Effectiveness of Therapy Ball Chairs on Classroom Participation in Children With Autism Spectrum Disorders

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KEY WORDS
- autistic disorder
- behavior control
- behavior therapy
- sensation
- treatment outcome

A single-subject design was used to assess the effectiveness of therapy ball chairs on classroom participation in 6 boys with autism spectrum disorder (ASD). The sensory processing pattern of each participant was assessed using the Sensory Processing Measure. Data on in-seat behavior and engagement were collected using digital video recordings during Circle Time. During baseline, participants sat on chairs. During intervention, participants sat on therapy ball chairs. Social validity was assessed by means of a questionnaire completed by the teacher. Each child demonstrated a unique response. The ball chair appeared to have a positive effect on in-seat behavior for the child who had the most extreme vestibular–proprioceptive-seeking behaviors. Children with poor postural stability were less engaged when sitting on the therapy ball chair. The results illuminate the complex nature of children with ASD and the importance of using sound clinical reasoning skills when recommending sensory strategies for the classroom.


The number of children ages 6 through 21 diagnosed with autism spectrum disorders (ASD) receiving services under the Individuals With Disabilities Education Improvement Act of 2004 has increased dramatically in the 21st century. In 2000, >79,000 children with ASD received services; in 2006, the number increased to >224,000 (U.S. Department of Education, 2007). This increase presents a major challenge to the nation’s special education service systems and to classroom educators. Communication, social interaction, and behavioral concerns are often cited as problems in the classroom (Fein & Dunn, 2007; Simpson, Myles, & LaCava, 2008). Behavioral concerns such as difficulty sitting still, attending to relevant stimuli, and engaging in teacher-initiated activities interfere with participation in classroom activities. A wide variety of strategies are used in the classroom to help children participate more fully, including environmental cues, behavior management and reinforcement, and environmental modifications (Simpson et al., 2008). An intervention approach often recommended by occupational therapists is the use of sensory processing strategies (Watling, Deitz, Kanny, & McLaughlin, 1999). Sensory processing strategies are designed to provide children with the sensory input needed to maintain arousal states so that they can respond more effectively to environmental challenges and thus participate in everyday occupations (Dunn, 2008a; Kimball, 1999). These strategies include the use of therapy ball chairs, weighted vests, and fidgets (objects to hold and manipulate) during classroom activities.

Sensory processing strategies are based on theories of sensory processing and sensory integration. Sensory processing is the neurological process involving the...
registration, modulation, and integration of sensory information (Schaaf & Miller, 2005). Efficient sensory processing is considered to be essential for optimal occupational functioning, including the ability to learn and modulate behavior (Ayres, 2005). Several studies have identified sensory processing differences in children with ASD (Kientz & Dunn, 1997; Tomchek & Dunn, 2007; Watling, Deitz, & White, 2001). Although patterns of sensory processing differ from child to child, the sensory processing difficulties associated with academic underachievement in children with ASD have been found to be tactile processing, auditory filtering, and under-responsiveness or sensory seeking (Ashburner, Ziviani, & Rodger, 2008).

To address sensory processing difficulties, various strategies are used. One such strategy is the therapy ball chair. These chairs consist of a therapy ball or exercise ball stabilized in a ring or with “feet” at the bottom to keep it stable. Therapy ball chairs are dynamic, relatively low-cost seating alternatives that provide children with the opportunity to “both actively move and maintain an optimal arousal level” (Schilling & Schwartz, 2004, p. 424). Therapy ball chairs are used with children with a variety of sensory-based concerns. As one distributor of therapy ball chairs suggested, “An exercise ball chair is the best seating solution for children (or adults) with issues regarding balance, postural control, attention, and sensory seeking behaviors of the vestibular and proprioceptive sense” (www.sensory-processing-disorder.com/exercise-ball-chair.html). In addition, therapy ball chairs are recommended for maintaining good posture and back health (Illi, 1994). Because of their positive effects, therapy ball chairs have been adopted for use in the classroom for typically developing children as well as for children with disabilities (Witt, 2001; Witt & Talbot, 1998).

Although therapy ball chairs have been used for many years with children with ASD, research examining their effectiveness is scant. Only one study has examined the use of therapy ball chairs with children with ASD (Schilling & Schwartz, 2004). Using a single-subject design, Schilling and Schwartz (2004) examined the effectiveness of the therapy ball chair on in-seat behavior and engagement in four preschool-age children with ASD. In addition, a measure of social validity was reported. Descriptions of the children’s behavior in the classroom were included, but no specific information about sensory processing concerns was reported. The therapy ball was implemented in the classroom during activities on the basis of each child’s individual needs. However, each child sat on the therapy ball for at least 10 min/day, 5 days/wk, for a 3-wk period. The results of the study indicated that all four students displayed marked improvement in their in-seat behavior and engagement when using the therapy ball chair. In addition, the teaching staff viewed the ball chair as an effective intervention, suggesting strong social validity. Limitations of the study include a small sample size, minimal information on the sensory processing needs of the participants, and a relatively short duration of intervention.

Because school-based occupational therapists are faced with the mandate to use scientifically based research to guide educational decisions regarding teaching and learning approaches, strategies, and interventions to enhance participation (Dunn, 2008b; Muhlenhaupt, 2003), there is a clear need for more research on the use of the therapy ball chair for children with ASD. One of the critiques of research on sensory processing strategies is the lack of attention to participants’ patterns of sensory processing (Stephenson & Carter, 2009). Participants are often chosen on the basis of problematic behavior and diagnosis and not patterns of sensory processing. As Dunn (2008a, 2008b) suggested, the application of a sensory processing approach requires careful assessment of a child’s sensory processing pattern.

This study was intended to extend and expand on the findings of Schilling and Schwartz’s (2004) work. The study is similar in that it uses a single-subject design to examine classroom participation—specifically, in-seat behavior and engagement and social validity. This study expands on the notion of social validity to include child preference and examines effectiveness in relation to patterns of sensory processing. The following research questions guided this study:

1. What effect do therapy ball chairs have on in-seat behavior?
2. What effect do therapy ball chairs have on engagement?
3. What are teachers’ perceptions of the use of the therapy ball chair?
4. What do children with ASD prefer to use as a seating device?
5. Which children (with which types of sensory processing patterns) respond best to the use of the therapy ball chair?

Method

Participants and Context

Six boys with ASD who attended a public school in a large urban school district participated in the study. All the children were enrolled in an intensive instructional program (kindergarten–1st grade) specifically designed for children with ASD who fall in the moderate to severe...
range of autism. In the program, the students’ sensory, language, behavioral, and social needs were addressed within the context of their curricular environment. Services, including speech and language and occupational therapy, were coordinated and integrated in the classroom and home environments. In the early stage of the program, the occupational therapist provided services in the classroom daily, working with the teacher to set up a daily sensorimotor time. At the time of the study, the occupational therapist worked directly in the classroom 30 min/wk. One child, Alex (all names are pseudonyms), received additional clinic-based occupational therapy services using a traditional sensory integration approach. The classroom teacher indicated that all the children in the class had difficulty participating in classroom activities and had problems with in-seat behavior and engagement during Circle Time. Four of the 6 children (Alex, Roland, Samuel, and Jack) were identified as having difficulty with in-seat behavior; 5 of the 6 children (Roland, Samuel, Jack, Omar, and Ricardo) were identified as having difficulty with engagement.

The teaching staff included one teacher, Beth, and three instructional aides. A daily classroom schedule was followed, giving the children a sense of routine. Circle Time, a group activity, occurred each morning and lasted approximately 16 min. It included an opening and closing song, discussion about who was present and the date, and opportunities to stand up and receive social reinforcers from the teacher. The Circle Time activities were designed to promote language, socialization, and early academic skills. Recorded music was used, and the classroom staff modeled singing and hand movements.

**Study Design**

This study used a single-subject design to examine the effects of using a therapy ball chair on in-seat behavior and engagement in 6 children with ASD. Single-subject design “involves one, or a small number of subjects, observed over time in which the treatment and outcome variables are controlled” (Zhan & Ottenbacher, 2001, p. 1). It is considered a useful design for defining educationally relevant practices at the level of the individual and for establishing evidence-based practices (Horner et al., 2005). An A-B-C design was used; A represented the baseline condition, B represented the intervention phase, and C represented a choice condition.

**Procedures**

**Preparation Phase.** After receiving institutional approval, the researchers obtained consent from the parents of the children. Although the class had a total of 7 children and consent was obtained for all of them, 1 child was ultimately not included in the study because of a prolonged absence. The research team met with the teacher and instructional aides to explain the study and to obtain their consent. During this meeting, team and classroom staff collaborated regarding the placement of the video cameras, use of the cameras, and the proper use of the ball chair. Each participant was fitted for a therapy ball by Chrissa Patterson to ensure proper sitting position of feet flat on the floor with the hips and knees at 90°. A ring stabilizer was also provided to keep the ball from rolling. The children were allowed to try out the ball chair before the beginning of the study so that they could learn how to use it properly. Some children initially needed help stabilizing themselves on the ball chair. Most of the children required verbal and physical cues to ensure proper use of the ball chair.

To develop a more complete profile of each child’s sensory processing, the teacher completed the Sensory Processing Measure (SPM): Main Classroom Form (Miller Kuhaneck, Henry, & Glennon, 2007; Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007). The SPM, a tool standardized on typically developing children, uses a rating scale based on frequency of behaviors (never to always). The tool provides standard scores and interpretive ranges. A score in the typical range indicates that the child’s sensory processing and behavior are similar to the sample. A score in the some problems range indicates mild to moderate differences in sensory processing and behavior. A score in the definite dysfunction range indicates sensory processing and behavioral concerns that are likely to interfere with daily activities. Table 1 presents the SPM results for each child.

**Phase A: Baseline.** During the baseline phase, the children and classroom staff carried out Circle Time according to their usual routine. The children sat in chairs facing the teacher. The classroom assistants sat behind the children and cued them verbally and physically as needed to enhance participation. The baseline phase lasted 5 days (1 school wk).

**Phase B: Intervention.** The intervention phase occurred over 9 days (2 school wk, with one holiday). Circle Time was conducted in the usual manner; the only change was that the children, teacher, and instructional aides sat on therapy ball chairs with a ring stabilizer. All the children and classroom staff used the therapy ball chair for the duration of Circle Time. The staff members were instructed to verbally cue the children to use the ball chair safely as a seating device when necessary. The children were allowed to bounce or move on the balls as long as the staff considered the movement safe.

**Phase C: Choice.** During the final phase (5 days), the children were given the choice of sitting on a regular
seating device (chair) or on a therapy ball chair. This choice was given to gain an understanding of the child’s preferred seating device. The children were asked to make a choice each day using their preferred mode of communication, which included verbal responses and the use of pictures. Choice-making was a skill that was emphasized in the curriculum, so the children were familiar with the process.

Postintervention. At the conclusion of the study, the teacher was asked to complete a brief questionnaire as a measure of social validity. Social validity in this study refers to the teacher’s perceptions of the usefulness of the therapy ball chair. The questionnaire asked the teacher to write comments about the effectiveness of the therapy ball chair for each child. It included a question about her preferred seating device and her desire to continue to use the therapy ball chair in the classroom. One year after intervention, the teacher was interviewed regarding whether and how she was using the therapy ball chairs.

Data Collection and Analysis

Data were collected daily for the entire 16 min (960 s) of Circle Time over 4 wk (19 days). Two video cameras were set up in the classroom so that each child could be viewed completely. Before the start of the study, the cameras were brought into the classroom. The children showed only initial curiosity when the cameras were introduced, and during the study, the children showed no reaction to them. A member of the research team set up the camera at the beginning of each week. The classroom staff turned the cameras on and off at the beginning and end of Circle Time each day. At the end of each week, a team member collected the digital recordings. Collecting data using digital video disks (DVDs) was chosen over momentary real-time sampling to allow for more accurate and complete ratings because segments could be watched multiple times. Video recordings also offered the opportunity for more fine-grained analysis (Pierce, 2005).

Data on two variables—in-seat behavior and engagement—were defined according to Schilling and Schwartz (2004) and recorded during video review. For the baseline phase (A), in-seat behavior was defined as “any portion of the child’s buttocks in contact with the seat portion of the chair” (Schilling & Schwartz, 2004, p. 427) and “the four legs of the chair in contact with the floor” (p. 427). For the intervention phase (B), in-seat behavior was defined as “any portion of the participant’s buttocks in contact with the ball, the ball in contact with the floor, and a minimum of one foot in contact with the floor” (Schilling & Schwartz, 2004, p. 427). Engagement was defined as “oriented towards appropriate classroom activity . . . or teacher and either interacting with materials, responding to the speaker or looking at the speaker” (Schilling & Schwartz, 2004, p. 427). This definition included orienting and responding to peers, singing songs, or using appropriate hand movements.

Two of the investigators (Bagatell and Reyes) reviewed the DVDs and recorded behaviors. To establish interrater agreement, they watched randomly selected segments of sessions as practice recordings to ensure that the definition of in-seat behavior and engagement were clear. The number of seconds a child demonstrated the behaviors (out-of-seat and not engaged) was recorded. Interrater agreement was defined as the observers’ being within 2 s in their timed observations. Once interrater agreement exceeded 90%, ratings were completed by Reyes. Bagatell conducted interrater checks by recording behaviors for at least one session per phase for each child, totaling 18% of the videos. Interrater agreement for in-seat behavior ranged from 96% to 100%. For engagement, the range was 88% to 100%. After all DVDs were reviewed, data were graphically represented and then visually inspected for level, variability, and trend (Zhan & Ottenbacher, 2001). The mean number of seconds each child was out of seat and not engaged was calculated for each phase.

Results

Each child’s data are presented in separate graphs in Figure 1. Four of the children were present on each of the
19 days of the study; Alex attended 17 days, and Samuel attended 18 days.

**In-Seat Behavior**

Each child demonstrated a unique response to the use of the therapy ball chair. For Alex, the ball chair appeared to have a positive effect on in-seat behavior reflected in a decrease in the amount of time out of seat each day during Phase B (Figure 1A). During Phase A (chair) the number of seconds Alex was out of seat ranged from 44 to 163 (mean [M] = 88.2). During Phase B, the range was 0–61 s (M = 22.8). During Phase C, Alex consistently chose the ball and demonstrated a stable pattern, with an average of 25.5 s out of seat. Note that on 2 days (A5 and B3) when out-of-seat behavior was high, Alex was seated next to a peer who was disruptive.

Jack, Roland, and Samuel, who showed little consistency during the baseline phase, showed slightly less...
variability while sitting on the therapy ball chair. For example, Jack’s out-of-seat behavior ranged from 0 to 55 s ($M = 26.8$) during Phase A and 0 to 17 s ($M = 5.3$) during Phase B (Figure 1B). During Phase C, Jack chose to sit on the chair 3 of 5 days; the mean for the days on the chair was slightly higher than for the ball chair (11.7 s and 7 s, respectively). Roland was less consistent during Phase A (range = 0–69 s, $M = 29.4$) and more consistent during Phase B (range = 10–34 s, $M = 21.3$). During Phase C, Roland’s out-of-seat behavior increased slightly when he chose to sit on the therapy ball chair (range = 25–59 s, $M = 45.6$; Figure 1C). During Phase A, Samuel’s out-of-seat behavior ranged from 0 to 166 s ($M = 105.8$). His out-of-seat behavior increased the first day of Phase B because of novelty and then was more stable (range = 48–122 s; $M = 77.6$). During Phase C, Samuel chose to sit on the chair, and his out-of-seat behavior decreased slightly (range = 0–82 s, $M = 64$; Figure 1D).

For Omar, whose baseline showed little to no out-of-seat behavior (range = 0–24 s, $M = 7.6$), sitting on the therapy ball chair actually resulted in a more variable performance, with out-of-seat behavior ranging from 0 to 99 s ($M = 37.1$; Figure 1E). During Phase C, when Omar chose to sit on a chair, his rate of out-of-seat behavior decreased, except for 1 day (range = 0–98 s, $M = 36.2$; Figure 1E).

### Engagement

The results for engagement were unique for each child. The use of the therapy ball chair did not positively affect engagement. Alex, who was consistently engaged during Phase A (except for 1 day when he was distracted by a disruptive peer), continued the same pattern during Phase B. Jack showed a pattern that was highly inconsistent, regardless of the seating device. His most difficult days occurred when he was upset about a nonroutine event (A5), when the teacher was absent (B1), and when a peer was disruptive (C2; see 1B). Roland’s level of nonengagement was fairly consistent across phases, except for 1 day (C2) when he was uncharacteristically distracted (see 1C).

Omar’s level of nonengagement was consistently high during Phase A (range = 245–395 s, $M = 300$) and remained high but with more fluctuation during Phase B (range = 97–503, $M = 299$). Interestingly, his level of nonengagement was even higher during Phase C when he chose to sit on a chair, peaking on C2 (range = 392–632 s, $M = 475$; see Figure 1E). Samuel did not have a consistent baseline (range = 86–369 s, $M = 187.25$), but his level of nonengagement was considerably higher and interestingly somewhat more stable during Phase B (range = 314–525 s, $M = 410.3$). This pattern continued during Phase C, when Samuel chose to sit on a chair (range = 359–453 s, $M = 397$; see Figure 1D). Similarly, Ricardo’s level of nonengagement was higher during Phase B. During Phase A, his nonengagement ranged from 230 to 439 s ($M = 327$), whereas in Phase B the range was 372–711 s ($M = 517.6$). During Phase C, Ricardo’s rate of nonengagement decreased regardless of his choice of seating device (range = 355–465 s, $M = 399.4$; Figure 1F).

### Teacher Perception

At the end of the study, the teacher, Beth, completed a short questionnaire for each child. She indicated that the therapy ball chair did not appear to be beneficial for any of the students. She noted that Alex appeared to enjoy sitting on the therapy ball chair and that he often bounced vigorously but that he still “had difficulty sitting quietly” on the ball. For Roland, the therapy ball chair was seen as a “fun activity,” because he too enjoyed bouncing and rolling on the ball, but Beth did not feel that it helped him focus. Beth thought that the ball was more of a distraction for Jack; she indicated that he was able to participate more when sitting on a chair. She did not see the therapy ball chair as helpful for Samuel, Omar, or Ricardo because they continued to need prompts to participate. Beth indicated that she would like to give the children a choice of seating device to use during Circle Time, and she requested that three of the balls remain in the classroom. In follow-up 1 year later, Beth indicated that she continued to use therapy balls, but only during the designated sensorimotor time and not as a seating device during Circle Time or other academic activities.

### Child Preference

During Phase C, Alex chose to sit on the therapy ball on 4 of 4 days, whereas Roland chose to sit on the ball on 4 of 5 days. Both boys were enthusiastic about sitting on the ball chair. Jack and Ricardo chose the ball on 2 of 5 days but showed less excitement. Samuel and Omar chose to sit on the chair all 5 days. Beth indicated that she believed that all the children understood the choice-making process except Samuel.

### Discussion

The main purpose of this study was to determine the effect of therapy ball chairs on classroom participation—specifically, in-seat behavior and engagement—for 6 children with ASD. A secondary purpose was to determine the social validity of the intervention as measured by teacher perception and child preference. Last, the study was designed to examine the effectiveness of the therapy ball chairs in relation to patterns of sensory processing. Unlike Schilling and Schwartz (2004), whose study showed positive results...
for all three children, the results of this study are mixed. The findings may be the result of several factors, discussed in the following sections.

**Pattern of Sensory Processing**

Sensory processing differences are well documented in children with ASD (Kientz & Dunn, 1997; Watling et al., 2001). Children with ASD, a heterogeneous group, present with various sensory processing patterns. In this study, the scores on the SPM highlight the differences in sensory processing in children with ASD. For example, Jack had rather mild sensory processing concerns; only tactile and social participation fell in the *some difference* range for him. Alex, however, had more significant sensory processing needs: His scores were in the *definite dysfunction* range in five of the seven SPM categories. Alex, who initially had difficulty staying in seat, made the most notable improvement using the therapy ball chair, as indicated by a decrease in the amount of time out of seat. Alex’s scores on the SPM indicated definite dysfunction in SPM Body Awareness and Balance and Motion. The items in those categories relate to proprioceptive and vestibular functioning. It is important to carefully examine the responses in these categories because there are different “sensory integration vulnerabilities” assessed (Miller Kuhaneck et al., 2007; Parham et al., 2007). On the SPM, the teacher reported that Alex *always* ran, hopped, stomped, jumped, slammed, and rocked but never slumped or leaned, indicating vestibular–proprioceptive seeking and good postural control.

The children who did not show vestibular–proprioceptive seeking on the SPM did not show improvement in in-seat behavior or engagement. In fact, for some children (e.g., Ricardo and Omar), engagement decreased when on the therapy ball chair. Interestingly, both boys had scores in the SPM Body Awareness and Balance and Motion categories that fell into the *typical* range. According to the teacher responses on the SPM, neither boy sought out vestibular–proprioceptive input but was noted to frequently slump, lean, or hold his head up with hands while seated. These behaviors suggest difficulties with postural control, a function of efficient vestibular–proprioceptive functioning. As Dunn (2008a) stated, “The vestibular and proprioceptive systems serve as silent partners during task performance, maintaining postural control while attention is focused on something else” (p. 352). It is possible that, given their poor postural control, the challenge of the therapy ball chair was too great. On the regular chair, both boys typically used a sacral sitting position and relied on the back rest for support. The therapy ball chair, a less stable sitting device, required postural adjustments that were, perhaps, too challenging. This high level of challenge may have made it more difficult for the boys to engage in the activities. Dunn (2008a) stated, “As children who have autism are focused on maintaining their own bodies in space, they may seem preoccupied and less available to engage in a cognitive activity or a social exchange” (p. 352). Note that fatigue did not appear to be a factor, because the amount of time unengaged did not increase toward the end of the sessions. Samuel had a similar pattern of sensory processing and was also less engaged during Phase B. Perhaps other seating devices that provide different input and support, such as a peanut ball, would be more appropriate for children with postural control issues.

The results suggest that therapy ball chairs may be more appropriate for children who seek out vestibular–proprioceptive input rather than for children with other patterns of sensory processing. The results underscore the importance of choosing strategies to improve classroom participation on the basis of patterns of sensory processing and not diagnosis. As Stephenson and Carter (2009) pointed out, therapists need to make better determinations about who is an appropriate candidate for sensory processing interventions. To gain a comprehensive understanding of a child’s pattern of sensory processing as it relates to classroom performance, data from standardized assessments; observations in the natural context; and interviews with key informants, including children when appropriate, should be carefully analyzed (Dunn, 2008a, 2008b). Further research is needed to better understand the relationship between patterns of sensory processing and positive responses to the use of the therapy ball chair.

**Complexity of Engagement**

*Engagement* is a complex construct that is difficult to define and quantify. Given that engagement is a multidimensional behavior (deKruif & McWilliam, 1999), it is unlikely that poor sensory processing can fully explain why children have difficulty engaging in classroom activities. As Ruble and Robson (2007) concluded, “Engagement is a state construct, influenced by external events, but also mediated by trait or internal factors” (p. 1463). After examining notations on the data collection forms used in this study, it is clear that the children’s engagement depended not only on their ability to attend and process information but also on an array of environmental factors and the nature of the task. Factors that influenced engagement included teacher absence, behavior of other children, visitors in the classroom, and the nature of the activity. For example,
Ricardo was often less engaged when the activity required social interaction (e.g., shaking hands or hugging a friend) and motor planning (e.g., hand movements) but was more engaged in activities requiring more cognitive engagement (e.g., spelling his name). Given the complexity of behaviors such as engagement, the results of this study reinforce the importance of a thorough occupational analysis, including performance skills, client factors, contexts, and activity demands (American Occupational Therapy Association, 2008) to increase meaningful participation in classroom activities.

**Social Validity**

The results of this study reinforce the importance of teacher perception of intervention and the importance of allowing children to participate in making intervention choices. Although Beth was open to the use of therapy ball chairs as a seating device, at the conclusion of the study she did not perceive them to be effective for increasing participation during Circle Time and did not continuing using them, even for Alex, who demonstrated a positive change in in-seat behavior. Alex often bounced vigorously on the ball, and this behavior was perceived as “not sitting quietly,” which was important to Beth. As research has shown, teachers often do not use strategies recommended by other team members because they view the strategy as disruptive, not meeting their needs, or creating a different problem (Johnson & Pugach, 1990; Tafa & Chlouverakis, 2000). Therefore, it is imperative that therapists collaborate with teachers to determine what constitutes appropriate classroom behavior and how change in behavior can be best defined and measured.

Interestingly, Alex, who showed the most improvement in in-seat behavior, chose to sit on the ball chair each day during Phase C. The other children, perhaps, recognized that the ball was not helpful. More research is needed to determine whether children are able to make informed decisions about seating devices.

**Limitations and Recommendations for Future Research**

The results of this study cannot be generalized because of several limitations. The study raises questions; as a result, recommendations for future research are offered.

The research was conducted with a small number of children in a particular context and particular activity. Children may benefit from the use of a therapy ball chair in activities other than Circle Time and at other times of the day. Inclusion of a larger number of children is recommended for future research.

The design of the study was essentially an AB design; Phase C provided the children with a choice of seating device. A stronger design would be an alternating-treatment or multiple-baseline design (Stephenson & Carter, 2009; Zhan & Ottenbacher, 2001).

The length of the study was limited by the constraints of the school schedule, such as school vacations. Future research should increase the length of each phase. Obtaining a stable baseline is important, because the interpretation of variable baselines makes interpretation of the results complex (Zhan & Ottenbacher, 2001). By using longer phases, researchers can investigate whether children can accommodate to the use of the ball chair and return to baseline levels or whether a more extended time on the ball chair gives children with poor postural control the opportunity to develop the skills to use the device effectively.

The children were chosen for the study not on the basis of their pattern of sensory processing but on diagnosis and behavioral concerns. Although this study begins to address the question of which children with ASD benefit the most from the use of the therapy ball chair, future studies should examine more closely the relationship between sensory processing and response to sensory strategies so that practitioners can more confidently recommend the use of the therapy ball chair.

Environmental variables, such as teacher and child absence, the presence of visitors in the classroom, and disruptive behavior of other children, could not be controlled for. This limitation is typical of classroom-based research and must be considered in daily practice as well.

**Conclusion**

This study adds to the literature on the use of the therapy ball chair in the classroom with children with ASD. The results of this study do not affirm the results of a previous study conducted by Schilling and Schwartz (2004), which revealed substantial improvements in in-seat behavior and engagement and strong social validity. Instead, the results illuminate the complex nature of children with ASD, of behavior and learning, and of occupation and the importance of using sophisticated clinical reasoning skills when making recommendations for interventions in the classroom for children with ASD. Additional research that addresses the relationship of sensory processing patterns and improved classroom participation is indicated before therapy ball chairs should be used as an evidence-based intervention.

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