Greenspan, 1989, 1995; Smith, 2000).

In terms of the relation between DSI and child behavior problems, Ayres (1989) speculated that behavior problems might stem from tactile defensiveness, gravitational insecurity and dyspraxia. Tactile defensiveness refers to intermittent negative and emotional reactions to touch sensations that do not typically elicit such responses in other people. Touch sensations that typically cause defensiveness are often light or sudden. Common examples of such sensations

are the rough texture of certain clothes, the inner tag of some clothes, the stitching in the toe of a sock, finger paint, sand or grass, splashing water, light or unexpected touches or caresses, and tickling. Children with tactile defensiveness may react to such sensations with fear, irritation, pained withdrawal or avoidance. They may also slap or rub the area of skin that was touched. They may have difficulty playing with other children and may be mislabeled as having behavior problems if the source of their difficulties is not appreciated.

Gravitational insecurity refers to “abnormal anxiety and distress caused by inadequate modulation or inhibition of sensations that arise when the gravity receptors of the vestibular system are stimulated by head position or movement” (p. 182; Ayres, 1989). It is an overreaction to movement sensations that generates an intense and exaggerated fear of falling. It may or may not involve significant or measurable vestibular processing difficulties (e.g., poor balance, poor postural control, poor eye and head movement coordination, and poor bilateral integration and coordination). Examples of typical child activities that may generate such fears are being on a swing or merry-go-round, jumping, going up or down stairs, climbing, leaning backwards from a sitting position, riding things or animals, or tilting the head. This fearfulness may limit a child’s enthusiasm for play with peers, especially for play involving typical movement activities performed on a playground. For latency age children who are so engaged in motor mastery and physical competence, gravitational insecurity may be particularly damaging to social status, self-esteem and peer relationships

(e.g., peers may tease this child and call him or her “chicken”). If caregivers force this child to participate in movement activities, the child may become avoidant or controlling of the external environment in an effort to manage their internal anxiety. This child’s behavior may then lead others to view him or her as obstinate, uncooperative or controlling.

Dyspraxia refers to a disorder of learning and behavior that involves poor motor planning, which is the first step in learning new motor skills. Motor planning requires effort, concentration, and attention, as compared to motor skills which are over-learned, automatic, and effortless. Children with dyspraxia have difficulty learning or consolidating new motor skills and may appear uncoordinated or inefficient or slow at learning. They may not engage with play objects in a spontaneous or creative way. For example, they may get inside a barrel but not think to roll. They may be able to see how other children play with certain toys but not be able to plan playing with that toy themselves. They may have difficulty putting on clothes or using buttons or zippers. These difficulties may lead to feelings of frustration, powerlessness, incompetence, insecurity and emotional lability, which may then lead to behavior problems or characterizations of the child as “negative, resistive, and manipulative” (p. 105; Ayres, 1989), particularly when caregivers do not appreciate the child’s difficulties and maintain unrealistic expectations about how quickly or effortlessly a child might learn new motor skills.

Out of these three areas of DSI, Ayres speculated that the most likely one to lead to behavior problems would be tactile defensiveness and gravitational insecurity. She believed that tactile defensiveness would be related to behavior problems because it might generate the most anxiety and negative emotional reaction because of its close relationship to the fight or flight system (i.e., touch is the sense through which organisms perceive the most imminent threat to physical safety). Gravitational insecurity might similarly lead to behavior problems because it might produce a great level of anxiety and distress. Dyspraxia on the other hand might lead to behavior problems because of a child's frustration and sense of incompetence. In all three cases, behavior problems are most likely to occur when a child with these difficulties is paired with caregivers who do not understand the child's difficulties, frustrations, and anxieties, disregard them and try to force the child to perform, or do not help manage the child's distress and gently and patiently encourage the child to overcome their difficulties.

Returning to Kopp's (1982) developmental model of self-regulation, sensory integration and praxis clearly fit into the developmental phase of sensorimotor modulation, when the infant's ability to create intentional actions (i.e., praxis) begins to emerge. Sensory integration and praxis even more clearly fit into Kopp's (1989) subsequent elaboration of her model, in which she articulates a developmental model for the regulation of distress and negative emotion and combines it with her developmental model of self-regulation. In this elaborated model, emotion regulation abilities initially depend on physical

soothing by other (e.g., rocking and caressing) and by self though in a more limited fashion (e.g., eye closing, non-nutritive sucking, and body rubbing). At this early stage, infants are critically dependent on caregivers for regulation of affect and arousal and for correcting the situations or discomforts causing the emotional distress. As infants enter the control phase, they are capable of planful motor behaviors and begin to act in ways to more independently regulate their own emotions. They more effectively self-soothe by rocking, rubbing their genitals, or chewing on fingers and thumbs. They distract themselves with toy play. And, they become more effective at signaling to caregivers about specific types of distress and the assistance they require. Furthermore, parent-child interactions at this stage and even slightly earlier often reflect a dyadically-driven process through which the infant experiences modulated variations in levels of affective arousal and intensity. This process is thought to enhance the infant's awareness of his or her own emotional state, discrimination of another person's affective displays, and the ability to use the caregiver's own emotional reactions to understand the affective valence of various situations and what might be appropriate behaviors in those situations (i.e., social referencing).

With regards to DSI, sensory modulation problems might lead some infants to more frequently exist in states of physical discomfort and distress. Gravitational insecurity and sensory defensiveness might lead some infants to experience rocking and caressing by caregivers as intolerable and overwhelming instead of soothing. Dyspraxia would clearly impair the infant's ability for planful

motor action and thus limit the behavioral options through which he or she might self-regulate emotions.

Similar to Kopp, Greenspan (1989, 1992, & 1995; Greenspan, & Porges, 1984) elaborated a developmental-structuralist model of infancy and early childhood, which centralizes sensory processing as a vital foundation of early development. This model is based on two assumptions. The first assumption is that the capacity to organize experience is present very early in life and matures in an ordered developmental sequence. This capacity to organize experience allows for increasing abilities in processing and tolerating a range of stimuli, including the vital stimuli from social interaction. The second assumption is that each phase of development has certain prototypic experiences that are enacted within this organizational structure. Metaphorically speaking, Greenspan and Porges (1984) liken these prototypic developmental experiences to a theatrical drama that is played out on the stage of the infant's developing organizational structure.

Adequate sensory processing in all sensory pathways is vital to infant development because it allows the infant to effectively attend to and interact with its external environment. The most important elements of the infant's environment are its caretakers, who not only attend to the infant's basic survival but also facilitate the acquisition of foundational developmental capacities—e.g., homeostasis (self-regulation and interest in the world); attachment; somatopsychological differentiation (purposeful communication); behavioral

organization, initiative, and internalization; and representational capacity and its elaboration. The development of these capacities occurs through direct interaction with caretakers and is significantly impeded if the infant cannot appropriately process the interaction on a sensory level. For example, an infant who is hypersensitive to touch or movement may use vision and hearing to self-regulate, take interest in the world, and organize experience but become irritable and disorganized when gently stroked or held upright. If this infant continues to have these difficulties and if its caretakers continue to rely more heavily on touch and movement to soothe or interact with it, then this infant may have difficulty maintaining homeostasis, developing a secure attachment with caretakers, or even behaving an in organized, purposive manner.

Through their clinical experience, Greenspan and his colleagues at Zero to Three have identified behavior problems to be so commonly paired with sensory processing difficulties in infancy and early childhood that they combined the two in a set of disorders called *regulatory disorders* in the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood (Zero to Three, 1994; see also Greenspan & Wieder, 2000). Regulatory disorders are divided into three types. The first type describes the infant/toddler who is hypersensitive to sensory stimuli and exhibits behaviors that are often described as defiant, oppositional, manipulative and over-controlling but are actually more often attempts at forcibly managing an over-stimulating environment. The second type of regulatory disorder describes the infant/toddler

who is under-reactive to sensory stimuli and thus appears behaviorally apathetic and withdrawn. The third type describes the infant/toddler who vacillates between under- and over-reactivity to sensory stimuli, craves sensory input, and is motorically disorganized (i.e., dyspraxic). Behaviorally, this infant/toddler appears to be hyperactive, impulsive, disorganized, sometimes aggressive and fearless. Because of their craving for sensory input and their poor behavioral control and planning, they may seek close contact with objects and people but break things, invade personal space or hit others (Greenspan, 1995).

DeGangi and colleagues (DeGangi, Breinbauer, Roosevelt, Porges, & Greenspan, 2000; DeGangi, Porges, Sickel, & Greenspan, 1993) report the empirical support for these clinically based classifications. Their studies include a report on a longitudinal study in which nine infants with untreated moderate to severe regulatory disorders were compared to a control group of 13 infants at 8 to 11 months and again at 4 years of age. At 4 years of age, five of the regulatory disordered infants were diagnosed with emotional lability and behavioral problems versus none in the control group. Thomas and Guskin (2001) compared Zero to Three's diagnostic system to the DSM-IV and the CBCL in a sample of 82 clinic children between 18 and 47 months of age. They found that of the 28 young children diagnosed with a disruptive behavior disorder, 16 of those children were also diagnosed with a regulatory disorder, and of the 29 children diagnosed with a regulatory disorder, 17 of those children scored in the significantly elevated range on the Externalizing Scale of the CBCL (t-score

above 66). Though these studies clearly support the relationship between regulatory disorders and EXT, they as yet have not extended their analysis to older, elementary school age children.

There have been very few research studies specifically examining DSI and behavior problems in elementary school aged children. Silberzahn (1975) may have published the only study that specifically examined the associations between behavior problems, praxis and sensory discrimination in elementary school age children. Her sample consisted of 54 children ages 5 to 9 referred to an outpatient clinic for behavior problems. She measured behavior problems with a brief behavior checklist guided by the Burks' Behavior Ratings Scales (1969; cited in Silberzahn, 1975). She measured DSI with the Southern California Sensory Integration Tests (SCSIT; Ayres, 1972), which was the standard test of sensory integration dysfunction created by Ayres.[3] She analyzed her data using a factor analysis approach similar to Ayres (1972). She acknowledged that sample size[4] and method for collecting behavioral data made her conclusions tentative. Nevertheless, she identified postural and bilateral integration, which are considered to be closely associated with certain aspects of vestibular functioning, as the only syndrome (i.e., factor) to clearly emerge in the factor analysis of SCSIT scores in this small sample.

[3] Since 1989, Ayres revised and replaced the SCSIT with the Sensory Integration and Praxis Tests (SIPT; Ayres, 1989), which was used in this present study.
[4] Conrey and Lee (1992; cited in Tabachnik & Fidell, 2001) state that a sample size of 50 is very poor for factor analysis and recommend at least 300 cases for factor analysis.

Fanchiang, Snyder, Zobel-Lachiusa, Loeffler, and Thompson (1990) appear to have undertaken one of the only other studies examining behavior problems and these domains of DSI. However, their sample consisted of adolescents: 12 adolescents identified as “delinquent-prone” and 114 “non-delinquent prone” adolescents used as a control group. They measured vestibular function with three subtests from the SIPT; somatosensory function with five subtests of the SIPT; and praxis with two SIPT subtests, the Finger Posture Imitation Test (Druker, 1980; cited in Fanchiang et al., 1990) and the MacQuarrie Test for Mechanical Ability (MacQuarrie, 1925/1953; cited in Fanchiang et al., 1990). On the SIPT subtests, they found that the delinquent-prone adolescents performed significantly worse on all tests of vestibular function and praxis but not on any of the somatosensory tests.

The conclusions of this study and their generalizability are questionable because of several methodological limitations. First, there were only 12 delinquent-prone adolescents in the sample. Second, the psychologist who identified and referred the delinquent-prone group was familiar with sensory integrative theory so may have been biased in selecting adolescents suspected of having sensory issues. Third, the evaluator who tested the delinquent-prone adolescents was not blind to the study hypotheses. Fourth, because the SIPT is normed for children up to 9 years of age and scores for the SIPT come in the form of age-normed z-scores, the median score on each subtest for these adolescents was over 1 standard deviation above the mean and some scores

extended beyond 3 standard deviations above the mean. This procedure is a problem statistically because (a) the scores are likely to be non-linear and non-normally distributed, (b) there is a natural statistical ceiling when z-scores become so large and (c) the difference between two scores further from the mean of a distribution becomes more difficult to interpret in the same way that a 10-point difference in IQ score means a different thing depending on where it falls along the normal distribution.

Miller and her colleagues (Miller, Reisman, McIntosh, & Simon, 2001; Mangeot, Miller, McIntosh, McGrath-Clarke, Simon, Hagerman, & Goldson, 2001; McIntosh, Miller, Shyu, & Hagerman, 1999) appear to be the only group examining EXT and sensory modulation problems in elementary school age children. They measure EXT with the CBCL and sensory modulation with the Short Sensory Profile (SSP; Dunn, 1999)[5] and a clinical interview. Miller et al. (2001) reported that children classified with severe sensory modulation problems scored significantly higher on the Aggressive Behavior Problems subscale of the CBCL as compared to a control group of typically developing children. Using Miller's sample but only those children diagnosed with ADHD (n = 19), Mangeot et al. (2001) reported fairly large and significant correlations between both Aggressive and Delinquent Behavior Problems subscales and three scales of the SSP (Seeks Movement Sensation, Tactile Sensitivity, and Auditory Filtering).

[5] The SSP is also used in this study.

Though the research from Miller and her colleagues support the association between EXT and sensory modulation problems, one potential limitation to their findings was that both variables were assessed with a parent-rated checklist, which may have spuriously inflated correlations because of shared method variance. Also, given that the severity of maternal ratings of child behavior problems has been shown to sometimes be inflated by the bias of maternal depression (Briggs-Gowan, Carter, & Schwab-Stone, 1996; Webster-Stratton, 1988), it might have also been possible that maternal ratings of sensory modulation problems were similarly inflated. However, McIntosh et al. (1999) offer support for the validity of the parent-rated SSP in their study of the electrodermal response. Their sample consisted of 19 children ages 3 to 9 identified with severe sensory modulation disruptions through clinical interviews and 19 matched with age and sex matched controls. They found that when presented with repeated trials of various sensory stimuli, children with sensory modulation disruptions evidenced greater frequency and amplitude of electrodermal response to the stimuli and habituated more slowly to the repeated exposures. They divided the entire sample into three groups according to their electrodermal responsiveness: hyper-responders, mid-range, and hypo-responders. They found that both the hyper- and hypo responsive groups scored significantly lower on the SSP versus the mid-range responsive group.

Summarizing the research on DSI and EXT, the three studies reviewed have generally supported an association between EXT and DSI. However, these

studies had many significant limitations which undermined confidence in the conclusions one might draw from their results. Silberzahn's (1975) study used an outdated measure of DSI, a very brief and adapted measure of behavior problems, and had a very small sample for the type of analysis performed. Fanchiang et al.'s (1990) study also had a very small sample, examined adolescents instead of elementary school-age children but still used a measure of DSI formally normed for children up to only 9 years of age, and acknowledged that subject selection bias may have biased the results in favor of the hypotheses. Finally, Miller and her colleagues ((Miller et al., 2001; Mangeot et al., 2001; McIntosh et al., 1999) also had relatively small sample sizes, and primarily relied on parent-rated questionnaires, which may have inflated correlations because of shared method variance.

Given the scarcity of research on DSI and EXT and the limitations of the studies noted above, this study was undertaken to empirically explore the association between DSI and EXT in elementary school-age children and to attempt to redress some of the limitations in prior studies. As compared to Silberzahn (1975), DSI was measured with the newer version of Ayre's sensory integration tests, the Sensory Integration and Praxis Tests (Ayres, 1989). As with Miller and her colleagues, sensory modulation problems were measured with the Short Sensory Profile (Dunn, 1999). To avoid shared method variance, sensory modulation problems and gravitational insecurity were also measured using the clinician-rated Evaluation Completion Form, and EXT was measured using both

the parent-rated CBCL and the teacher-rated version of the CBCL[6] (CBCL-TRF). To be consistent with the transactional effects model of child behavior problems, parenting practices were also measured using Frick's (1991) Alabama Parenting Questionnaire. Finally, given the fact that many of these measures were parent-rated questionnaires primarily completed by mothers, which may lead to bias through maternal depression (Briggs-Gowan, Carter, & Schwab-Stone, 1996; Webster-Stratton & Lindsay, 1999) and social desirability (Crowne & Marlowe, 1960), the Beck Depression Inventory-II (BDI-II; Beck, Steer & Brown, 1996) and a short version of the Marlowe-Crowne Social Desirability Scale (MC-SDS; Reynolds, 1982) were included as control measures.[7]

The first hypothesis for this study was derived directly from Ayres' (1989) speculations about the relationship between DSI and EXT. It was that EXT would be significantly associated with tactile sensitivity, gravitational insecurity, and dyspraxia. The second hypothesis was derived from Frick et al.'s (1999) finding and stated that EXT would be related to parental involvement and inconsistent discipline. The final hypothesis was derived from the transactional effects model and stated that the association between DSI and EXT would be stronger with more negative parenting practices and less strong with more positive parenting practices.

[6] Unfortunately, participation rates for the teacher-rated CBCL were so poor that there were not enough data for use in statistical analyses.
[7] Participation rates for the control measures were also very low, which precluded their use in statistical analyses.

CHAPTER 2

METHODS

Participants

Participants were recruited from a private clinic outside of Boston, where families seek evaluations and treatment of DSI. In total, 57 children and their parents were recruited for this study. However, two children were administered an alternative to the SIPT more appropriate for very young children; two children did not complete the evaluations; one parent did not complete the CBCL at all; and two parents omitted so many items on the CBCL that they were unscorable. Finally, one 7-year-old boy was excluded because he had been held back in school and had a diagnosis of Pervasive Developmental Disorder. The number of participants used for analysis was thus reduced to 49.

Children's ages ranged from 4 to 9 years (M child age = 6.2 years, SD = 1.51). There were 36 boys and 13 girls. All but four of the parents who completed the questionnaires were female. All but two of the children were White. One child was bi-racial, and one child was of Asian descent and adopted by White parents at an early age. One other child was also adopted. Family socio-economic status (SES), as measured with the Hollingshead Two-Factor Index (Hollingshead & Redlich, 1958), ranged from upper-middle to upper class (M Hollingshead two-factor ISP = 19.18, SD = 5.80).

Consistent with the criteria used by Frick et al. (1999) to validate the Alabama Parenting Questionnaire, inclusion criteria for participation in this study

were: (a) the child must not have mental retardation, as evidenced by IQ scores below 70 or grade-level below age-expected norms, and (b) the reporting caregiver must have lived with the child for at least 1 month prior to the evaluation. Most of the children did not have IQ scores. However, all children except the one child mentioned above were in their age-expected grades. All parents had lived with the participating child for more than 1 month prior to the evaluation.

Measures

Child Behavior Checklist

The Child Behavior Checklist (CBCL; Achenbach, 1991a) is used to assess behavior problems in children ages 4 to 16. It contains 118 items rated on a Likert-type scale from 0 (not true) to 2 (very true). Higher scale scores indicate greater problems. It comes in three versions which differ by rater (parent, teacher, or clinician). As noted above, this study originally included both the parent-rated and teacher-rated versions (CBCL-TRF), but the CBCL-TRF was not used in the analysis because of the extremely poor return rate.

The CBCL produces two broadband scales, called Internalizing Problems and Externalizing Problems, and nine narrowband subscales. The Externalizing Problems scale is comprised of the Aggressive Behavior and Delinquent Behavior subscales. The Internalizing Problems scale consists of the Anxious/Depressed, Somatic Complaints, and Withdrawn subscales. There are

four other subscales unrelated to either broadband scale: Attention Problems, Social Problems, Thought Problems, and Sex Problems.

For the hypotheses of this study, scores on the Externalizing Problems broadband scale and its constituent parts, the Aggressive and Delinquent Behavior subscales, were used. The Externalizing Behavior Problems scale is associated with disruptive, acting-out behavior problems. Aggressive Behavior Problems is related to the clinical diagnosis of Oppositional Defiant Disorder and is associated with disobedience, tantrums, yelling, fighting, and other acts of negative emotive intensity. Delinquent Behavior Problems is associated with Conduct Disorder and is characterized by more deviant social behavior such as lying, cheating, stealing, and swearing.

The computer scoring program, Assessment Data Manager (version 1.0; Achenbach, 1999), was used to calculate scale scores, which are reported as age-normed t-scores. However, raw scores for each scale were used for statistical analysis in this study because Achenbach (1991b) specifically recommended the use of raw scores in research.[8] Larger scores indicate greater problems.

The CBCL is a widely used and well-standardized rating scale for behavior problems. The internal consistency of the syndrome scales is fairly high, which is not surprising given that the scales were originally derived from principal components analyses. Cronbach's alpha for boys 4 to 11 years old were .93 for

Externalizing Problems, .74 for Delinquent Behavior, and .92 for Aggressive Behavior. For girls, alphas were either the same or different by only .01 (Achenbach, 1991b). One week test-retest reliability was also high and significant at less than .01 (mean rs were .93 for Externalizing Problem, .86 for Delinquent Behavior, and .91 for Aggressive Behavior). Content validity is supported by the fact that nearly all items on the CBCL discriminate between demographically matched clinic referred and nonreferred children. Construct validity is supported by the high concurrent correlations between the CBCL and the Conners' Parent Rating Scale (rs = .67 to .86) and the Quay-Peterson Revised Behavior Problem Checklist (rs = .59 to .88).

For this sample, Cronbach's alpha for both boys and girls combined was .48 for Delinquent Behavior, .84 for Aggressive Behavior, and .85 for Externalizing Problem.[9]

Alabama Parenting Questionnaire

The Alabama Parenting Questionnaire (Frick, 1991; see Appendix A) was specifically designed to measure parenting practices related to child behavior problems. It contains 42 items rated along a 5-point frequency scale (never, almost never, sometimes, often, and always). The items are grouped into six scales: parental involvement, positive parenting, poor monitoring/supervision,

[8] Statistical analyses were run to explore whether t-scores might produce different results. This analysis is noted in the Results chapter.
[9] The internal consistency for the Delinquent scale is much lower than Achenbach's. One possible reason for this difference is that delinquent behavior problems do not typically become a

inconsistent discipline, corporal punishment, and other discipline practices. The last scale, other discipline practices, was not used for analyses because its items were simply intended to hide or embed the items for corporal punishment in order to reduce an implicit negative bias towards the corporal punishment items. The poor monitoring/supervision scale was also omitted from analyses because a few of its items were not valid for younger children (e.g., "Your child stays out in the evening past the time he/she is supposed to be home;" see Appendix B), which led many parents to simply leave these items blank.

The APQ comes in multi-method and multi-informant formats: parent and child rated, paper and pencil global report forms that asks about parenting in general, and parent and child telephone interview formats that asks about specific parenting behaviors in the past three days over the course of 2 to 4 weeks. Only the parent global report format was used in this study. The child and interview formats were not used for many reasons. First, Shelton, Frick and Wootton (1996) found that young children often applied a response set on all items in the interview format. Second, the Inconsistent Discipline and Corporal Punishment scales, as measured in the interview format, were highly significantly correlated with the social desirability index on the MMPI-2 ($p<.001$); whereas, on the global format only the Inconsistent Discipline scale produced a significant though much smaller correlation ($r=.24$, $p<.05$). To control for the effect of social desirability, a short version of the Marlow-Crowne Social Desirability Scale

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consistent clinical presentation until children are slightly older and entering adolescence.

(Reynolds, 1982) was used (see below). The exclusive use of the global report form is also justified by the fact that it was highly significantly correlated with the interview format for each parenting subscale (rs ranged from .30 to .55, all with p<.001) and because both formats were similarly capable of distinguishing between families of children with Disruptive Behavior Disorder diagnoses and control families.

The internal consistency of subscale scores on the parent global report format of the APQ has varied (Shelton et al., 1996). The Involvement and Positive Parenting subscales had good internal consistency with unstandardized alpha coefficients of .80. The Poor Monitoring/Supervision and Inconsistent Discipline subscales had fair internal consistency with unstandardized alpha coefficients of .67. But, the Corporal Punishment subscale had poor internal consistency with an unstandardized alpha coefficient of .46. Shelton et al. (1996) suggest that one reason for this poor internal consistency was the fact that this subscale consisted of only three items and a parent may be prone to using only one form of corporal punishment (e.g., spanking) versus another (e.g., slapping or hitting with an object). The child global report format produced a similar pattern of alpha coefficients ranging from .44 for Corporal Punishment and .72 for Involvement. For the sample from this current study, Cronbach's alphas were fairly similar: .67 for Involvement, .72 for Positive Parenting, .73 for Poor Monitoring/Supervision, .69 for Inconsistent Discipline, and .44 for Corporal Punishment.

The content validity of the APQ is supported by the fact that the parent report formats were able to distinguish between families of children with Disruptive Behavior Disorder diagnoses and control families. More specifically, Shelton et al. (1996) found that families of children with DBD diagnoses had elevations in many more negative parenting subscales as compared to control families, though they found no difference in the elevation of positive parenting subscales.

Marlowe-Crowne Social Desirability Scale

Given the possibility that parents may distort their ratings of parenting practices because of a desire to present a socially acceptable image, a short version of the Marlowe-Crowne Social Desirability Scale (MC-SDS; Crowne & Marlowe, 1960) created by Reynolds (1982) was administered as a control for social desirability.

The MC-SDS has been widely used in research to assess the impact of social desirability, defined as the need to respond in "culturally sanctioned ways" (Crowne & Marlowe, 1960) on self-report measures. It originally consisted of 33 true-false items, but over the years many researchers have developed short versions of the MC-SDS that pared away outdated items and also provided better factor analytic fit and similar internal consistency (Loo & Thorpe, 2000). Reynolds' (1982) 13-item short version was used in this study because it

provided the best factor analytic fit among all the short versions (Loo & Thorpe, 2000).

The validity of the original MC-SDS has been established through (a) correlations with other clinical measures of social desirability such as the Edwards Social Desirability Scale and the F, L, and K scales of the Minnesota Multiphasic Personality Inventory (Crowne & Marlowe, 1960), and (b) factor analytic studies of the short versions (Loo & Thorpe, 2000; Fischer & Fick, 1993) and comparison to random short forms (Silverstein, 1983). The reliability coefficients for Reynolds' (1982) short version range from .73 to .87. For the parents who completed the MC-SDS in this study (n = 26), Cronbach's alpha was low (.57).

Beck Depression Inventory-II

Because maternal depression may bias mother's ratings of the severity of child behavior problems and negativity of parenting practices (Briggs-Gowan, Carter, & Schwab-Stone, 1996; Webster-Stratton, 1988), the Beck Depression Inventory-II (BDI-II; Beck, Steer & Brown, 1996) was administered to control for this potential bias. However, because of poor response rate noted above, this variable was omitted from the main analyses.

The BDI-II is a widely used measure for major depression and has also been used in other studies attempting to control for the effect of maternal depression on rating scales (e.g., Moran, 2000; Webster-Stratton, 1988). The

second version is reviewed to be a significant improvement over the original BDI in all aspects including content, psychometric validity, and external validity (Arbisi, 1989). It retains the 21-item format rated on a Likert-type scale of not present (0) to severe (3) and has been revised to reflect the diagnostic criteria of the DSM-IV (APA, 1994).

Beck, Steer, and Brown (1996) report that internal consistency is quite high, with coefficient alphas at .92 for outpatients and .93 for a nonclinical sample. Test-retest reliability at a one-week interval was also quite high at .93. Concurrent validity was assessed by a moderately high correlation with the Beck Hopelessness Scale and the Hamilton Psychiatric Rating Scale for Depression-Revised in outpatient samples. Content validity was supported by the fact that outpatients had higher scores on the BDI-II than college students and individuals with mood disorders had higher scores than individuals with anxiety or adjustment disorders. Factor analysis also found two strong factors classified as Somatic-Affective and Cognitive. For the parents who completed the BDI-II in this study (n=26), Cronbach's alpha was .93, which is consistent with Beck et al. (1996).

Sensory Integration and Praxis Test

The Sensory Integration and Praxis Test (SIPT; Ayres, 1989) is the most widely used tool for identifying and measuring sensory discrimination and praxis in children ages 4 to nine years. It can only be administered and interpreted by

trained and certified occupational or physical therapists. It includes 17 tests which have been categorized into four overlapping groups: Form and Space Perception, Somatic and Vestibular Sensory Processing, Praxis, and Bilateral Integration and Sequencing (see Appendix C). The SIPT is scored through a computer program, which produces standard deviation (SD) and percentile scores for each test. Lower scores indicate poorer functioning in the relevant area. For this exploratory study, the primary analyses are based on SD scores from individual subtests.

With regards to reliability, the SIPT has high interrater reliability for each test (.94 to .99) and has acceptable test-retest reliability for all 17 tests (.69 to .90) except for four: Postrotary Nystagmus (.48), Kinesthesia (.50) and Localization of Tactile Stimuli (.53), and Figure-Ground Perception (.56). One reason for these low test-retest reliabilities, especially for Postrotary Nystagmus, is that the retest interval was only 1 to 2 weeks, which dramatically increases the possibility that retest scores improved through a practice effect (T. May-Benson, personal communication, April 2001). In fact, other studies found a much higher test-retest reliability (around .80) when using longer retest intervals (Ayres, 1975; Kimball, 1981; Punwar, 1982; Dutton, 1985; cited in Ayres, 1989). T. May-Benson (personal communication, April 2001) also reports that the low test-retest reliability is of less concern because these tests measure subtle neurological processes that fluctuate in terms of functional efficiency, as most neurocognitive processes does.

With regards to validity, Ayres (1989) provides 38 pages of research on the content, criterion-related, and construct validity of the SIPT. Criterion-related validity was addressed throughout the development of the SIPT and its predecessor, the Southern California Sensory Integration Tests (Ayres, 1980; cited in Ayres, 1989). Construct validity was supported through numerous factor analytic studies and cluster analyses that produced similar results.

Short Sensory Profile

The Short Sensory Profile (SSP; Dunn, 1999) is a parent-rated measure of sensory modulation designed for use with children ages 5 to 10 but also ages 3 to 4 though with different cut-scores. It is the short form of the Sensory Profile and was created to more specifically measure sensory sensitivities. Items from the SSP are grouped into seven scales: Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Under-Responsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, Visual/Auditory Sensitivity, and Total Sensory Problems. These scales are defined in Appendix D and listed with the items from the SSP associated with them. Each item is rated on a 5-point frequency scale from 1 (always) to 5 (never). Lower scores indicate greater sensory problems.

Test reliability for the SSP was reported only in terms of internal consistency (Cronbach's alpha). The alpha values for the various sections ranged from .70 to .90 (Dunn, 1999). Internal validity was examined through intercorrelations between SSP section scores. These correlations ranged from

.25 to .76. Construct validity was supported by demonstrating that children with abnormal electrodermal responses to sensory stimuli scored lower on all sections of the SSP compared to children with normal electrodermal responses.

For the sample from this study, Cronbach's alphas were: .82 for Tactile Sensitivity, .90 for Touch/Smell Sensitivity, .79 for Movement Sensitivity, .74 for Under-Responsive/Seeks Sensations, .63 for Auditory Filtering, .67 for Low Energy/Weak, .70 for Visual/Auditory Sensitivity, and .88 for Total Sensory Problems.

Evaluation Completion Form

The Evaluation Completion Form (ECF) was added as a clinician-rated measure of sensory modulation problems and gravitational insecurity. The ECF has six items related to sensory modulation problems (General State of Arousal, Tactile Modulation, Vestibular Modulation, Auditory Modulation, Visual Modulation, and Modulation of Multiple Inputs) and one item related to gravitational insecurity. Originally, these items were scored along a 3-point scale (1 = Definite Difficulty, 2 = Moderate Difficulty, 3 = No Problem), and clinicians had the option of using 1.5 or 2.5 to further differentiate their ratings, thus turning it into a 5-point scale. Two-thirds of the way through data collection, the clinic began to use a new version of the ECF that used a strict 4-point scale (1 = Definite Difficulty, 2 = Moderate Difficulty, 3 = Mild Difficulty, 4 = No Problem). This created a problem for how to create one comparable scale across all

subjects. This problem was solved by keeping the 4-point scale and converting the original 3-point (sometimes 5-point) scale as follows. The items labeled the same were directly converted (i.e., 1 remained 1 for Definite Difficulty, 2 remained 2 for Moderate Difficulty, and 3 became 4 for No problem). Then, 2.5, which originally indicated the middle ground between Moderate Difficulty to No Problem, was converted to 3 for Mild Difficulty; and 1.5 was converted to 1 for Definitely Difficulty. The rationale for this conversion was to remain as consistent with the labels for the ratings as possible. Scores for each item related to sensory modulation problems were summed to create a total ECF Sensory Problems score. Smaller numbers were indicative of greater problems.

In terms of reliability, the clinic performed a small analysis comparing the Total Sensory Modulation Problem Index scores for 10 subjects from two clinicians. The intraclass correlation coefficient between these two clinicians was reported at .98. In this study's sample, Cronbach's alpha was .80.

Procedures

Human subjects approval was obtained from the Institutional Review Board at the University of Massachusetts at Boston.

This study was undertaken in collaboration with the clinic for occupational therapy, who was engaged in their own research on DSI. For their own research purposes, this clinic was already collecting the majority of data used in this study, except for the MC-SDS, BDI-II and the CBCL-TRF. Therefore, the excluded measures were handed to volunteering parents in a separate packet along with

an informed consent form and an authorization form to allow clinic staff to contact the child's teacher to complete the CBCL-TRF.

When families arrived for DSI evaluations, clinic staff asked parents if they would volunteer to complete the two packets of questionnaires regarding research on DSI. Participation was completely voluntary, no monetary compensation was given, and clinic staff reassured parents that their decision to participate or not would in no way impact the quality of clinical care and services provided to the families.

Given the concern that participation rates for the second packet might be reduced by parents' concerns about their personal privacy, parents were informed in writing and in person that their answers to the control measures would not be shared with the clinic unless they explicitly gave written permission to do so. Parents also had the option of sealing the control questionnaires in the return envelope so that clinic staff would not have access to their responses. The consent forms were handed back to the clinic, who maintained them securely with their own records. This procedure was established so that this researcher would not have access to any identifying information and patient confidentiality could be maintained. If parents provided written consent to contact teachers to complete the CBCL-TRF, clinic staff mailed teachers a packet containing an introductory letter explaining the research project, a consent form, the CBCL-TRF, and a return envelope to be mailed back to the clinic. The clinic then handed this researcher the returned envelope without opening it.

The clinic also handed this researcher the completed questionnaires from the first packet to score and maintain in a computer database, results from the SIPT, which they scored themselves, relevant demographic information (e.g., age, gender, race, SES, etc.), and clinical ratings for sensory modulation problems. The CBCL was scored using the Assessment Data Manager-version 1.0 (Achenbach, 1999), while the APQ, Sensory Profile, BDI-II, and MC-SDS were scored by hand.

To protect confidentiality, parents and teachers were explicitly instructed to not place identifying information on the questionnaires, and all spaces and questions for identifying information were blacked out before being distributed. Finally, clinic staff scanned all questionnaires and other materials handed to this researcher for identifying information and erased that information if found. Ultimately, these procedures insured that no identifying information was made available to this researcher.

The participation rate on the control variables was extremely low. Out of the 49 participating parents, only 24 parents completed the BDI-II; 27 completed the MC-SDS; 10 parents authorized teacher contact; and 6 teachers actually returned the CBCL-TRF. One parent even wrote a note apologizing for not authorizing teacher contact but remaining firm in her decision to not do so. Because of the low return rates, these variables were omitted from the major analyses, though they were explored in terms of whether or not participating

parents differed significantly from non-participating parents (results of which are presented in the following chapter).

CHAPTER 3

RESULTS

These results are organized in three sections. The first section describes issues around participation rates, missing data, missing items, data screening, and preliminary analyses. The second section describes the analyses related to the study hypotheses. The third section presents post-hoc exploratory analyses to answer questions that arose during the course of analysis. An alpha level of .05 (2-tail) was used for all statistical tests.

Section 1: Data Screening, Demographic Variables, Missing Data

Preliminary Data Analysis

For the purpose of preliminary data screening and analysis, the dataset was first reviewed to insure proper data entry. Variable means, ranges, minimums, and maximums were examined to insure reasonableness.

Normality was tested using the Shapiro-Wilk Test for Normality and explored statistically and visually through analysis of skew, kurtosis, coefficients of variation, histograms and stem-and-leaf plots. Results from these analysis showed that many of the variables were not normally distributed and had significant skews and kurtosis (e.g., all CBCL scales, most SSP scales, and all ECF items). This result might be viewed as reasonable and expected given that many of the variables measure child problems and are not designed to result in normal distributions (i.e., “typical” functioning occurs at the end of the distribution

resulting in significant skew). Because of this lack normality, all bi-variate correlations were computed using Spearman rank correlations.

Outliers were examined visually through histograms, boxplots, and stem-and-leaf plots. Among all study variables, there were no extreme univariate outliers—defined as being 3 standard deviations away from the mean (Tabachnik & Fidell, 2001).

For the CBCL, recall that Achenbach (1991b) had recommended using raw scores instead of t-scores for research purposes. Before following this recommendation, statistical analyses were run to explore whether there were any differences in results when using raw scores versus t-scores. First, Spearman rank correlations were calculated between the raw scores and the t-scores. These correlations were extremely high ($r > .95$ for all correlations), suggesting that the two scores could be used interchangeably and produce similar correlations with other variables. Indeed, all study analyses were run using t-scores instead of raw scores and the results were nearly identical to the results using the raw scores. Therefore, raw scores were used for subsequent analysis.

Missing Data

To test whether parents who completed the control measures were different from parents who did not complete the control measures, t-tests comparing the two groups were performed. For the MC-SDS, there were no significant differences between the two groups on any demographic or main study variables. For the BDI-II, the only significant difference between the

children of parents who completed the BDI-II (n=24) versus the children of parents who did not do so (n=25) was found on the SIPT subtest Manual Form Perception (M(24) = -0.53, SD = 1.33; M(25) = 0.14, SD = 0.98; t = 2.03, p < .05). Most importantly, there were no differences between the parenting styles of those parents who did and did not complete the BDI-II. For the CBCL-TRF, the only significant difference between the children of parents who authorized teacher contact (n = 10) versus the children of parents who did not (n = 39) was found on the SIPT subtest Localization of Tactile Stimuli (M(10) = -0.84, SD = 1.12; M(39) = -0.07, SD = 0.76; t = 2.03, p < .01). At an alpha level of .05, the number of variables expected to produce significant results by chance alone was 2.45 for the 49 variables examined. Therefore, it was possible that the single significant differences found between the participants and non-participants for the BDI-II and CBCL-TRF groups were spurious. Furthermore, the means for each group were all still within the range of typical functioning (defined as -1 to 1), suggesting that the difference in scores do not have any clinical meaningfulness. For these reasons, it was concluded that the children with and without completed control measures were not meaningfully different so were grouped together for subsequent analyses.

Outside of the problem with participation on the control variables, there were also occasionally missing items on other measures in the final sample of 49 subjects. For the ECF, missing items were very infrequent. There were two instances of missing scores for Vestibular Modulation and one instance for Visual

Modulation. These items were replaced with an average score based on each individual total score divided by 6. For the CBCL, missing items were handled by the computer scoring program, which was able to produce all scale scores even for cases with missing items.

For the SIPT, some subtests for some children were either not completely administered or labeled “unscorable” by the software. Out of the 17 subtests, 15 subtests had 2 or less missing subtest scores. However, Postrotary Nystagmus had five missing subtest scores, and Localization of Tactile Stimuli had eight missing subtest scores. J. Koomar (personal communication, July 2003) explained that the greater number of missing scores for Postrotary Nystagmus (PRN) and Localization of Tactile Stimuli (LTS) might have been due to the fact that clinicians sometimes decide to not complete administration of these two tests if they notice that the child reacts with significant discomfort to them.

Given the possibility then that missing items on these two subtests might indicate vestibular and tactile defensiveness, respectively, t-tests comparing the children with and without missing scores were run using variables measuring vestibular and tactile sensitivities. For the PRN groups, no significant group differences were found on other measures of vestibular processing. For the LTS group, one significant difference was found on Graphesthesia ($M(8) = 0.37$, $SD = 1.03$; $M(41) = -0.62$, $SD = 1.26$; $t = 2.11$, $p < .05$), which suggested that the children with missing LTS scores actually performed better on this test than did children without. This finding contradicts speculations. Furthermore, the means

for each group were within the range of typical functioning, which suggests that this difference though statistically significant is not clinically meaningful. Therefore, children without scores on either PRN or LTS were not considered to be meaningfully different from children with scores on these tests, and missing subtest scores were replaced with across-subject means for each subtest.

For the SSP, there were no obvious or consistent patterns to the missing items. Missing items were replaced with a within-subject mean equal to the sum of the relevant scale score divided by the number of items in the scale.

For the APQ, many parents, especially parents of younger children, left items from the Poor Monitoring/Supervision scale blank. Some parents left as many as eight of these items blank. This occurred because many of the items for this scale were not relevant for younger children (e.g., “Your child stays out in the evening past the time he/she is supposed to be home,” or “Your child is out with friends you don’t know”). Therefore, this scale was not used for the testing of hypotheses. The only other item that was consistently left blank came from the Parental Involvement scale: “You help your child with his/her homework,” which was not relevant for some children who did not routinely have homework to do. This item was replaced with the mean of the each child’s Parental Involvement scale score.

Analysis of Demographic Variables

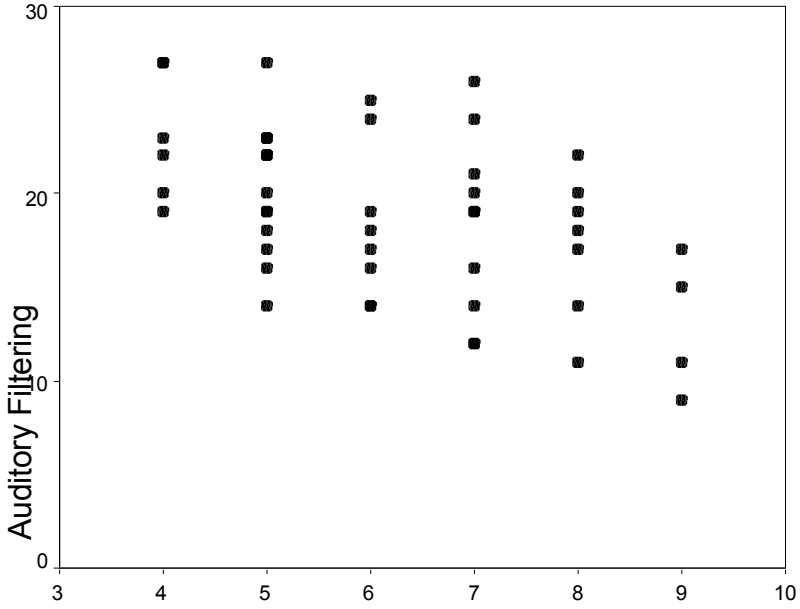
This section reports the analysis of demographic variables (SES, age and gender) as potential covariates in subsequent analyses. SES was ruled out as a

potentially significant covariate because of the major homogeneity of SES classifications for this sample (recall that the range of SES classifications was quite narrow, ranging from upper-middle to upper class (M Hollingshead two-factor ISP = 19.18, SD = 5.80)).

With regards to age, two analyses were performed. The first analysis examined whether 4-year-old children were significantly different from the children ages 5 to 9. The samples was divided into a 4-year-old group (n = 6) and a 5- to 9-year-old group (n = 43), and t-tests were computed on all study variables. Among all 49 variables tested, the two variables on which the two groups differed significantly were Attention Problems on the CBCL (M(6) = 4.33, SD = 2.58; M(43) = 8.77, SD = 4.97; t = -2.13, p < .05) and Auditory Filtering on the Short Sensory Profile (M(6) = 23, SD = 3.41; M(43) = 18.33, SD = 4.32; t = 2.54, p < .05). This result suggests that the 4-year-old children had worse attention problems but were less distracted by auditory stimuli. With regards to Attention Problems, the means and range of scores for both groups were within the range of typical functioning so were not considered to be clinically meaningful and reason enough to be cautious about adding the 4-year-old children to the sample. For Auditory Filtering, this argument could not be applied because the mean and range of scores fell within a range of clinical significance. However, an examination of age trends on Auditory Filtering, as seen in the scatterplot of Figure 1, showed that the scores for the 4-year-old children followed the trend

across ages that with increasing age, children performed worse on Auditory Filtering.

Figure 1
Scatterplot of Age and Auditory Filtering



Note. For Auditory Filtering, lower scores indicate greater problems.

Because the scores for the 4-year-old children were consistent with the age trend for the rest of the sample (ages 5 to 9), they were considered to fit the sample appropriately so were included for further analyses. Furthermore, to account for this noted age trend with Auditory Filtering, age was used as a covariate for analyses with Auditory Filtering.

To examine whether age as a scale variable might potentially serve as a significant covariate, Spearman rank correlations between age and all study variables were calculated (see Table 1).

Table 1
Correlations between Age and All Study Variables (N = 49)

	Age
Demographic Variables	
Gender	-.12
Child Behavior Checklist	
Withdrawn	.03
Somatic Problems	.02
Anxious/ Depressed	.16
Social Problems	.14
Thought Problems	.07
Attention Problems	.46**
Delinquent	-.01
Aggressive	-.04
Internalizing	.10
Externalizing	-.06
Alabama Parenting Questionnaire	
Parental Involvement	-.33*
Positive Parenting	-.14
Inconsistent Discipline	.05
Corporal Punishment	-.05
Short Sensory Profile	
Tactile Sensitivity	.00
Taste / Smell Sensitivity	-.01
Movement Sensitivity	-.03
Under-Responsive/Seeks Sensations	-.10
Auditory Filtering	-.50**
Low Energy	-.10
Visual / Auditory Sensitivity	-.12
Total Sensory Problems	-.19

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 1 (cont'd)

	Age
Sensory Integration and Praxis Tests	
Space Visualization	-.01
Figure Ground Perception	-.08
Manual Form Perception	.06
Kinesthesia	-.06
Finger Identification	-.07
Graphesthesia	-.08
Localization of Tactile Stimuli	.21
Praxis on Verbal Command	.05
Design Copy	.06
Constructional Praxis	.07
Postural Praxis	.28
Oral Praxis	.15
Sequencing Praxis	.01
Bilateral Motor Coordination	.04
Standing Walk Balance	-.15
Motor Accuracy	.19
Postrotary Nystagmus	.02
Evaluation Completion Form	
General State of Arousal	.07
Tactile Modulation	.23
Vestibular Modulation	-.23
Auditory Modulation	-.04
Visual Modulation	-.19
Multiple Input Modulation	.16
Total Sensory Modulation Problems	-.01
Gravitational Insecurity	-.20

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 1 shows that age was not correlated to most of the study variables. Most importantly, age was not significantly correlated to the delinquent, aggressive, and externalizing behavior problems scales, which supports the validity of using raw scores, as Achenbach (1991b) recommended. The only variables with which age was significantly correlated were parental involvement,

attention problems and auditory filtering, indicating that as age increased parental involvement decreased and problems with attention and auditory filtering increased. Therefore, age was included in subsequent analyses involving these variables.

To examine whether there were any significant gender differences in study variables, t-tests were calculated with all study variables, as shown in table 2.

Table 2
Gender Differences among All Variables (N = 49)

	Boys (n = 36) M (SD)	Girls (n = 13) M (SD)	t
Demographic Variables			
Age	6.31 (1.51)	5.92 (1.55)	0.78
SES	19.96 (5.70)	17.18 (5.84)	1.36
Child Behavior Checklist			
Withdrawn¥	3.50 (2.80)	3.92 (4.96)	-0.29
Somatic Problems	1.25 (1.52)	1.54 (2.26)	-0.51
Anxious/ Depressed	4.28 (4.08)	7.54 (6.97)	-2.02*
Social Problems	4.36 (2.99)	2.69 (2.36)	1.82
Thought Problems	1.78 (1.71)	1.77 (2.49)	0.01
Attention Problems	8.89 (5.28)	6.38 (3.38)	1.59
Delinquent	2.31 (2.10)	2.31 (3.04)	0.00
Aggressive	10.50 (6.79)	12.23 (9.13)	-0.72
Internalizing	8.83 (6.96)	13.00 (10.67)	-1.60
Externalizing	12.81 (8.32)	14.54 (12.00)	-0.57
Alabama Parenting Questionnaire			
Parental Involvement	41.50 (3.87)	42.23 (3.88)	-0.58
Positive Parenting	26.33 (2.29)	25.77 (2.89)	0.71
Inconsistent Discipline¥	12.75 (2.32)	12.77 (3.44)	-0.02
Corporal Punishment¥	3.42 (0.69)	3.77 (1.17)	-1.03

Note. All t-scores assume equal variance, except for the three variables marked with ¥.
*p < .05. **p < .01. (2-tailed)

Table 2 (cont'd)

	Boys (n = 36) M (SD)	Girls (n = 13) M (SD)	t
Sensory Integration and Praxis Test			
Kinesthesia	-0.40 (0.93)	0.18 (1.03)	-1.85
Finger Identification	-0.23 (1.23)	-0.10 (1.13)	-0.33
Graphesthesia	-0.74 (1.21)	0.31 (1.13)	-2.74**
Localization of Tactile Stimuli	-0.17 (0.86)	0.04 (1.06)	-0.70
Praxis on Verbal Command	-0.20 (1.17)	-0.20 (0.91)	-0.01
Design Copy	-0.49 (1.37)	-0.64 (1.51)	0.31
Constructional Praxis	-0.26 (0.98)	-0.41 (0.87)	0.47
Postural Praxis	-0.64 (1.30)	-1.11 (1.34)	1.11
Oral Praxis	-0.49 (1.10)	-0.62 (1.27)	0.34
Sequencing Praxis	-0.35 (0.97)	0.35 (0.94)	-2.26*
Bilateral Motor Coordination	0.02 (1.00)	-0.54 (0.76)	1.85
Standing Walk Balance	-1.01 (1.07)	-0.94 (1.36)	-0.19
Motor Accuracy	0.02 (1.05)	-0.07 (1.27)	0.24
Postrotary Nystagmus	-0.43 (1.00)	0.07 (0.88)	-1.60
Short Sensory Profile			
Tactile Sensitivity	27.58 (5.59)	27.62 (5.30)	-0.02
Taste / Smell Sensitivity	15.28 (3.98)	14.92 (5.25)	0.25
Movement Sensitivity	12.47 (2.44)	12.38 (2.90)	0.11
Under-Responsive/Seeks Sensations	23.17 (4.79)	25.23 (6.06)	-1.24
Auditory Filter	18.67 (4.17)	19.54 (5.33)	-0.60
Low Energy	21.25 (7.26)	19.08 (8.22)	0.89
Visual / Auditory Sensitivity	17.69 (3.37)	17.31 (4.05)	0.34
Total SSP Sensory Problems	136.11 (18.34)	136.08 (21.33)	0.01
Evaluation Completion Form			
General State of Arousal	1.94 (0.83)	2.54 (0.88)	-2.19*
Tactile Modulation	1.89 (0.89)	2.00 (0.71)	-0.41
Vestibular Modulation	2.36 (1.02)	3.08 (0.95)	-2.21*
Auditory Modulation	1.86 (0.80)	2.15 (0.99)	-1.06
Visual Modulation	1.92 (0.87)	2.77 (1.01)	-2.89**
Multiple Input Modulation	1.75 (0.81)	1.85 (0.69)	-0.38
Total ECF Sensory Problems	11.72 (3.96)	14.38 (2.50)	-2.26*
Gravitational Insecurity	3.44 (0.97)	3.31 (0.86)	0.45

Note. All t-scores assume equal variance, except for the three variables marked with ¥.
*p < .05. **p < .01. (2-tailed)

The significant gender differences shown on Table 2 suggest that boys were viewed as having greater attention problems, sensory discrimination and possibly sensory modulation problems (as measured on Graphesthesia), poorer ability to remember and repeat motor sequences (Sequencing Praxis), greater difficulties with regulating arousal, greater vestibular and visual sensitivities, and more overall sensory modulation problems. These gender differences are consistent with the general finding that boys have more subtle difficulties in many areas of functioning. This point is highlighted by the fact that there were nearly 3 times as many boys than girls in the sample, which is also typical of similar research with this age group. Given these gender differences, gender was used as a control variable for analyses using those variables with significant gender differences. Gender was not included as a covariate for all analyses because it did not produce significant differences on most variables. To verify that gender as a covariate would not have an impact on other correlations, peripheral analyses including gender as a covariate were run and compared to correlations without gender as a covariate (see Appendix E). These analyses confirmed that gender as a covariate had minimal effect on all bi-variate correlations.

Section 2: Results by Hypotheses

This section reports the results of this study organized around the original hypotheses.

Hypothesis 1

The first hypothesis was that EXT would be significantly associated with tactile sensitivity, gravitational insecurity, and dyspraxia. Tactile sensitivity was measured on both the SSP and ECF (labeled Tactile Modulation). Gravitational insecurity was measured with the Movement Sensitivity scale of the SSP and the Gravitational Insecurity item from the ECF. To explore their association with EXT, Spearman rank correlations were computed between EXT and the relevant scales. Table 3 displays the correlations between EXT and all scales of the SSP and ECF.

Table 3
Correlations between Externalizing Behavior Problems (EXT) and Scales from the Short Sensory Profile and Evaluation Completion Form (N = 49)

	EXT
Short Sensory Profile	
Tactile Sensitivity	-.41**
Taste / Smell Sensitivity	-.06
Movement Sensitivity	.01
Under-Responsive / Seeks Sensations	-.39**
Auditory Filtering	-.33*
Low Energy / Weak	-.03
Visual / Auditory Sensitivity	-.20
Total SSP Sensory Problems	-.36*
Evaluation Completion Form	
General State of Arousal	-.22
Tactile Modulation	-.40**
Vestibular Modulation	-.02
Auditory Modulation	-.17
Visual Modulation	-.24
Modulation of Multiple Inputs	-.28*
Total ECF Sensory Problems	-.29*
Gravitational Insecurity	.17

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Tables 3 shows that EXT was significant correlated to tactile sensitivity as measured by both the SSP and the ECF, which directly supports the hypothesis that greater problems in tactile sensitivity would be associated with greater externalizing behavior problems. With alpha set at .05 (2-tail), the power of both correlations were .85. However, EXT was not significantly correlated with gravitational insecurity as measured by the Movement Sensitivity scale of the SSP or the Gravitational Insecurity item of the ECF, which does not support this part of the first hypothesis.

With regards to the other correlations in Table 3, EXT was significantly correlated with Under-Responsive/Seeks Sensations, Auditory Filtering and Modulation of Multiple Inputs, which suggest that greater behavior problems are associated with excessive desire to seek sensory stimulation, difficulty ignoring auditory distractions or paying attention when hearing background noise, and difficulty modulating sensory experiences from multiple inputs. The other non-significant correlations shown in Table 3 suggest that child behavior problems are not related to taste/smell sensitivities, auditory or visual modulation problems, or low energy levels/poor muscle tone.

Dyspraxia was measured with the following subtests of the SIPT: Praxis on Verbal Command, Design Copying, Constructional Praxis, Postural Praxis, Oral Praxis, Sequencing Praxis, and Bilateral Motor Coordination. To examine the relationship between EXT and dyspraxia, EXT was correlated with the subtests of the SIPT (see Table 4).

Table 4
Correlations between Externalizing Behavior Problems (EXT) and Subtests from the Sensory Integration and Praxis Tests (SIPT) (N = 49)

Sensory Integration and Praxis Tests	EXT
Space Visualization	.20
Figure-Ground Perception	-.09
Manual Form Perception	.00
Kinesthesia	.38**
Finger Identification	.20
Graphesthesia	.15
Localization of Tactile Stimuli	-.17
Praxis on Verbal Command	.10
Design Copying	.20
Constructional Praxis	.37**
Postural Praxis	-.06
Oral Praxis	-.18
Sequencing Praxis	.05
Bilateral Motor Coordination	.08
Standing Walking Balance	.18
Motor Accuracy	.13
Postrotary Nystagmus	.13

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 4 shows that all subtests related to praxis except for Constructional Praxis were not significantly correlated to EXT, which does not provide strong support for the hypothesized association between EXT and dyspraxia. Furthermore, the direction of the correlation between EXT and Constructional Praxis was opposite to the hypothesis and suggested that child behavior problems were associated with *better* scores on this test of praxis. Kinesthesia, a test of sensory discrimination was the only other SIPT subtest correlated with EXT, and it too was in a surprising direction. Further analyses to explore these

surprising findings, including examination of means and clinical significance, were run and reported in the Exploratory Analyses section of the Results.

Hypothesis 2

The second hypothesis stated that EXT would be moderately correlated with parental involvement and inconsistent discipline. To test this hypothesis, Spearman rank correlations were run between EXT and the scales of the APQ. These correlations are displayed in Table 5.

Table 5
Correlations between Externalizing Behavior Problems (EXT) and Scales from the Alabama Parenting Questionnaire (APQ) (N = 49)

APQ Scales	EXT
Parental Involvement	-.34*
Positive Parenting	.00
Inconsistent Discipline	.09
Corporal Punishment	.14

Note. Correlations are Spearman rank correlations.
*p < .05. (2-tailed)

As shown in Table 5, hypothesis 3 was only partially supported in that Parental Involvement but not Inconsistent Discipline was significantly correlated with EXT. The direction of the correlation with Parental Involvement suggests that greater child behavior problems are associated with less parental involvement. Given that age was found to be significantly correlated with Parental Involvement in the preliminary analyses, a partial correlation between EXT and Parental Involvement was calculated controlling for age. This correlation was also significant ($pr(46) = -.35$, $p < .05$).

Hypothesis 3

The final hypothesis was that the association between DSI and EXT would be stronger with more negative parenting practices and weaker with more positive parenting practices. To test this hypothesis, the relevant child and parent variables with significant correlations to EXT were selected for a hierarchical regression analysis. These variables were Parental Involvement and Tactile Sensitivity. Because tactile sensitivity was measured using both the SSP and the ECF and produced similar correlations with EXT, two separate regression models were created, using each measure of tactile sensitivity separately. Because age was significantly correlated with Parental Involvement, age was also included in the regression model. The analyses consisted of hierarchical regressions in which age, Parental Involvement and Tactile Sensitivity were entered into the model in Step 1, and the interaction variable, Parental Involvement X Tactile Sensitivity, was entered in Step 2. Table 6 presents the summary of the hierarchical regression using Tactile Sensitivity from the SSP. Table 7 presents the hierarchical regression using Tactile from the ECF.

Table 6
Summary of Hierarchical Regression Analysis for Variables Predicting Externalizing Behavior Problems Using Tactile Sensitivity from the Short Sensory Profile (SSP) (N = 49)

Variable	B	SE B	β
Step 1			
Age	-0.75	0.84	-0.12
Parental Involvement	-0.92	0.33	-0.38**
SSP Tactile Sensitivity	-0.68	0.22	-0.40**
Step 2			
Age	-0.78	0.86	-0.13
Parental Involvement	-1.46	2.07	-0.60
SSP Tactile Sensitivity	-1.52	3.18	-0.89
SSP Tactile Sensitivity X Parental Involvement	0.00	0.07	0.54

Note. R^2 = .28 for Step 1 ($p < .01$); ΔR^2 = .00 for Step 2 ($p = .79$).
*$p < .05$. ** $p < .01$. (2-tail)

Table 7
Summary of Hierarchical Regression Analysis for Variables Predicting Externalizing Behavior Problems Using Tactile Modulation from the Evaluation Completion Form (ECF) (N = 49)

Variable	B	SE B	β
Step 1			
Age	-0.51	0.86	-0.08
Parental Involvement	-0.89	0.34	-0.35*
ECF Tactile Modulation	-4.13	1.45	-0.37**
Step 2			
Age	-0.56	0.87	-0.09
Parental Involvement	-0.33	0.85	-0.13
ECF Tactile Modulation	10.03	20.78	0.90
ECF Tactile Modulation X Parental Involvement	-0.34	0.50	-1.30

Note. R^2 = .26 for Step 1 ($p < .01$); ΔR^2 = .01 for Step 2 ($p = .50$).
*$p < .05$. ** $p < .01$. (2-tail)

Results from the hierarchical regressions shown in Tables 6 and 7 do not support the hypothesis that the interaction of parental involvement and tactile sensitivity would significantly predict EXT (ΔR^2s = .00 & .01). However, one must be cautious about drawing conclusions from these results because the sample size for this regression model was too low to produce adequate power. Tabachnik and Fidell (2001) note that regression analyses of this type generally require that the sample size follow this equation: $N \geq 50 + 8M$ (where *M* is the number of independent variables). With four independent variables (including the interaction variable), an adequate sample would have at least 82 subjects.

Section 3: Exploratory Analyses

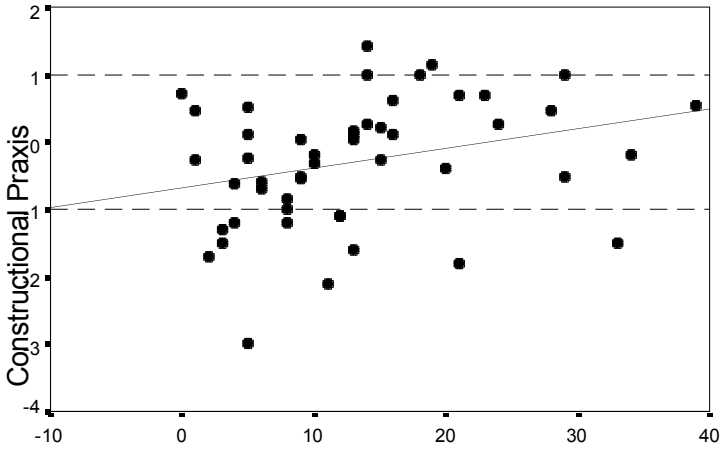
This section reports the results from post hoc exploratory analyses for the questions that arose as a result of the main analyses but were outside the focus of the main hypotheses.

Exploration of Constructional Praxis and Kinesthesia

Further exploration of the association between EXT and Constructional Praxis and Kinesthesia were performed because of the surprising finding that greater behavior problems were associated with better performance on these subtests. First, a visual exploration was performed by examining the scatterplots for relationships between these subtests and EXT (figures 2 and 3).

Figure 2

Scatterplot of Constructional Praxis and Externalizing Behavior Problems

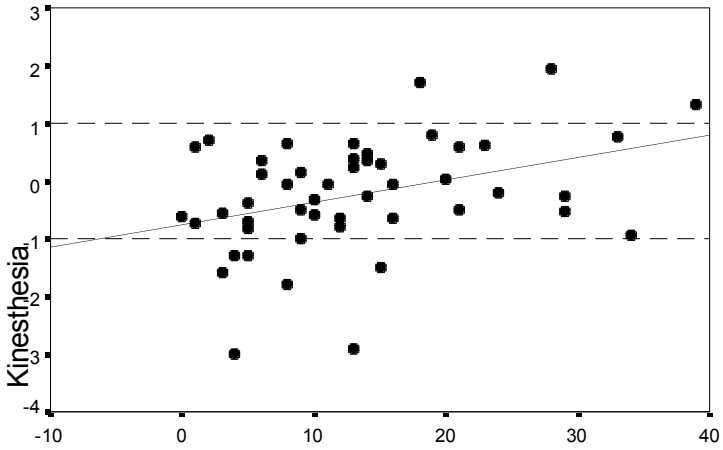


Note: Solid line represents the regression line.

Dashed lines mark the range for typical functioning.

Figure 3

Scatterplot of Kinesthesia and Externalizing Behavior Problems



Note: Solid line represents the regression line.

Dashed lines mark the range for typical functioning.

Figures 2 and 3 suggest that the correlations of EXT with Constructional Praxis and Kinesthesia appeared to be valid and not the by-products of extreme bi-variate outliers.

Next, the correlation matrix for the subtests of the SIPT and all scales of the CBCL was examined to determine whether Constructional Praxis and Kinesthesia were related to other scales of the CBCL in a surprising direction and whether there were other SIPT subtests with unexpected directions in their correlations with CBCL scales. This correlation matrix is presented in Table 10.

Table 8
Correlations between the Subtests of the Sensory Integration and Praxis Tests (SIPT) Subtests and Scales of the Child Behavior Checklist (CBCL) (N = 49)

	CBCL Scales			
SIPT Subtests	Withdrawn	Somatic Problems	Anxious/ Depressed	Social Problems
Space Visualization	.13	-.01	.07	-.10
Figure Ground Perception	.03	.09	.07	-.16
Manual Form Perception	.13	.13	.03	-.14
Kinesthesia	.03	-.03	.18	-.14
Finger Identification	-.04	-.07	.05	.00
Graphesthesia	-.03	.06	.14	-.07
Localization of Tactile Stimuli	.13	.06	-.04	-.07
Praxis on Verbal Command	-.02	.10	-.09	.02
Design Copy	.09	-.16	.11	.12
Constructional Praxis	.14	-.12	.07	-.03
Postural Praxis	.01	.01	.01	-.16
Oral Praxis	.00	-.06	-.10	-.13
Sequencing Praxis	-.15	-.01	.08	-.09
Bilateral Motor Coordination	.01	.02	-.01	-.06
Standing Walking Balance	-.06	-.04	.17	.03
Motor Accuracy	.11	.04	.11	-.02
Postrotary Nystagmus	-.24	-.21	-.06	-.05

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 8 (cont'd)

	CBCL Scales			
SIPT Subtests	Thought Problems	Attention Problems	Delinquent	Aggressive
Space Visualization	-.06	-.21	.27	.15
Figure Ground Perception	-.04	-.29*	-.06	-.08
Manual Form Perception	.18	-.01	-.09	.00
Kinesthesia	.06	-.22	.36*	.38**
Finger Identification	-.10	-.18	.21	.15
Graphesthesia	-.21	-.29*	.14	.13
Localization of Tactile Stimuli	-.06	-.29*	.00	-.21
Praxis on Verbal Command	-.19	-.24	.19	.04
Design Copy	-.03	.05	.15	.20
Constructional Praxis	-.11	-.07	.32*	.34*
Postural Praxis	-.14	-.19	.12	-.11
Oral Praxis	-.19	-.25	-.15	-.17
Sequencing Praxis	-.12	-.19	.15	.03
Bilateral Motor Coordination	-.05	-.06	.13	.05
Standing Walking Balance	-.07	-.08	.29*	.15
Motor Accuracy	.09	.17	.18	.11
Postrotary Nystagmus	-.24	.02	.15	.11

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 8 shows that Constructional Praxis and Kinesthesia were not significantly related to any other scales of the CBCL. Among the correlations of other SIPT tests, there were only four SIPT subtests with significant relationships to other CBCL scales. One of these correlations was between Standing Walking Balance and Delinquent Behavior Problems (r_s = .29, p < .05), which was also in the opposite direction to expectations. The other three significant correlations were between Attention Problems and Graphesthesia (r_s = -.29, p < .05), Localization of Tactile Stimuli (r_s = -.29, p < .05), and Standing Walking Balance (r_s = .29, p < .05). The last correlation was also in the opposite direction to expectations. These results do not help explain the unusual correlations of EXT with Constructional Praxis and Kinesthesia.

Analysis of Delinquent and Aggressive Behavior problems

Next, the subscales of EXT, Delinquent (DEL) and Aggressive (AGG) Behavior problems, were separately analyzed to examine whether there were any differences in their patterns of correlations with the other study variables. First, the correlation between DEL and AGG was examined to assess the strength of their relationship, because if they were highly collinear then finding differences in their relationships to other variables would be less likely. Their correlation was quite large and highly significant (r_s = .68, p < .01), suggesting that large correlational differences were not likely to be found. Nevertheless, Spearman rank correlations were calculated with AGG, DEL and all study

variables to examine the pattern of correlations with all study variables (see Table 9).

Table 9
Correlations of the Aggressive and Delinquent Behavior scales with All Study Variables (N = 49)

	Aggressive	Delinquent
Alabama Parenting Questionnaire		
Parental Involvement	-.30*	-.38**
Positive Parenting	.02	-.09
Inconsistent Discipline	.11	-.04
Corporal Punishment	.17	.07
Sensory Integration and Praxis Tests		
Space Visualization	.15	.27
Figure Ground Perception	-.08	-.06
Manual Form Perception	.00	-.09
Kinesthesia	.38**	.36*
Finger Identification	.15	.21
Graphesthesia	.13	.14
Localization of Tactile Stimuli	-.21	.00
Praxis on Verbal Command	.04	.19
Design Copy	.20	.15
Constructional Praxis	.34*	.32*
Postural Praxis	-.11	.12
Oral Praxis	-.17	-.15
Sequencing Praxis	.03	.15
Bilateral Motor Coordination	.05	.13
Standing Walk Balance	.15	.29*
Motor Accuracy	.11	.18
Postrotary Nystagmus	.11	.15

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 9 (cont'd)

	Aggressive	Delinquent
Short Sensory Profile		
Tactile Sensitivity	-.44**	-.22
Taste / Smell Sensitivity	-.04	-.14
Movement Sensitivity	.03	-.06
Under-Responsive / Seeks Sensations	-.43**	-.19
Auditory Filter	-.35*	-.23
Low Energy	-.05	.01
Visual / Auditory Sensitivity	-.21	-.07
Total SSP Sensory Problems	-.39**	-.21
Evaluation Completion Form		
General State of Arousal	-.23	-.11
Tactile Modulation	-.40**	-.25
Vestibular Modulation	.01	-.16
Auditory Modulation	-.15	-.09
Visual Modulation	-.27	-.15
Multiple Input Modulation	-.29*	-.20
Total ECF Sensory Problems	-.28	-.25
Gravitational Insecurity	.15	.06

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 9 shows that there were in fact some variables for which one of the Externalizing Behavior subscales had a significant relationship and the other did not. The significances of the correlational differences were analyzed using a single-sample dependent differences statistic calculated using a computer program found on the website Simple Interactive Statistical Analysis (http://home.clara.net/sisa/corrhlp.htm). None of the correlational differences were large enough to be significant.

Correlational Analyses with Internalizing Behavior Problems

As part of post-hoc exploratory analyses, the Internalizing Behavior Problems scale from the CBCL was correlated to all major study variables. Table 10 shows these correlations with INT and includes the correlations with EXT as a reference.

Table 10
Correlations of Internalizing (INT) and Externalizing (EXT) Behavior Problems with Scales of the Short Sensory Profile (SSP) (N = 49)

	INT	EXT
Alabama Parenting Questionnaire		
Parental Involvement	-.25	-.33*
Positive Parenting	-.02	.00
Inconsistent Discipline	.13	.09
Corporal Punishment	.07	.14
Sensory Integration and Praxis Tests		
Space Visualization	.11	.20
Figure Ground Perception	.10	-.09
Manual Form Perception	.10	.00
Kinesthesia	.14	.38**
Finger Identification	.01	.20
Graphesthesia	.09	.15
Localization of Tactile Stimuli	.05	-.17
Praxis on Verbal Command	-.02	.10
Design Copy	.07	.20
Constructional Praxis	.05	.37**
Postural Praxis	-.04	-.06
Oral Praxis	-.08	-.18
Sequencing Praxis	.02	.05
Bilateral Motor Coordination	-.03	.08
Standing Walk Balance	.05	.18
Motor Accuracy	.13	.13
Postrotary Nystagmus	-.15	.13

Note. Correlations are Spearman rank correlations.
*p < .05. **p < .01. (2-tailed)

Table 10 (cont'd)

	INT	EXT
Short Sensory Profile		
Tactile Sensitivity	-.55**	-.41**
Taste / Smell Sensitivity	-.12	-.06
Movement Sensitivity	-.15	.01
Under-Responsive / Seeks Sensations	-.06	-.39**
Auditory Filter	-.35*	-.33*
Low Energy	-.37**	-.03
Visual / Auditory Sensitivity	-.34*	-.19
Total SSP Sensory Problems	-.54**	-.36*
Evaluation Completion Form		
General State of Arousal	-.09	-.22
Tactile Modulation	-.20	-.40**
Vestibular Modulation	.16	-.02
Auditory Modulation	-.06	-.17
Visual Modulation	-.01	-.24
Multiple Input Modulation	-.10	-.28*
Total ECF Sensory Problems	-.02	-.29*
Gravitational Insecurity	-.11	.17

Note. Correlations are Spearman rank correlations.
*$p < .05$. **$p < .01$. (2-tailed)

Examining the correlations of INT with other study variables, the only variables significantly related to INT were scales from the SSP. The correlations of INT with SSP were slightly different in profile compared to the correlations of EXT with SSP. The major difference was that INT alone was significantly correlated to Low Energy/Weak and EXT alone was significantly correlated to Under-Responsive/Seeks Sensations. However, these correlational differences were not statistically significant though they were reasonable considering that the Low Energy/Weak scale referred to behaviors reflecting poor endurance and tiring easily, which overlaps with some of the INT symptoms on the CBCL and

Under-Responsive/Seeks Sensations refers to more active, out-of-control and excessive behaviors. Unlike with EXT, INT was significantly correlated to tactile sensitivity as measured on the SSP but not as measured on the ECF.

Associations between Measures of Sensory Integration Dysfunction

Finally, post-hoc analyses end with an examination of the correlations between the SIPT and SSP for the purpose of convergent validity (Table 11). However, the SIPT and SSP measure different aspects of sensory processing (sensory discrimination and praxis versus sensory modulation) so one would not expect a strong association between their scores. According to the SIPT manual (Ayres, 1989), there are two correlations that one might expect to be significant. Standing Walking Balance, which tests a child's sense of balance, might be related to gravitational insecurity as measured by Movement Sensitivity. Localization of Tactile Stimuli might be related to tactile sensitivity because of the nature of the tactual stimulus used for testing.

Table 11
Correlations Between the Sensory Integration and Praxis Tests (SIPT) and the Short Sensory Profile (SSP) (N = 49)

	SSP Scales			
SIPT Subtests	Tactile Sensitivity	Taste / Smell Sensitivity	Movement Sensitivity	Under-Responsive / Seeks Sensations
Space Visualization	-.06	-.08	-.03	.05
Figure Ground Perception	-.05	-.08	.25	.14
Manual Form Perception	-.01	.08	-.07	.03
Kinesthesia	-.09	-.10	.08	.15
Finger Identification	.02	.17	.17	.01
Graphesthesia	.13	.01	.12	.30*
Localization of Tactile Stimuli	-.02	.09	.03	.21
Praxis on Verbal Command	.13	-.09	.07	.12
Design Copy	-.33*	-.10	-.07	-.09
Constructional Praxis	-.07	.01	-.02	-.02
Postural Praxis	.13	.05	.09	-.04
Oral Praxis	-.10	-.04	.11	.32*
Sequencing Praxis	-.11	-.14	.03	.15
Bilateral Motor Coordination	.06	-.13	.27	.03
Standing Walking Balance	-.10	-.06	.15	-.10
Motor Accuracy	-.25	-.17	-.07	.04
Postrotary Nystagmus	.15	.05	.13	-.03

Note. Correlations are Spearman rank correlations.
*$p < .05$. (2-tailed)

Table 11 (cont'd)

	SSP Scales			
SIPT Subtests	Auditory Filter	Low Energy / Weak	Visual / Auditory Sensitivity	Total Sensory Problems
Space Visualization	.14	.18	-.01	.08
Figure Ground Perception	.14	.26	.07	.16
Manual Form Perception	.06	-.08	.05	.00
Kinesthesia	.15	.01	.01	.02
Finger Identification	-.03	.06	-.01	.12
Graphesthesia	.21	.18	.09	.26
Localization of Tactile Stimuli	-.02	.07	-.05	.05
Praxis on Verbal Command	.18	.05	.20	.23
Design Copy	-.11	.10	-.25	-.14
Constructional Praxis	.09	.17	.12	.12
Postural Praxis	.01	.18	.10	.19
Oral Praxis	.18	.14	.02	.21
Sequencing Praxis	.09	.03	.00	.05
Bilateral Motor Coordination	.04	.22	.12	.18
Standing Walking Balance	.01	.29*	.10	.09
Motor Accuracy	-.12	-.02	-.20	-.12
Postrotary Nystagmus	-.11	.16	.11	.11

Note. Correlations are Spearman rank correlations.
*p < .05. (2-tailed)

The correlations in Table 11 do not support the expected correlations. Standing Walking Balance was not correlated with Movement Sensitivity (r_s = .15), nor was Localization of Tactile Stimuli correlated with Tactile Sensitivity (r_s = -.02). The only significant correlations were between Design Copy and Tactile Sensitivity (r_s = -.33, $p < .05$), Graphesthesia and Under-Responsive / Seeks Sensations (r_s = .30, $p < .05$), Oral Praxis and Under-Responsive / Seeks Sensations (r_s = .32, $p < .05$), and Standing Walking Balance and Low Energy / Weak (r_s = .29, $p < .05$). These correlations do not have any obvious meaning and do not theoretically support convergent validity of the SIPT and SSP.

CHAPTER 4

DISCUSSION

The purpose of this exploratory study was to examine whether externalizing behavior problems (EXT) were associated with sensory integration dysfunction (DSI), particularly in the realms of tactile sensitivity, gravitational insecurity and dyspraxia as speculated by Ayres (1989), and parenting practices. It was hypothesized that (1) EXT would be significantly associated with tactile sensitivity, gravitational insecurity and dyspraxia, (2) EXT would be significantly associated with parental involvement and inconsistent discipline, and (3) the significant DSI and parenting variables would interact such that the strength of association between EXT and DSI would be stronger with more negative parenting practices and weaker with more positive parenting practices.

Results from this study provided partial support for the first and second hypotheses and suggested that child behavior problems were associated with tactile sensitivity but not gravitational insecurity or dyspraxia and with parental involvement but not inconsistent discipline. Furthermore, the regression model that tested the third hypothesis did not support the hypothesized interaction effect.

The significant association between EXT and tactile sensitivity was consistent with Ayres' (1964) early speculations that tactile sensitivity might be associated with aggressive behavior problems because the tactile system was closely involved with an organism's fear and safety system. In other words,

dysregulation of the tactile system might cause an organism to misperceive touch sensations as threats to bodily integrity and react aggressively or defensively to that misperception.

Furthermore, the significant association between EXT and the SSP measure of total sensory modulation problems was consistent with the findings of Miller and her colleagues (Miller et al., 2001; Mangeot et al., 2001; McIntosh et al., 1999), who also found significant correlations using the same measures. The results of this study add to Miller et al.'s findings and support the validity of the parent-rated SSP in the fact that the clinician rating for total sensory modulation problems (ECF) also produced a similar result.

Tying these results back to a more theoretical neurodevelopmental perspective, the stronger association between aggressive behavior problems and tactile sensitivity might make sense as a disruption in the development emotion regulation, as regulated by the medial aspect of the prefrontal cortex. Neuropsychiatrists such as Schore (1994) and Siegel (1999) have recently integrated the latest research from neurobiology and neuro-imaging studies to argue that early parent-infant relationships directly shape neurophysiologic development and ultimately help to determine an individual's neurophysiologically-based capacities for emotion regulation. Siegel states that the medial aspect of the prefrontal cortex is important for many important emotional, behavioral and interpersonal functions relevant to this study. He states that these functions mature and come "on-line" at different developmental

stages. The first of these functions/stages is regulation and registration of the body (i.e., effective sensory processing). Then, follows attuned communication, regulation of emotion, response flexibility (executive function), social cognition, autonoesis (also called “autobiographical knowing”), extinction of fear, and morality. This developmental model appears to be quite similar to Kopp’s (1982, 1989) developmental model with the neurological findings that implicate the involvement of the medial aspect of the prefrontal cortex in this developmental process.

With regards to the surprising correlations of EXT with Constructional Praxis and Kinesthesia, which are subtests related to praxis and sensory discrimination, respectively, the reasons for these contrary relationships remained unclear. They may have just been the by-product of experiment-wise Type I error, which was quite high given the fact that there were 17 subtests for the SIPT. If a standard Bonferonni adjustment were made to the alpha level, then alpha would be set to 17/.05 = .003, and these correlations would not have remained significant. Other evidence to suggest that these findings were either suspect or limited in their generalizability was that other measures of praxis and sensory discrimination did not produce significant correlations to EXT.

As for EXT and parenting practices, the significant negative correlation between child behavior problems and parental involvement was consistent with Frick et al. (1999). However, unlike Frick et al., this study did not find a significant relationship between child behavior problems and inconsistent discipline. One

possible source for this lack of association may have been a difference in the nature of referrals and sample demographic characteristics between this study and Frick et al.'s. This sample consisted of families seeking evaluation and treatment for sensory integration issues who come from an upper-middle to upper class, New England background. The sample from Frick et al.'s study consisted of families seeking evaluation and treatment for behavioral, emotional, or learning problems who live in a rural to semi-rural southern region of the United States.

Examining the items that comprise each scale of the APQ (see Appendix B), it is interesting to note that the Parental Involvement scale refers to parental participation and interest in the child's daily life; whereas, the other parenting scales used in this study (Positive Parenting, Inconsistent Discipline, and Corporal Punishment) refer to parental management of child behaviors. Though not directly justified, one might speculate that, as compared to the other parenting scales which refer to child behavior management, parental involvement might be more closely associated with having a friendly relationship with one's child (i.e., playing games with one's child, being interested in one's child's friendships and school life, and actively volunteering and participating in one's child's special activities) and thus possibly with having a better understanding of one's child. If this speculation were true, then the result that only parental involvement was associated with child behavior problems in this sample would be consistent with Ayres' (1989) statement that parental patience and

understanding of a child's sensory processing difficulties might help prevent these difficulties from escalating into behavior problems.

Finally, with regards to the lack of support for the interaction hypothesis, no confident conclusions to support or discount this hypothesis could be drawn given the lack of power in the regression model due to the small sample size.

Limitations

There were several limitations in this study. First, the size of the sample was much lower than planned, which compromised the power of this study and limited the ability to run multivariate regression analyses. Nevertheless, the main bi-variate correlations of EXT with tactile sensitivity and parental involvement had sufficient power (above .80). Second, the very narrow demographic characteristics of this small sample limited the generalizability of these findings. Third, the small number of girls in the study prevented analysis of whether or not the gender differences found remained significant and undermined analyses using gender as a covariate. However, this appears to be a common problem for research studying mental health problems in young children.

The more important sampling problem was the very low participation rate in completing the two control measures and the teacher-rated CBCL. These measures were originally included to control for the potential impact of maternal depression and social desirability on parent ratings of their child's problematic behaviors and their own parenting practices. The teacher-rated CBCL was included to overcome shared method variance and have another rating of child

behavior problems. Because these measures were not able to be collected, the problems that they were meant to address remained limitations in this study.

There were also limitations in the measures used for this study. The Alabama Parenting Questionnaire had many items that asked about parenting behaviors that were not relevant for the youngest children in this sample. Therefore, the Poor Monitoring/Supervision scale had to be omitted from data analysis. The Short Sensory Profile contained items that appeared to significantly overlap with items from the Child Behavior Checklist. This problem, along with the problem of shared method variance, called for caution and conservatism in drawing valid conclusions from these results.

Future Research

Future studies would benefit from addressing the limitations noted above. For example, one might supplement parent-rated questionnaires with data from observational methods. One might create an experimental situation in which parents are asked to interact with their child and expose him or her to various sensory experiences that test for sensory modulation problems. These interactions could be videotaped for subsequent analysis of the parent-child interactions during situations that challenge a child's sensory processing. These studies might also more directly test the theories about the etiology of behavior problems by including tests that challenge and assess the child's frustration tolerance and response flexibility. Adaptations of various neuropsychological instruments such as the Wisconsin Card Sort or the Continuous Performance

Test might serve as such measures of frustration tolerance and response flexibility.

Conclusion

In conclusion, the findings from this study, though tentative, ultimately advance the two-pronged goal of (a) helping to investigate those pejorative attitudes and beliefs about children with behavior problems that appear to be so common in society and exacerbate the very behavior problems that are the target of such criticism and (b) providing evidence to support those more recent clinical interventions that acknowledge and address the child deficits that appear to underlie many instances of child behavior problems.

APPENDIX A

Alabama Parenting Questionnaire

Instructions: The following are a number of statements about your family. Please rate each item as to how often it TYPICALLY occurs in your home. The possible answers are Never (1), Almost (2), Sometimes (3), Often (4), and Always (5). PLEASE ANSWER ALL ITEMS.

	Never	Almost Never	Sometimes	Often	Always
1. You have a friendly talk with your child.	1	2	3	4	5
2. You let your child know when he/she is doing a good job with something.	1	2	3	4	5
3. You threaten to punish your child and then do not actually punish him/her.	1	2	3	4	5
4. You volunteer to help with special activities that your child is involved in (such as sports, boy/girl scouts, church youth groups).	1	2	3	4	5
5. You reward or give something extra to your child for obeying you or behaving well.	1	2	3	4	5
6. Your child fails to leave a note or to let you know where he/she is going.	1	2	3	4	5
7. You play games or do other fun things with your child.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
8. Your child talks you out of being punished after he/she has done something wrong.	1	2	3	4	5
9. You ask your child about his/her day in school.	1	2	3	4	5
10. Your child stays out in the evening past the time he/she is supposed to be home.	1	2	3	4	5
11. You help your child with his/her homework.	1	2	3	4	5
12. You feel that getting your child to obey you is more trouble than it's worth.	1	2	3	4	5
13. You compliment your child when he/she does something well.	1	2	3	4	5
14. You ask your child what his/her plans are for the coming day.	1	2	3	4	5
15. You drive your child to a special activity.	1	2	3	4	5
16. You praise your child if he/she behaves well.	1	2	3	4	5
17. Your child is out with friends you don't know.	1	2	3	4	5
18. You hug or kiss your child when he/she has done something well.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
19. Your child goes out without a set time to be home.	1	2	3	4	5
20. You talk to your child about his/her friends.	1	2	3	4	5
21. Your child is out after dark without an adult with him/her.	1	2	3	4	5
22. You let your child out of a punishment early (like lift restrictions earlier than you originally said).	1	2	3	4	5
23. Your child helps plan family activities.	1	2	3	4	5
24. You get so busy that you forget where your child is and what he/she is doing.	1	2	3	4	5
25. Your child is not punished when he/she has done something wrong.	1	2	3	4	5
26. You attend PTA meetings, parent/teacher conferences, or other meetings at your child's school.	1	2	3	4	5
27. You tell your child that you like it when he/she helps out around the house.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
28. You don't check that your child comes home at the time she/he was supposed to.	1	2	3	4	5
29. You don't tell your child where you are going.	1	2	3	4	5
30. Your child comes home from school more than an hour past the time you expect him/her.	1	2	3	4	5
31. The punishment you give your child depends on your mood.	1	2	3	4	5
32. Your child is at home without adult supervision.	1	2	3	4	5
33. You spank your child with your hand when he/she has done something wrong.	1	2	3	4	5
34. You ignore your child when he/she is misbehaving.	1	2	3	4	5
35. You slap your child when he/she has done something wrong.	1	2	3	4	5
36. You take away privileges or money from your child as a punishment.	1	2	3	4	5
37. You send your child to his/her room as a punishment.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
38. You hit your child with a belt, switch, or other object when he/she has done something wrong.	1	2	3	4	5
39. You yell or scream at your child when he/she has done something wrong.	1	2	3	4	5
40. You calmly explain to your child why his/her behavior was wrong when he/she misbehaves.	1	2	3	4	5
41. You use time out (make him/her sit or stand in a corner) as a punishment.	1	2	3	4	5
42. You give your child extra chores as a punishment.	1	2	3	4	5

Appendix B

Items of the Alabama Parenting Questionnaire Organized by Scale

Parental Involvement

1. You have a friendly talk with your child.
4. You volunteer to help with special activities that your child is involved in (such as sports, boy/girl scouts, church youth groups).
7. You play games or do other fun things with your child.
9. You ask your child about his/her day in school.
11. You help your child with his/her homework.
14. You ask your child what his/her plans are for the coming day.
15. You drive your child to a special activity.
20. You talk to your child about his/her friends.
23. Your child helps plan family activities.
26. You attend PTA meetings, parent/teacher conferences, or other meetings at your child's school.

Positive Parenting

2. You let your child know when he/she is doing a good job with something.
5. You reward or give something extra to your child for obeying you or behaving well.
13. You compliment your child when he/she does something well.
16. You praise your child if he/she behaves well.
18. You hug or kiss your child when he/she has done something well.
27. You tell your child that you like it when he/she helps out around the house.

Poor Monitoring / Supervision

6. Your child fails to leave a note or to let you know where he/she is going.
10. Your child stays out in the evening past the time he/she is supposed to be home.
17. Your child is out with friends you don't know.
19. Your child goes out without a set time to be home.
21. Your child is out after dark without an adult with him/her.
24. You get so busy that you forget where your child is and what he/she is doing.
28. You don't check that your child comes home at the time she/he was supposed to.
29. You don't tell your child where you are going.
30. Your child comes home from school more than an hour past the time you expect him/her.
32. Your child is at home without adult supervision.

Inconsistent Discipline

3. You threaten to punish your child and then do not actually punish him/her.
8. Your child talks you out of being punished after he/she has done something wrong.
12. You feel that getting your child to obey you is more trouble than it's worth.
22. You let your child out of a punishment early (like lift restrictions earlier than you originally said).
25. Your child is not punished when he/she has done something wrong.
31. The punishment you give your child depends on your mood.

Corporal Punishment

33. You spank your child with your hand when he/she has done something wrong.
35. You slap your child when he/she has done something wrong.
38. You hit your child with a belt, switch, or other object when he/she has done something wrong.

APPENDIX C

Brief Descriptions of the Tests of the Sensory Integration and Praxis Test

(Excerpted from Ayres, 1989)

The Form and Space Perception Tests

Space Visualization

This test assesses visual space perception and mental manipulation. It uses four egg-shaped blocks, four diamond-shaped blocks, and two plastic formboards. Pegs are inserted into the formboards in different locations to create different test items. For each item the child is presented with one formboard and two blocks, only one of which fits into the formboard. The child must choose one of the two blocks and place it in the formboard.

Figure-Ground Perception

This test assesses the child's ability to separate a foreground figure from rival background. All stimulus figures are line drawings and the child must point to the correct figure embedded in rival incorrect figures.

Manual Form Perception

This two-part test assesses the child's ability to perceive the form of an object through active tactile and kinesthetic perception alone. In the first part, the child touches an object and then points to its visual counterpart. In the second part, the child touches an object in one hand and then selects with the other hand the same object out of five choices.

Motor Accuracy

This test measures visuomotor coordination. The child draws a red line over a heavy, curved, black line using both preferred and non-preferred hands alternately.

The Somatic and Vestibular Sensory Processing Tests

Kinesthesia

This test measures the child's kinesthetic perception. With the child's vision occluded by a shield, the examiner places the child's finger on Point A, then

moves that finger to Point B and back to Point A. Then, the child is instructed to return the finger to Point B. Items on this test are performed alternating between hands.

The Tactile Tests: Finger Identification, Graphesthesia, and Localization of Tactile Stimuli

These three tests measure tactile perception. In Finger Identification, the child is asked to identify the finger(s) previously touched by the examiner. In Graphesthesia, the child is asked to trace a design that the examiner traced on the back of the child's hand. In Localization of Tactile Stimuli, the child places his or her finger on the spot on the child's hand or arm that the examiner touched previously.

Postrotary Nystagmus

This test assesses the integrity of the vestibular system. The child sits on a nystagmus board which the examiner rotates by hand for 10 rotations in 20 seconds. Then the examiner measures the duration of the child's oculomotor reflex (nystagmus).

Standing and Walking Balance

This test evaluates the child's ability to balance on one or both feet, both statically and dynamically, with eyes open and closed.

The Praxis Tests

Design Copying

This test measures the child's ability and planfulness in accurately copy a series of geometric designs.

Postural Praxis

This test measures the child's ability to assume and hold different postures demonstrated by the examiner.

Praxis on Verbal Command

Similar to Postural Praxis this test asks the child to assume and hold different postures but only guides the child with verbal commands rather than demonstrations by the examiner.

Constructional Praxis

This test uses building blocks. The child is asked to duplicate structures first created by the examiner.

Sequencing Praxis

This test requires that the child remember and execute a series of movements demonstrated by the examiner. Each movement consists of either tapping the table, the other hand, or the head with the hand or forearm.

Oral Praxis

This test requires that the child imitate the examiner's movements of the tongue, teeth, lips, cheeks, or jaw.

The Bilateral Integration and Sequencing Tests
Oral Praxis, Sequencing Praxis, Graphesthesia, and Standing and Walking Balance, discussed above, are also used to assess bilateral integration and sequencing.

Bilateral Motor Coordination

This test requires that the child imitate smoothly executed movements with both hands and both feet.

Appendix D

Description of the Short Sensory Profile

Below are the definitions for the scales that comprise the Short Sensory Profile (Dunn, 1999). Underneath each scale are the items from the Sensory Profile used to calculate each scale, numbered according to the original numberings in the Sensory Profile.

Tactile Sensitivity The child's response to touch experiences in daily life.

30 Expresses distress during grooming (e.g., fights or cries during haircutting, face washing, fingernail cutting).
31 Prefers long sleeved clothing when it's warm or short sleeved clothing when it's cold.
35 Avoids going barefoot especially in sand or grass.
36 Reacts emotionally or aggressively to touch.
37 Withdraws from splashing water.
38 Has difficulty standing in line or close to others.
39 Rubs or scratches out a spot which has been touched.

Taste/Smell Sensitivity The child's response to taste and smell experiences in daily life.

55 Avoids certain tastes/smells that are typically part of children's diets.
56 Will only eat certain tastes.
57 Limits self to particular food textures/temperatures.
58 Picky eater, especially regarding textures.

Movement Sensitivity The child's response to movement experiences in daily life.

18 Becomes anxious or distressed when feet leave ground.
77 Fears falling or heights.
19 Dislikes activities where head is upside down (i.e., somersaults) or rough housing.

Under-Responsive/Seeks Sensations The child's level of noticing sensory events in daily life.

8 Enjoys strange noises/seeks to make noise for noise sake.
24 Seeks all kinds of movement and this interferes with daily routines.

89 Becomes overly excitable after a movement activity.
45 Touches people and objects.
46 Doesn't seem to notice when face or hands are messy.
123 Jumps from one activity to another so frequently it interferes with play.
53 Leaves clothing twisted on body.

Auditory Filtering The child's ability to use and screen out sounds in daily life.

4 Is distracted or has trouble functioning if there is a lot of noise around.
6 Appears not to hear what you say.
5 Can't work with background noise (i.e., fan, refrigerator).
3 Has trouble completing tasks when the radio is on.
7 Doesn't respond when name is called but you know the child's hearing is OK.
48 Difficulty paying attention.

Low Energy/Weak The child's ability to use muscles to move in daily life.

69 Seems to have weak muscles.
67 Tires easily, especially when standing or holding particular body position.
70 Has a weak grasp.
71 Can't lift heavy objects.
72 Props to support self (even during activity).
73 Poor endurance/tires easily.

Visual/Auditory Sensitivity The child's response to sounds and sights in daily life.

1 Responds negatively to unexpected or loud noises (i.e., vacuum cleaner, dog barking, hairdryer).
2 Holds hands over ears to protect from sound.
14 Is bothered by bright lights after others have adapted to the light.
98 Watches everyone when they move around the room.
15 Covers eyes or squints to protect eyes from lights.

Appendix E

Analyses Controlling for Gender

Below are the results of the correlational analyses from the study but controlling for gender throughout.

Table 12
Correlations of All Study Variables with Externalizing Behavior Problems (EXT) with and without Gender as a Covariate (N = 49)

	EXT	
	Without Gender	With Gender
Alabama Parenting Questionnaire		
Parental Involvement	-.33*	-.33*
Positive Parenting	.00	-.03
Inconsistent Discipline	.09	.16
Corporal Punishment	.14	.22
Sensory Integration and Praxis Tests		
Space Visualization	.20	.13
Figure Ground Perception	-.09	-.05
Manual Form Perception	.00	-.12
Kinesthesia	.38**	.37*
Finger Identification	.20	.19
Graphesthesia	.15	.15
Localization of Tactile Stimuli	-.17	-.24
Praxis on Verbal Command	.10	.06
Design Copy	.20	.16
Constructional Praxis	.37**	.30*
Postural Praxis	-.06	-.03
Oral Praxis	-.18	-.17
Sequencing Praxis	.05	.10
Bilateral Motor Coordination	.08	.01
Standing Walk Balance	.18	.21
Motor Accuracy	.13	.08
Postrotary Nystagmus	.13	.12

Note. Correlations without gender are Spearman rank correlations. Correlations with gender are partial correlations.
*p < .05. **p < .01. (2-tailed)

Table 12 (cont'd)

	EXT	
	Without Gender	With Gender
Short Sensory Profile		
Tactile Sensitivity	-.41**	-.40**
Taste / Smell Sensitivity	-.06	-.14
Movement Sensitivity	.01	-.06
Under-Responsive / Seeks Sensations	-.39**	-.46**
Auditory Filter	-.33*	-.36*
Low Energy	-.03	-.02
Visual / Auditory Sensitivity	-.19	-.21**
Total SSP Sensory Problems	-.36*	-.41**
Evaluation Completion Form		
General State of Arousal	-.22	-.24
Tactile Modulation	-.40**	-.39**
Vestibular Modulation	-.02	.01
Auditory Modulation	-.17	-.16
Visual Modulation	-.24	-.26
Multiple Input Modulation	-.28*	-.28
Total ECF Sensory Problems	-.29*	-.30*
Gravitational Insecurity	.17	.13

Note. Correlations without gender are Spearman rank correlations. Correlations with gender are partial correlations.
*p < .05. **p < .01. (2-tailed)

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