How Does Sensory Processing Dysfunction Affect Play?

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OBJECTIVE. This study investigated sensory processing dysfunction (SPD) and playfulness and the effect of intervention on playfulness.

METHOD. Twenty children with SPD and 20 children who were typically developing took the Short Sensory Profile (SSP) and Test of Playfulness (ToP). Children with SPD took the praxis tests from the Sensory Integration and Praxis Tests (SIPT) and received 20 intervention sessions. Correlations among measures and differences between mean scores of groups and pre-intervention and post-intervention were examined.

RESULTS. Group ToP scores differed significantly; ToP did not increase post-intervention. Correlations among ToP and SSP ranged from .36 to .72; ToP and SIPT, from –0.1 to –0.46.

CONCLUSION. Modulation affects playfulness. Although intervention was not effective, both groups had high scores initially, making the finding difficult to interpret.

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To play optimally, players must act effectively and efficiently on the environment. Because deficits in sensory processing interfere with the ability to interact with people and objects, it seems logical that children with sensory processing disorder (SPD) may have difficulty playing. Nonetheless, there is relatively little research in this area. Bundy (1987) found that boys with SPD engaged in less social play outdoors and that their Preschool Play Scale (PPS) (Bledsoe & Shepherd, 1982; Knox, 1997) scores were lower than that of boys who were typically developing. However, Clifford and Bundy (1989) concluded that SPD did not always impair play.

Although there is little research examining the play of children with SPD, there *are* studies examining play in children with disorders of attention (e.g., attention deficit hyperactivity disorder [ADHD] and developmental coordination disorder [DCD]), conditions that share common features with SPD (Parush, Sohmer, Steinberg, & Kaitz, 1997). Children with ADHD play for shorter periods with each toy than do children who are typically developing. Additionally, children with ADHD frequently shift their play and find it difficult to return to an activity once interrupted (Barkley, 1996; Leipold & Bundy, 2000). They move around, run, and climb more than other children. They play noisily, talk excessively, and interrupt others. They are less able than peers to wait in line or take turns (Rogers, Gordon, Schanzenbacher, & Case-Smith, 2001) and they get into more mischief (Leipold & Bundy, 2000).

Toddlers and preschoolers with DCD have delays in using gross motor toys (Puderbaugh & Fisher, 1992). When they finally master an activity, they often repeat it with little variation. They commonly seek out younger playmates (Clifford & Bundy, 1989) and, if they pursue sports, it is generally individual sports, decreasing the time they spend in peer interaction (Smyth & Anderson, 2000).

Sensory integration theory describes play as the medium for intervention (Ayres, 1972; Bundy, Lane, & Murray, 2002). For the past 30 years, occupational therapists have used this theory to provide direct "playful" interventions for children with SPD. However, many conflicting conclusions are associated with studies that have evaluated the effectiveness of sensory integration intervention. Some researchers have found that sensory integration therapy improved performance in motor, language, and academics. Others have concluded that sensory integration therapy is no more effective than tutoring or perceptual–motor training. Only Case-Smith and Bryan (1999) have investigated the effects of sensory integration–based intervention on play, finding it highly effective with children with autism. The purpose of this study was to investigate playfulness and SPD. We addressed the following:

• Does SPD interfere with playfulness? We hypothesized that the mean Test of Playfulness (ToP) score of children with SPD would be significantly lower than that of the children who were typically developing.

• How do the major manifestations of SPD (poor modulation and dyspraxia) relate to playfulness? We hypothesized a significant positive relationship between scores on the ToP and (a) the Short Sensory Profile (SSP) and (b) the praxis tests of the Sensory Integration and Praxis Tests (SIPT).

• Will occupational therapy based on sensory integration theory result in increases to playfulness? We hypothesized that children with SPD would have significantly higher ToP scores after intervention.

Method

Participants

Two groups participated. Group 1 comprised 20 children (4 girls and 16 boys) from ages 4.4 years to 9.8 years ($M =$ 6.9, $SD = $ 1.6) with deficits in SPD. All had sensory modulation dysfunction; some also had dyspraxia. Group 2 comprised 20 children (9 girls and 11 boys) from ages 4.7 to 11.7 years ($M = $ 7.5, $SD = $ 1.7) who were typically developing. Children in Group 2 had no evidence of SPD (i.e., normal scores on the Sensory Profile; no concerns of caregivers regarding motor coordination). The groups represented a convenience sample, and no systematic matching was done; however, there was no statistically significant difference in age or gender ($t = $ 0.06, $\chi^2 = $ 2.01). No data were collected on parental income or education, but all children were thought to be from families with middle social economic status.

The children with SPD were recruited from the Occupational Therapy Department at The Children's Hospital in Denver, Colorado. They were part of a larger study of the effects of intervention on SPD, and they had no previous intervention for SPD. Inclusion in the larger study was based on an experienced occupational therapist's rating of behavior during intake, a telephone interview with parents, and a detailed open-ended parent interview conducted by an occupational therapist. The particular emphasis of the larger study was on sensory modulation. Thus, at intake, all children had at least one score on the SSP more than 3.0 SD below the mean and significant symptoms in two or more sensory domains on the SSP. The children had a range of scores on the praxis tests from the SIPT. Individual children's mean scores on the group of praxis tests ranged from approximately –1.5 to +0.8; only four fell in the dysfunctional range (i.e., < 1.0). All children with SPD had scores within normal limits (> 85) on the Wechsler Intelligence Scale for Children–III (Wechsler, 1991) administered by a psychologist at The Children's Hospital.

Children with diagnosed conditions (e.g., cerebral palsy, fetal alcohol syndrome, autism) were excluded, as were those who had motor or behavior problems but no evidence of abnormal reactions to sensation. Children with Fragile X syndrome, Tourette's syndrome (classified using *ICD-9-CM* codes; U.S. Department of Health and Human Services, Public Health Service, and Health Care Financing Administration, 1991), or mental retardation (classified using *DSM-IV* codes; American Psychiatric Association, 1994) also were excluded.

The sample of children who were typically developing was recruited from Fort Collins, Colorado, a middle-class, moderate-size (population ~120,000) university town. None of the children had a traumatic birth history, medical conditions, atypical development, or traumatic life events. All were reported by parents to have normal intelligence and appropriate behavior and learning ability.

Instruments

The Test of Playfulness (ToP, Version 4) (Bundy, 2005) represented the operational definition of playfulness. The ToP consists of 29 items scored on a 4-point (0–3) scale. Each score reflects extent (proportion of time), intensity (degree), or skillfulness (ease of performance) relative to specific behaviors representing intrinsic motivation, internal control, freedom from unnecessary constraints of reality, or framing. Bundy, Nelson, Metzger, and Bingaman (2001) reported preliminary evidence of construct validity and interrater reliability with Version 2 of the ToP. Reliability and validity estimations of Version 4 have not been published but do not differ markedly from Version 2 (Bundy, 2005).

The SSP is a 38-item scale measuring sensitivity to touch, vision, hearing, taste and smell, movement, auditory

filtering, low energy, and sensation seeking. Researchers have provided evidence for the scale's construct validity (Dunn, 1999; McIntosh, Miller, Shyu, & Dunn, 1999) and internal reliability (Dunn, 1999). Low scores on the SSP (and for some children the praxis tests of the SIPT) represented the operational definition of SPD used in this study. (See aforementioned description of children with SPD for details.)

Six of the 7 praxis tests from the SIPT (Ayres, 1989) were used to assess praxis only in the children with SPD: Bilateral Motor Coordination, Constructional Praxis, Sequencing Praxis, Oral Praxis, Postural Praxis, and Design Copying. Using factor analysis, Ayres (1989) and Mulligan (1998) provided evidence for construct validity of the SIPT. Ayres (1989) also reported excellent interrater and test–retest reliability when trained raters administered the SIPT.

Procedure

In accord with the recommended ToP protocol, each child was videotaped by an unobtrusive examiner during 15 min of free play in a natural environment of the child's choosing. The play settings included interesting toys and, generally, a playmate. One 15-min video clip of free play was assessed for each child who was typically developing. To examine the effects of intervention on the children with SPD, two clips of free play were assessed for each: one pre-intervention and one post-intervention. Each tape was scored by one of three raters trained by the test's author and calibrated to ensure reliability. All raters were in the final year of study in occupational therapy, two were undergraduates, and one was a professional master's-degree student. None was aware of group membership; none scored more than one tape of any particular child.

SSPs were completed by parents; they were scored and interpreted by an investigator in accord with procedures specified in the manual (Dunn, 1999). The SIPT was administered by certified occupational therapists at The Children's Hospital. The SIPT was given in a standard fashion in a quiet area and scored via a computer program generated for the purpose. Because all children with SPD had sensory modulation dysfunction, both groups of children took the SSP; this method ensured a range of scores for the correlational analysis. In contrast, only children with SPD took the SIPT; because data were collected first on the children with SPD, we knew that the necessary range of scores already existed on the praxis tests.

Intervention was given to children with SPD in 20 (×1 hr) individual sessions in one of five clinics associated with The Children's Hospital. The same therapist conducted all 20 sessions with any child. All clinics comprised a large room equipped with sensory activities and toys. Sessions involved children engaging with materials that provided enhanced sensation during challenging activities. Therapists were vigilant observers of subtle actions. Intervention was based on principles of sensory integration; a thorough description of the process appears in *Sensory Integration: Theory and Practice* (Miller, Wilbarger, Stackhouse, & Trunnell, 2002). To ensure fidelity to the approach, therapists followed a protocol in which they explicitly identified sensation, task, environment, predictability, self-monitoring, and interaction style. The six therapists met bimonthly to critique tapes of one another's sessions.

Data Analysis

To obtain interval level ToP scores, we subjected raw scores to Rasch analysis using the computer program Facets (Winsteps, PO Box 811322, Chicago, IL 60681-1322) (Linacre, 2002). Scores were then entered into further calculations. One-tailed tests were used; significance levels were set at $p = .05$. To test the difference in mean ToP scores between children who were typically developing and children with SPD, we used an independent t test. To test the relationship between the ToP and the SSP, we calculated Spearman rank coefficients; between the ToP and the SIPT, we calculated Pearson product-moment coefficients. (Data from only 16 children were entered into the Pearson calculation because 4 children with SPD were too young to take the SIPT.) To test the difference in ToP means pre-intervention and post-intervention, we used a paired t test.

Results

As expected, mean ToP scores of the children who were typically developing were significantly higher than those of the children with SPD. Results of the t tests are shown in Table 1. To assist with the interpretation of the results, the approximate means for the total ToP sample also are shown in Table 1. Although the groups differed significantly, the mean score of the group with SPD was equivalent to the mean score of all typically developing children in the ToP sample. Thus, it could be said that both groups were relatively playful.

A Spearman rank order correlation coefficient describing the relationship between overall ToP scores and total raw scores on the SSP (Dunn, 1999) was .72 ($p < .0005$). Correlations with individual sections of the SSP ranged from .36 to .66; all were statistically significant.

In contrast, Pearson correlation coefficients between overall ToP scores and the composite mean of the praxis tests from the SIPT was –.42. Correlations with individual tests ranged between –0.1 and –0.46. This result is in the

Table 1. Comparison of ToP Means by Group and Pre-Intervention and Post-Intervention

Group	M*		SD	Range	t	p	d
Children who are typically developing	2.20	(.41)	.73	.82–3.52	−7.22	< 0.001	2.3
Children with SPD	.41	(−.38)	.83	.87–1.78			
Children with SPD pre-intervention	.41		.83	.87–1.78	−.82	0.43	.26
Children with SPD post-intervention	.21		.73	−1.14–1.95			

Note. ToP = Test of Playfulness; SPD = sensory processing dysfunction. *Approximate mean scores of children who are typically developing and children who are not typically developing in total ToP sample shown here for comparison to this sample's mean score.

opposite direction of that hypothesized (i.e., as SIPT scores increased, ToP scores decreased). Four coefficients were in the moderate range but only two are statistically significant ($p < .05$).

Also contrary to our hypothesis, there was no significant difference on the ToP for the children with SPD before and after occupational therapy intervention. Results of the paired *t* test appear in Table 1.

Additional Findings

In light of the two unexpected findings (i.e., negative correlations between the ToP and SIPT, and no significant differences in ToP scores pre-intervention and post-intervention), we performed two additional analyses, both with data from the children with SPD. First, we examined the play activities in which they engaged pre-intervention and post-intervention. Second, we examined goodness of fit of the ToP data to the Rasch measurement model.

We were particularly interested in two findings. First, we were curious about differences in ToP scores when children engaged in active versus sedentary play because active play is more demanding of both motor skills and ability to maintain optimal arousal. Second, we wondered whether the nature of the play changed after intervention (i.e., did the children engage in more active play post-intervention?). We were able to access only 32 of the 40 tapes to observe the play activities.

In general, all children with SPD engaged in relatively sedentary activity most of the time (23 of 32 observations). However, children who engaged in both active and sedentary play (*n* = 5), either in the same or different observation periods, tended to have lower ToP scores in the context of the active play. Table 2 compares the scores and activities for these 5 children. Further, when children engaged in active

play before intervention (*n* = 3), they also engaged in active play after intervention. However, 3 children who selected sedentary play before intervention chose active play after intervention. Table 3 shows a comparison of activities pre-intervention and post-intervention.

In examining goodness of fit of the ToP data, we were interested in whether the items "worked the same" for children with SPD as for other children in the total ToP sample. Did children with SPD find the same items to be easy or difficult that other children in the sample also found to be easy or difficult? If the ToP is, in effect, a different test for children with SPD than for other children, this difference might have contributed to the unexpected findings.

The Rasch analysis provided two pairs of goodness-of-fit statistics for each child. Fit statistics are expressed as *MnSq* and *t* values with acceptable values of 1 ± .4 and 0 ± 2 respectively (e.g., Bond & Fox, 2001). Data from approximately 5% of children are expected to be out of range by chance (Bond & Fox, 2001). However, in this sample, data from 30% of the children with SPD (*n* = 6) fell outside the acceptable range.

We then examined any rating that was unexpectedly high or low, indicating that children with SPD found the items more or less difficult than others in the total sample (e.g., children got high scores on hard items but low scores on easy items). We were interested in both the total number of unexpected scores and in potential patterns of items that commonly yielded unexpected results. A total of 59 unexpected ratings were awarded to the children with SPD. This number represents just less than 5% (i.e., the number expected by chance) of the total ratings (30 items × 2 tests × 20 children = 1,200 ratings). Forty-six of the 59 unexpected ratings (78%) were awarded to items representing five descriptors: unconventional use of objects (*n* = 14),

Table 2. Comparison of Sedentary and Active Play for Selected Children

ID	Sedentary (ToP score)	Mixed (ToP score)	Active (ToP score)
707		Jumping on a beach ball and assembling puzzle	Swing and bike riding
596	Toys (0.0)	Running and drawing (often wandering) (−0.65)	
307	Pretending to be a tour guide at home (1.1)		Soccer (0.59)
300	Playing balls in ball pool and reading (1.24)		Swing (1.58)
1077	Computer games (0.43)	Jumping on a beach ball and assembling puzzle (1.36)	Swing and bike riding (1.11)
			Ball catching and throwing (0.12)

Note. ToP = Test of Playfulness.

Table 3. Comparison of Selected Play Activities Pre-Intervention and Post-Intervention

ID	Play Pre-Intervention (Category)	Play Post-Intervention (Category)
219	Chess (S)	Chess (S)
300	Balls in ball pool and reading (M)	Swing (A)
307	Pretending to be a tour guide at home (S)	Soccer (A)
502	Playing computer and baseball (M)	Playing computer games and trampoline (M)
505	Toys (S)	Playing an instrument (S)
518	Reading and storytelling (S)	Chess (S)
586	Reading (S)	Toys and balloon (S)
596	Toys (S)	Running and drawing (M)
707	Swing and bike (M)	Jumping and assembling puzzle (M)
844	Playing computer games (S)	Playing computer games (S)
897	Toys (S)	Blocks (S)
1077	Playing ball (A)	Playing computer games and playing ball (M)

Note. S = Sedentary, A = Active, M = Mixed.

clowns or jokes ($n = 9$), pretends ($n = 8$), mischief and teasing ($n = 8$), and remains engaged ($n = 7$).

Discussion

We set this study in the context of a central tenet of sensory integration theory applied to play: that SPD would interfere with play. Thus, we expected that the mean ToP score of the children with SPD would be significantly lower than that of the children who were typically developing, and it was. However, this finding is not as straightforward as it seems because *both* groups were extraordinarily playful. In fact, the children with SPD in this sample were as playful (pre-intervention mean = 0.41) as the typically developing children in the total ToP data set ($m = 0.41$). Even the slightly lower post-intervention mean was higher than the total test sample mean of children with disabilities (–0.38) (Bundy, 1987). The mean for the typically developing children in this sample (2.20) was *much higher* than that for all of the typically developing children in the total ToP data set ($m = 0.41$), which contains more than 2,000 observations. Thus, the finding that SPD impairs playfulness may be misleading. Clearly, further research is required.

The reason why all the children were so playful is unclear. Of course, one cannot completely dismiss the possibility of rater leniency. However, all raters had undergone a rigorous training program not long before they scored the tapes. As a part of their training, all had calibrated their scoring using training tapes. Thus, rater leniency seems somewhat unlikely.

Given the postulate that SPD affects all aspects of daily life (Ayres, 1972; Bundy et al., 2002; Dunn, 1997), we expected a significant positive relationship between playfulness and the measures representing the two major types of sensory processing deficits: the SSP and the SIPT. We were half right.

As expected, the overall correlation between the ToP and the SSP was quite high. However, because there was very little overlap between the two groups on either mea-

sure, the correlation coefficients may be somewhat inflated (Shavelson, 1996).

In contrast, the negative relationship between playfulness and praxis was a surprise ($mr = -.31$). Previous literature describing the magnitude of the contribution that motor skills make to play is mixed. Whereas some researchers (Bundy, 1987; Clifford & Bundy, 1989) have found little relationship between play and motor skills, we found no prior studies reporting a negative relationship.

In an attempt to understand these complicated findings, we did a descriptive analysis of the play activities of the children with SPD to see if that would shed any light. Because not all of the children had dyspraxia, we considered SIPT scores simultaneously with their activities. The children spent most of their time in sedentary play (e.g., computer games, chess). Only children whose SIPT scores were average or above engaged in active play, but even those children often chose sedentary activity. Apparently, sedentary play allowed all of the children with SPD to be relatively playful *despite* their limitations.

On the rare occasions when the children engaged in active play, their ToP scores tended to go down. For example, when one child (with normal SIPT scores) pretended to be a tour guide at his home, he got an overall score of 1.10. When he played soccer on the playground, he got a score of 0.59. Three children who engaged in solitary play chose active play after intervention. Perhaps as their sensory processing abilities improved they became more willing to do active play. However, because active play requires greater effort, the children appeared less playful.

The phenomenon of increased effort associated with skill development is well known in motor learning (e.g., Keogh & Sugden, 1985). Thus, the observation that children appeared less playful when engaged in active play is easily understood for the very young children and children with dyspraxia. Perhaps children with decreased modulation who may have trouble maintaining optimal arousal and attention tend to be like young children when learning

new motor skills. As plausible as this argument seems, it is offered with caution. The ToP scores of many of the children differed quite a lot between their two observations—even when they were engaged in the same activity both times.

Change in context (i.e., children chose to play something different or with a different playmate) may have contributed to the changes in ToP scores. However, Brentnall (2005) found that 80% to 85% of repeated ToP scores from children free to choose the context fell within 1 standard error. Even scores that fell outside the band generally remained quite close to its edges. Thus, something more than changing context seems to be responsible for the present findings. Not surprisingly, difficulty becoming engaged was relatively common and represented another factor that resulted in lowered ToP scores during some observations. Decreased attention may have contributed to frequent changes in activity (Barkley, 1996).

The high number of children whose data failed to conform to the expectations of the Rasch model suggested that the order of difficulty of the ToP items may be different for children with SPD than for other children. Of the items that commonly yielded unexpected scores, three (clowns and jokes, pretends, and unconventional use of objects) were particularly interesting because all or most of the unexpected ratings were in the same direction (consistently easier or harder). Specifically, the children scored higher than expected on clowns (8/8) and lower than expected on pretends (8/8) and unconventional use of objects (9/14). The direction of unexpectedness was evenly split on mischief and engagement.

In some ways, the unexpected patterns are reminiscent of Bundy et al.'s earlier findings with children who have physical disabilities but no cognitive limitations (Harkness & Bundy, 2001) and children with ADHD (Leipold & Bundy, 2000). Both groups of children in the earlier studies, like some of the children in this study, had unexpectedly low scores on engagement. Like the children with SPD, children with physical disabilities had unexpectedly high scores on clowning and joking (Harkness & Bundy, 2001). The children with physical disabilities, like some of the children with SPD, had unexpectedly high scores on mischief and teasing, a concept closely aligned with clowning and joking. Perhaps these similarities are understandable given that many children with SPD also have ADHD and some have significant difficulty with motor skills (Parush et al., 1997).

The unexpectedly low scores of children with SPD on items that require imagination (pretends and unconventional use of objects) separate these children from the previous groups. Although this finding is interesting, it may reflect the relative playfulness of this group of children with

SPD. Pretends and unconventional use of objects are moderately difficult items; children with overall low ToP scores would not be expected to get high scores on these items. Thus, in a less playful sample, low scores on pretends and unconventional use of objects would not have been flagged by the analysis as unusual. Further research is required to clarify this finding.

Despite the playful nature of intervention based on sensory integration theory and contrary to Case-Smith and Bryan's (1999) findings, the children with SPD were not more playful after intervention. Once again, the reason is unclear. We certainly cannot discount the fact that the children with SPD began as a fairly playful group. We reviewed the videotapes for 12 of the 20 children to examine potential changes to the demand of the activities pre-intervention and post-intervention. However, the viewing provided little insight. Whereas 3 children undertook more active play, the remaining 9 engaged in similar activities both times. Further research clearly is required to examine the effects of intervention on play.

Limitations

This pilot study had a number of limitations, not the least of which was related to the measurement of play. Play is freely chosen; if we attempt to control it, we are at risk of losing its essence. Observation-based measurement of free play provides some assurance that the children being studied are actually playing. However, this method comes with all the threats to reliability that accompany tests without standard formats. Additionally, small numbers and the convenience nature of the sample affect statistical power and the generalizability of the findings.

Summary and Conclusions

We examined the relationship between playfulness (ToP) and two concepts related to sensory processing: sensory modulation (SSP) and praxis (SIPT). Although ToP scores were strongly positively correlated with SSP scores, the relationship with SIPT scores was low to moderate and negative. Thus, we conclude that modulation seems to have a more direct effect than praxis on playfulness. The 4 children with the lowest SIPT scores had ToP scores well within normal limits, whereas the children with the highest SIPT scores tended to have much lower playfulness, suggesting that the relationship is quite complex. At the very least, we conclude that some children with poor praxis compensate for their difficulties. Compensatory clowning may play a role in this as does the ability to adapt play preferences to match skills.

We also found that ToP scores of children with SPD were significantly lower than those of peers who were typically developing and that intervention based on the principles of sensory integration theory did not result in gains to playfulness. However, the relative playfulness of both groups made these findings difficult to interpret. Further research clearly is needed to understand the effects of SPD on play and the capacity of intervention to increase it.

Implications for Practice and Future Research

The results of this study point to the importance of monitoring the play of children with SPD, particularly those with poor sensory modulation. They also suggest that, although some children with SPD may alter their play preferences to accommodate for their limitations, others may need assistance to do so. The long-term consequences of such alterations need further study. In addition, further research is needed to examine the nature of playfulness of children with SPD and the effects of intervention on play. ▲

Acknowledgments

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