Differential Treatment of Toddlers with Sensory Processing Disorders in Relation to Their Temperament and Sensory Profile

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Abstract: *The major question posed in the current study was how temperament and sensory processing variables predict maternal behavior in interactions with toddlers identified as having sensory processing disorders. Participants were 49 mothers and infants with sensory processing disorders. They were videotaped in a free-play interaction. Observations were coded using general interaction criteria and criteria of teaching behavior (mediation). A clear distinction was found between temperament characteristics of children whose sensory processing was identified as sensory seeking or sensory avoiding. The main difference between them was their emotional behavior. High levels of sensory seeking were related to a high activity level and positive affect, whereas high levels of sensory avoiding were related to low levels of positive affect and high levels of anger. It was found that children's temperament and sensory profiles were related to the profile of their mother's mediation.*

One of the major findings of this study was that children's level of activity may not be related to maternal behavior. This trait is represented in two distinguishable groups of children for whom high activity levels are related to different neuro-physiological causes—a group of children whose high level of activity is caused by sensory avoidance and another group whose high activity level is related to sensory seeking.

Introduction

There is no question today that both child and parent variables play a significant role in weaving the complex pattern of child development. The question in recent studies is no longer which of these two sets of variables has more of an effect than the other, but rather which specific child variables relate to which specific parent variables, thus affecting the interactions or transactions between them and consequently shaping child development. There is a considerable amount of research on children's temperament. In fact, it is one of the most researched child variables, following age and gender. Temperament represents typical characteristics of children's behavior across different contexts and is, at least partially, genetically determined. In view of the growing awareness that the quality of adult-child interactions affects social-emotional and cognitive development, the effect of temperament on parent-child interactions has been studied extensively (Barton & Robins, 2000; Kochanska, Aksan, & Joy, 2007; Rothbart & Bates, 2006).

Following the classical longitudinal studies on temperament by Thomas, Chess and Birch (1968), temperament has been assessed and studied in a variety of ways. The basic assumption underlining all of them is that temperamental traits, which are genetically based, determine the characteristic patterns of responding to environmental experiences as well as regulating inner sensations and creating patterns of interpersonal relations. Temperament has been defined as an expression of biologically based individual differences in the basic functioning of the central nervous system, particularly in relation to the individual's ability for self-regulation (Rothbart, 1981). In line with this definition, temperament variables may be at least partially expressed in terms of sensory processing variables (Barton & Robins, 2000).

Sensory processing refers to the brain's ability to receive sensory information from the environment, combine it with internal sensory information from the body (e.g., movement, balance and touch), and process it into a coherent understanding of what is going on in a given situation and what is the appropriate response (Ayres, 1979; Bundy & Murray, 2002; Kandel, Schwartz, & Jessell, 2000). Self-regulation is a complex ability developing rapidly in the first two years of life when infants are faced with the need to process sensory information, regulate their emotions and behavior via this incoming sensory information, and respond appropriately (Ayres, 1979; DeGangi, 2000; Dunn, 1997; Miller & Lane, 2000; Miller, Reisman, McIntosh, & Simon, 2001; Miller & Summers, 2001). Self-regulation is related to physiological factors including arousal, attention, affect, and action (Dunn, 1997; Williamson & Anzalone, 2000), as well as to environmental variables, particularly those related to caregivers' sensitivity and responsivity to the child (DeGangi, 2000; Zero to Three, 2005). There is growing evidence that interpersonal relations, particularly mother-child early relations, may have a marked effect on children's ability to process sensory information, to maintain a well regulated, positive emotional state, and to develop the ability for future regulation of emotion and behavior (Dunn, 2002; Greenspan & Wieder, 1998; Zero to Three, 2005).

Regulation of behavior has been identified as one of the best predictors of children's cognitive and social-emotional learning (Blair, 2002). Difficulties in sensory processing and self-regulation are related to a wide range of behavior disorders including attention deficits, temper tantrums, and social isolation (Barton & Robins, 2000). Young children with sensory-processing and self-regulation disorders have been found to have difficulties in social, emotional, cognitive and sensory-motor development (Case-Smith, Butcher, & Reed, 1998; DeGangi, 2000; Dunn, 1997; Greenspan & Wieder, 1998) and are at risk for non-optimal development (DeGangi, Breinbauer, Doussard-Roosevelt, Porges, & Greenspan, 2000; DeSantis, Coster, Bigsby, & Lester, 2004) There is an urgent need for early interventions that target these toddlers' mal-adaptive behavior and enhance their developmental outcome. Identifying parental behavior that meets the toddlers' special sensory and regulatory needs should be a focus for such intervention.

Most educators and other professionals working with young children commonly use temperament variables to describe individual differences between children. Temperament variables describe patterns of behavior, but hardly suggest information about what may cause those patterns of behavior. Thus, temperament variables may not provide information that would be sufficient for constructing intervention programs that may enhance interaction with children, particularly those with sensory processing disorders. Better understanding of the interplay between temperament and sensory processing to patterns of mother-child relationships is needed.

The general objective of the current study was to examine the relations between infants' sensory processing variables and their temperament variables in relation to their mothers' interaction with them. The specific objective of the study was to examine possibilities of differential treatment of children with various sensory-processing disorders, as reflected in their mothers' play with them.

Most studies of mother-child interactions focus on general factors such as sensitivity and responsivity, synchrony, or mutual organization, intrusiveness etc. The current study incorporates a double focus both on the general interaction variables and on the maternal pattern of teaching behavior (Klein, Wieder, Greenspan, & 1987; Klein, 1996; Klein, 2006).

Method

Participants

The participants were 49 infants and toddlers with sensory processing disorders. They were healthy, full-term infants with no medical problems or developmentally clear and defined problems (i.e., cerebral palsy, metabolic problems, or genetic syndromes such as Down's syndrome, etc.).

The infants and toddlers ranged in age between 13–19 months and 53% of them were boys. Most of the participants were first born (57%) and were only children (55%). The mothers' age ranged between 21–40 years and their education was mostly above high school; 51% were university graduates, 14% had some college education, and 35% were high school graduates.

The diagnosis of sensory processing disorders was based on the following three measures: Infant/Toddler Symptom Checklist (DeGangi, Poisson, Sickel, & Wiener, 1995); Sensory Profile (Dunn, 2002) and the Test of Sensory Function in Infants (TSFI), (DeGangi & Greenspan, 1989).

In the current study, children were identified as having sensory processing disorders when they were identified as "at risk" on at least two of these three measures.

The following are definitions of criteria for children's sensory processing (Dunn, 2002).

Sensory seeking refers to the child's behavior that represents his attempts to compensate for high neurological

thresholds (under-sensitivity). It is expressed in active behavior in order to get intensive sensory input that the child misses due to his high thresholds.

Sensory avoiding refers to the child's behavior that represents her attempts to compensate for her low neurological thresholds (over-sensitivity) by acting in a non-adaptive manner in order to avoid threatening situations.

Sensitivity to stimuli refers to the child's behavior that is caused by low neurological thresholds (over-sensitivity). Children who have sensory sensitivity tend to be distracted easily and may display hyperactivity.

Poor registration refers to high neurological thresholds (under-sensitivity). In this case, the child is missing basic sensory input that he needs in order to engage himself in an adaptive response. These children tend to appear uninterested, overly tired, self-absorbed and can have flat or dull affect.

Measures

In addition to the three measures of sensory processing used in the process of selecting the participants in this study, the children's temperament was assessed using the Toddler Behavior Assessment Questionnaire (TBAQ) (Goldsmith, 1994), yielding measures of activity level, joy, social anxiety, anger, and interest.

Mother-child interactions were assessed based on the analysis of videotaped interactions during free play. Mothers were instructed to play with their children as they normally do at home. The interactions were analyzed using two measures:

- The CIB—Coding of Interactive Behavior (Keren, Feldman, & Tyano, 2001), focusing on maternal sensitivity and responsivity, intrusiveness, mutual organization, and the child's positive involvement. Due to the low level of consistency, the factor of child's positive involvement was eliminated from the analysis.
- The OMI—Observing Mediational Interactions, focusing on maternal teaching behavior (Klein, 1996; Klein & Alony, 1993; Klein, Wieder & Greenspan, 1987). The OMI yielded measures of five major variables: Focusing, Affecting, Expanding, Encouraging, and Regulation of Behavior. For an overview of the developmental mediation approach, including the variables of teaching behavior (mediation) in adult-child interaction see Klein's article on the literacy of interaction (2006). Although well known in educational research, these criteria have not been previously used in research within this context. Thus, the basic criteria of mediation behavior are presented as follows.

Focusing. Any act or a sequence of acts that appears to be directed toward affecting a child's perception or behavior. Examples include bringing objects closer to the child; exaggerating or accentuating sights, sounds, or fragrances; moving objects; and covering up distracting stimuli to assure that the child focuses on others. These behaviors are considered as focusing only when they are reciprocal, i.e., when the child responds, vocally, verbally, or nonverbally.

Affecting (Exciting). This is behavior that expresses verbal or nonverbal meaning and significance, excitement, appreciation, or affect in relation to people, animals, objects, actions, or any form of cultural content. For example, the mother might say, "Wow, what a beautiful bird," "This is an interesting story about a little girl," or "This pen is very special. It belonged to your grandfather."

Expanding. This is behavior directed toward the expansion of a child's cognitive awareness, beyond what is necessary to satisfy the immediate need that triggered the interaction. For example, the caregiver might talk to the child about the origin of different types of food while feeding, or relating to the temperature of the water or to the specific fragrance of the soap while bathing the child.

Encouraging. This is verbal or nonverbal behavior that expresses satisfaction with a child's behavior and that identifies a specific component or components of the child's behavior which contribute to the experience of success. For example, the mother might say, "Very good, Dan, you have used all these colors," or "Good boy, you have packed every toy back into its box."

Regulation of Behavior. These are behaviors that model, demonstrate, and/or verbally suggest to the child regulation of behavior in relation to the specific requirements of a task, or to any other cognitive process required prior to overt action. The caregiver suggests the need to think or plan before doing, for example, "Be careful now, slowly, gently" or "Let's see, what do we put on first, the boots or the pants?" or "First, we look for all the pieces that have the picture of a dog and then we are going to see if they fit in here."

Two graduate students were trained over a period of three months until reliability of over .85 was reached. Inter-rater reliability for both measures ranged between .85 and .92 for all the categories observed.

Procedure

Mothers of all participants were approached by the medical staff of public infant health centers in the munic-

Table 1.

Pearson correlations between temperament variables and sensory processing variables

	Sensory Processing			
Temperament	**Poor Registration**	**Sensory Seeking**	**Sensitivity to Stimuli**	**Sensory Avoiding**
Activity level	.25	.37**	–.09	–.02
Anger (negative affect)	.18	.19	.07	.27**
Joy (positive affect)	–.07	.50***	–.08	–.36*
Social Anxiety	–.16	–.19	.10	.19

*p<.05, **p<.01, ***p<.001

ipality of the city of Tel-Aviv, located in the urban central region of Israel. The public health nurses handed out questionnaires describing infants' behavior in relation to sensory processing in everyday interactions involved in caregiving and play. This questionnaire served as an initial screening tool for the identification of children with sensory processing disorders. Mothers of all children with a score of 6 or higher on this questionnaire (namely, children with significantly more than average problems involving sensory regulation) were invited for a follow-up and further evaluation. Mothers who agreed to participate (85% of the mothers) were invited to come with their children for the two additional assessments of sensory processing.

Infants and toddlers whose difficulties regulating behavior were identified as related to sensory processing disorders were chosen as potential participants in the study. Most (92%) of the mothers of these children agreed to participate in the study.

Children identified on the two measures as having sensory processing disorders were videotaped interacting with their mothers in a 10-minute free-play situation. The observation was carried out in the child health center. A 10-minute time unit was found to represent the major characteristics of the interaction as efficiently as much longer observation periods of two hours or more (Klein, 1988; Klein & Alony, 1993).

The observation room was carpeted. A box of toys was placed in the center of the room. The box contained a doll, small plastic feeding utensils, a ring tower, a small picture book, a toy telephone on wheels, and a simple wooden puzzle of basic geometric forms. Mothers were given the following instructions: "play with your child as you normally play with him/her at home."

Results

In Table 1, we see several statistically significant relations between temperament and sensory processing variables. Children rated high on sensory seeking were found to rate high on activity level as well as on positive affect; whereas sensory-avoiding children were characterized by low frequencies of positive affect and much negative affect. The mothers' general behavior in interactions with their toddlers did not seem to be related to their ratings of their infants' temperament (see Table 2); however, their teaching behavior did relate significantly to their ratings of their children's affect (see Table 3).

In Table 3, the toddlers' high level of negative affect (anger) was found to coincide with high levels of focusing (directing the child's attention), and low levels of affecting (expressing meaning and significance of things). A high level of positive affect was related to high levels

Table 2.

Correlations between sensory processing variables and general criteria of mother-child interaction (CIB).

Sensory Processing	**Sensitivity/ Responsivity**	**Mutual Organization**	**Positive Involvement**
Poor Registration	–.13	–.21	–.04
Sensory Seeking	–.01	.09	–.11
Sensitivity to Stimuli	.00	.05	–.02
Sensory Avoiding	–.04	–.08	–.11

Table 3.

Correlations between temperament variables and maternal mediation variables.

	Maternal Teaching Behavior				
Temperament	**Focusing**	**Affecting**	**Encouraging**	**Expanding**	**Regulating**
Activity level	.28	–.13	–.05	–.06	.11
Anger (negative affect)	.38**	–.33	–.21	.00	–.16
Joy (positive affect)	.09	–.09	.03	.33*	–.06
Social Anxiety	.02	–.13	–.18	–.14	–.08

*<.05, **p<.01

Table 4.

Correlations between sensory processing variables and maternal teaching (mediation) behavior.

	Maternal Teaching Behavior				
Sensory Processing	**Focusing**	**Affecting**	**Encouraging**	**Expanding**	**Regulating**
Poor Registration	.16	-.14	-.18	.06	-.19
Sensory Seeking	.15	-.08	.13	-.41**	.19
Sensitivity to Stimuli	-.16	-.12	.01	.23*	-.12
Sensory Avoiding	.23*	-.10	-.24*	.22	-.17

*p<.05, **p<.01

of expanding (providing information and creating associations that go beyond the immediate experience).

Clear specific relations were found between sensory-processing variables and maternal teaching behavior (see Table 4). Children rated high on sensory seeking received low rates of expanding, whereas those who rated as highly sensitive to stimuli received high rates of expanding. Children who were sensory avoiding received more focusing and less encouraging mediation. Based on the videotaped observations and on qualitative analysis of recorded informal open conversations with the mothers prior to or following the videotaped observations, the following information and behavior patterns emerged.

Children who scored high on sensory seeking were expressing their hunger for visual, auditory, tactual, or vestibular stimulation, by actively moving from one thing to another. They did not create optimal situations for the maternal teaching behavior of expanding, i.e., behaviors involving creation of associations between objects, events or experiences in the immediate present and other experiences, relating to similarities, differences, cause and effect relations, and other cognitive functions involving the use of higher levels of reasoning. Mothers seemed to be repeatedly trying to ensure that their child will sit down and look at them quietly as they try to tell or teach him something. Since this was difficult for the child, few instances of expanding occurred in mothers' interactions with these children. Children who were highly sensitive to stimuli, i.e., children who easily noticed even the slightest sensory input or variations between stimuli, seemed to "invite" maternal expanding, for example, through their immediate differential responses to variations in sound, taste, or feel of things. They were captive audiences for maternal mediation, which served at times as a way of reducing anxiety by persuading them that the stimuli they were experiencing at the moment as different was in fact similar to one they had experienced before.

Mothers of children who were sensory avoiding tended to use more focusing behavior in order to ensure that their children were focusing on what they considered important at the moment. However, focusing most frequently did not suffice to lead the child to be active and consequently did not invite the mothers to give encouragement. It should be noted that no statistically significant gender differences or age differences were found in this study.

In summary, in terms of teaching behavior, children who were identified as most at risk for receiving poor mediation were those rated as high on negative affect (the angry children), the sensory-avoiding children, and those who were sensory seeking. A summary of the findings relating temperament, sensory processing variables, and maternal teaching behavior variables is presented in Table 5.

Table 5.

Summary of Findings: Relations between Temperament, Sensory Processing, and Maternal Teaching Behavior

	Maternal Teaching Behavior				
Child Variables	**Focusing**	**Affecting**	**Expanding**	**Encouraging**	**Regulating**
Negative Affect	+	–			
Positive Affect			+		
Sensory Seeking			–		
Sensitivity to Stimuli			+		
Sensory Avoiding	+			–	

Note: Statistically significant positive and negative relations between variables are represented by + and – signs.

Discussion

There are many studies in the literature concerning the relations between children's characteristics and maternal behavior. Some studies suggest that mothers are less sensitive and responsive to infants with sensory processing disorders or to fussy infants. (Calkins, Hugerford, & Dedmon, 2004; DeGangi et al., 1997; Feldman, Greenbaum, Mayes, & Erlich, 1997; Van den Boom & Hoeksma, 1994). In previous studies, maternal sensitivity, responsivity, and mutual organization were found to be related to their children's temperament (Feldman et al., 1997; Klein, 1988). In the current study, maternal sensitivity and responsivity, mutual organization, and intrusiveness were not found to be related to maternal perception of their children's temperament. However, maternal teaching behavior was found to be related to some of the temperament variables; mothers who rated their children as showing more positive affect provided more experiences of expanding. Children rated high on negative affect (anger) were given more mediation of focusing. There were fewer statements such as "This is a big, hairy dog," "Listen to the bird singing," or "The rose smells good." Although not a statistically significant finding, angry children appeared to have higher levels of activity. It is possible that in an attempt to assure that the children benefited from various experiences, their mothers tried to focus their attention again and again on different things in the environment. The latter might have resulted in high frequencies of focusing but low frequencies of affecting, (i.e., endowing things with meaning), rarely engaging in more complex, higher levels of mediation such as expanding the experience of "here and now" to developmentally appropriate, more abstract thinking processes.

High frequencies of focusing unaccompanied by sufficient mediation of affecting, expanding, regulation of behavior and encouraging, were found to be ineffective in promoting cognitive development, or even harmful, causing fragmented unrelated experiences (Klein, 1996; Klein, 2006). Angry children were less interactive and expressed less positive affect in interactions with their parents. Consequently, their parents might have had fewer chances to learn what makes their children happy and had less experience in which they themselves were successful in eliciting positive responses in interaction with them.

The current findings suggest that mothers were able to regulate their general interaction behavior as measured by the CIB factors. They were sensitive and responsive to their children, regardless of their perceived temperament. However, they were probably not aware of their teaching behavior and their children's "mental diet" in relation to their own teaching behavior. As stated earlier, a "diet" of high frequencies of focusing and low affecting and expanding may be problematic to future development (Feuerstein, 1980; Klein, 1996; Klein & Alony, 1993).

It was hypothesized that infants characterized by high sensory seeking or sensitivity to stimuli (both associated with high activity levels), invite higher rates of intrusive behavior associated with more focusing designed to keep the children attentive. Alternatively, infants with a sensory profile characterized by high rates of sensory avoiding or poor registration (both associated with low activity levels), are involved in interactions with more mediation of expanding and meaning.

It was found that children characterized as sensory seeking seemed to receive different types of mediation as compared to children characterized as sensitive to stimuli. Although both of these groups typically have high levels of activity, the sensory-seeking children received significantly lower rates of expanding behavior as compared to children with high rates of sensitivity to stimuli. Mothers of the sensory-seeking children, seemed to give up on telling their children things beyond the here and now, possibly because these children seem to crave sensory motor experiences that are gained by moving around

from one motor experience to another, touching, jumping, pushing, opening, etc. Children who were highly sensitive to stimuli seemed uneasy with their experiences and parents were called upon to help their children adjust to situations by explaining, associating, comparing, contrasting, etc. All of these experiences actually represent expanding.

Contrary to the mediation provided to children who were highly sensitive to stimuli, maternal interactions with children who were sensory avoiding (characterized by low levels of activity, retreating from uneasy sensory experiences) included high frequencies of focusing or attempts to direct their children's attention, to "wake them up" to experience the world around them. These interactions were also characterized by low levels of encouragement. The latter may be understood in light of the relatively low activity levels of these children, which reduced their chances to experience success.

Children who are sensory seeking may be jeopardized by an educational environment that attempts to block their movement—the fulfillment of their need for sensory stimulation. This study calls for rethinking the need to stop motor activity in order to force children to learn. Based on this finding, possible strategies may involve the need to include creative means of mediation that may enable these children to benefit from experiences of expanding while the child is moving around. For example, we can introduce situations in which variability in the sensory-motor experience is associated with meaning and cognitive challenges. For example, solving meaningful motor challenges, jumping on different surfaces, bouncing balls of varying materials, the need to recall and reconstruct experiences in a meaningful social context, are possible options.

One of the interesting findings of this study was that children's level of activity is differentially related to their mother's teaching behavior, depending on the etiology of their activity level. High levels of activity are represented in two distinguishable groups of children for whom high activity levels are related to different neuro-physiological ethiologies: A group of children whose high level of activity is probably caused by sensory avoidance and another group whose high activity level is related to sensory seeking. Each of these groups may have different educational needs that are not met by the use of a "one size fits all" approach, i.e., reducing children's level of activity to achieve learning.

There is a general consensus regarding the basic educational approach to children who are characterized by high activity levels. There is also a general assumption among educators that children's attention span or ability to concentrate could be enhanced by causing them to remain inactive for the period in which learning is assumed to occur. Following this assumption, any attempt to teach children who are highly active has to be preceded by attempts to stop their motor movement. The current findings suggest the need to reexamine this generalized assumption. Behavior patterns of children labeled as having high activity levels may be related to two different sensory processing patterns and may consequently invite different teaching behaviors in interaction with their mothers. For the infant or toddler who is highly sensitive to sensory sensation, every minor variation in sensory input attracts attention and is followed by movement, so less movement and a quiet environment may be needed for concentration and learning. Some infants who have high sensory thresholds, however, may move around craving sensory input, so that slowing them down may actually prevent them from concentrating on anything. It is almost like a hungry child who finds it difficult to concentrate when she needs to eat.

Raising the awareness of parents and teachers or caregivers about the mediation they provide for very young children may be the first important step toward improving the children's future development.

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