



## Original Article

## Can Air Seat Cushions and Ball Chairs Improved Classroom Behaviors of Students with Autism Spectrum Disorder: A Single Subject Study

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### ABSTRACT

**Background:** Classroom behaviors are disturbed in autistic students because of their repetitive, restlessness, and disruptive behaviors. This study aimed to examine the impacts of sitting on a ball, cushion, and/or common chair on classroom behavior of four students with Autism Spectrum Disorder (ASD).

**Methods:** Four children with Autism participated in this single-subject study. Students' behaviors were video recorded in three phases: Sitting on their common chairs during phase A, air-sit cushioned in phase B, and ball chairs in phase C. Sitting times and on-task/off-task behaviors were quantified by momentary time sampling (every 10 seconds) and compared during different phases for important changes. Social validity was taken by the teacher at the end of the research as well.

**Results:** The findings demonstrated increases in on-task and in-seat behaviors in four students when seated on air sit cushioned chairs. Despite rises of on-task behaviors for all students, only two of the students showed enhanced in-seat behaviors when seated on therapy balls. Social validity findings indicated that the teacher preferred the use of the balls and air-cushioned chairs for her students.

**Conclusion:** Therapy balls/cushioned chairs for students with ASD may facilitate in-seat and on-task behavior.

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### Introduction

The number of students in inclusive schools with Autism Spectrum Disorder (ASD) has risen to 1 case per 110 in the United States [1]. An analysis of data attained over a three-year period on over 1.32 million children aged 5 to 6 years of age screened, acquiesce an overall prevalence of 6.26 per 10,000 which is comparable with reported rates from other countries [2]. Problems of participation in class tasks, low attention span and inappropriate behaviors are common in these students, which interfere with their ability to take part in educational activities [3]. This is a

great challenge for the education system.

Students with ASD usually experience delays in educational improvement with traditional intervention strategies. This could be due to not addressing the sensory issues that may eliminate or reduce the disruptive behavior [4, 5]. In a broad research on 200 children with autism, 95% had difficulties in sensory modulations [3, 6]. Physiological need for proper sensory stimulation leads to spending most of the students' time on stereotype and repetitive movements to adjust their sensory system. Therefore, their attention would not be concentrated on learning and assignments in class [3]. Researchers argued that a decrease in sensory processing may result in social isolation and inattention to class tasks [3]. Furthermore, children with low sensory sensibility require additional

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sensory stimulation to accomplish the tasks demanding attention and concentration [7]. Therefore, one of the major approaches to address the behavioral problems in these children could be the sensory integration approach.

Sensory integration approach includes integration of different modalities, among which are three essential sensory systems, including proprioceptive, vestibular, and tactile systems. These systems regulate the awareness of the body in space, joint and limbs positions, control sensations of gravity and movement, and perception of the sense of touch [8]. Moreover, these senses greatly affect the regulatory systems of the nervous system [9]. Sensory integration theory focuses on these specific key sensory systems which are useful in a person's interpretation and application of sensory information.

Proper sensory integration is necessary for achieving educational objectives through successful application of sensory and perceptual systems which would lead to forming vital skills for performing class task [8]. Occupational therapists who work in schools often use sensory techniques to increase students' attention span, on-task behavior, and performance in the classroom [10]. Many clinicians speculate that these approaches are successful in promoting functional classroom behavior [10]. According to the previous findings, 99% of occupational therapists use sensory integration techniques for ASD children [10, 11]. A survey of 292 occupational therapists had shown that Sensory integration-based therapy was the most commonly applied technique among all of them [11]. Proper sensory integration improves a student's ability towards educational achievements and success by goal-directed use of sensory and perceptual systems. This method might lead to achievement in learning. Furthermore, formal research conducted on sensory-based interventions has supported this belief [10].

Some authors reported that lack of environmental modification in the classroom directly refers to the limitation of a student's engagement [12]. So, proper changes in the environment might lead to improvements in learning. Moreover, previous emphasis in pediatric occupational therapy has been on modifying the individual's behavior, with less emphasis placed on changing the environment, but the focus is now on transferring to ergonomic and sensory adjustments to promote academic success [13]. Various sensory-based strategies, including the use of alternative seating devices, have been examined by researchers for children with Attention Deficit Hyperactivity Disorder (ADHD), and found to promote functional classroom behavior. Two of these functional methods are the using of balls and air cushions instead of common chairs [14].

Gamache-Hulsmans (2007) found that students reported better feeling and more comfort [7]. The use of therapeutic balls led to marked improvements in the in-seat behaviors and legible word production in school age children with ADHD, and also increased the engagement and in-seat behavior of preschoolers with ASD [13]. Although sitting on ball chairs also has its own limitation, such as occupying large spaces in a small class room, especially classrooms with lack of standard educational space. Therefore,

clinicians have been using other dynamic seating, such as the Disc 'O' Sit cushion, to assist students to increase their attention span. While clinical evidence shows that these devices might lead to desirable results, there are little studies on similar devices, particularly the impacts of sit cushions on ASD. There was no available study on comparing these sit devices. Therefore in the present study the impacts of sitting on a ball, and air cushion on in-seat/on-task and off-task behaviors were investigated to answer two important questions.

Firstly, to what extent will dynamic seating chairs affect on-task/in-seat behaviors? Secondly, which one (air cushion or ball) is preferred as a result?

## Methods

A single subject multiple treatments withdrawal design A-B-A-C was used to investigate the effects of two seating options, including common therapy balls and air cushions on in-seat on class task behaviors of four students with ASD. During the two A phases, all students sat on typical chairs. Then they sat in B phase on air cushions and, during C phase, they sat on therapeutic balls. According to Goldstein's opinion, efficacy studies of Ayres's sensory integration must consist of "well-controlled single-subject design experiments with a few subjects" [9].

A convenience sample including four participants was recruited from the preschool students in a public autism elementary school in Mashhad, Iran. Specialists diagnosed participants with ASD who consume their own medicine normally throughout the study. According to teacher reports, all children were identified as having difficulty with in-seat and on-task behaviors because they do not sit calmly on their seat. Inclusion criteria were ASD student diagnosed by specialists in age between 7 and 10 years. Exclusion criterion was any balance problems which prevent them from sitting on ball and cushion.

This study and research project was approved by the "University of Social Welfare and Rehabilitation Ethical Committee." Informed consents were obtained prior to experiment, and contents were comprehended and signed by students' legal representatives. All participants' legal representatives were provided with the information sheet and assured that their participation in the research was voluntary, and they were able to withdraw from the study at any stage of the process. Following their consent, data were collected at the participant's convenient time and day. The sample consisted of all students whose guardian signed and returned the consent form. Subjects were blinded to the purpose of the study.

### *Instruments*

#### *On-Task Behavior*

On task was defined as "oriented towards appropriate classroom activity or teacher and either interacting with materials, responding to the speaker or looking at the speaker" [3]. This definition included writing as well. Otherwise is off-task behavior. It is probable that off-task behavior could occur while seated (either on a chair or on a ball or air cushion). Observers considered on-task and in-seat

options, because students might be on-task but out of the seat, cushion, or ball. Conversely, students might be doing stereotyped movements, or be napping but in sitting position.

#### *In-Seat Behavior*

Data of in-seat behaviors was defined: Any of the child's buttocks in get in touch with the seat segment of the chair and all legs of the chair in get in touch with the floor [3]. For the intervention phase (B), any parts of the student's buttocks in contact with the air cushion, the air cushion in get in touch with the seat segment of the chair, the all legs of the chair in get in touch with the floor [13]. For the intervention phase (C), in-seat behavior was defined as any segment of the student's buttocks get in touch with the ball, the ball get in touch with the floor, and at least one foot get in touch with the floor [3].

#### *Teacher Social Validity Scale*

A social validity questionnaire was used at the end of the study to evaluate teacher opinion regarding the intervention. The questionnaire consisted of 10 questions (5 questions for ball and 5 questions for air sit cushion) and assessed effects of the intervention on sitting and activity participation, as well as the extent of preference of stability balls or air cushions instead of chairs. Questions were answered on a 5-point Likert scale that ranged from strongly disagree (1) to strongly agree [5].

#### *Data Collection*

Camera recorders in the class were used to record the students' behaviors during class tasks (sitting times and performance related to the class tasks). Students' behaviors were quantified three times per week, one day after another, with an overall of 12 sessions and for 10 minutes each session. Two occupational therapists were trained as observers of videos. In-seat and on-task behavior data were collected via momentary time sampling (MTS). In MTS observers watched videos at 10 second intervals individually, stopped them, and marked the observations on each child's worksheet that designated by researcher, thus resulting in 60 observations per session per participant. The observers coded the student's behavior on the basis of several behavioral classifications. This MTS interval served to make the observations more valid and representative of the child's in-seat and on-task behavior throughout the baseline and interventions periods.

To assess the students' class behavior, the teacher gave no extra feedback on students' sitting behaviors throughout the duration of the research. But, if a student committed a behavior that could potentially be harmful to him, peers, or the teacher, it had to be prevented by the teacher. To remove any novelty effects, students were introduced to therapy balls and air cushions instead of their common chairs for 2 days before baseline data collection. Video records were regularly checked by two occupational therapists throughout the study to determine inter and intra rater reliability agreement for at least one session per phase for each of the participants. For recognizing judgment difference between film observers, inter rater point-by-point agreement percentages were analyzed.

They ranged from 95% to 100% for in-seat behaviors and from 85% to 100% for on-task behaviors. This inter-reliability ranged from 88% to 100% in the Alicia L. Fedewa et al. research (2011). Intra rater point-by-point agreement percentages ranged from 98% to 100% for in-seat behavior and from 92% to 100% for on-task behavior after two weeks interval. These inter and intra rater must be more than 85% for conducting accurate observation.

#### *Therapy Balls*

The selected therapy balls used in the classroom had a diameter of 55 cm (Gymnic, Sit 'n' Gym, Italy), with five little feet to prevent them from moving or rolling when used as a sitting ball. Therapy balls were individually fitted with air pressure into the ball (at different degrees of inflation) that confirmed the student could sit comfortably with his feet flat on the floor, with knees and hips flexed at 90 degrees (Figure 1).

**Figure 1:** Ball



#### *Air Cushion*

The Disc 'O' Sit cushion (Sanctband, Malaysia) is round and filled with air. The Disc 'O' Sit are strong enough to sit on. They are designed to fit on a classroom chair and provide movement while seated [13] (Figure 2).

**Figure 2:** Chair and Air Cushion



#### *Chair*

A general wooden, iron frame classroom chairs without armrests (height 72 cm; depth 34 cm; width 39 cm; seat height 36 cm) (Figure 2).

**Results**

Students' class behaviors during two intervention phases (each 1 week) separated by one week intervals were compared with class behaviors during baseline and withdrawal phases (each one week). Each child's data were presented in a separate table.

Four students aged 8.75±1.9 years, mean height 132.5±9 cm, and mean weight 29.25±8.5 kg, participated in this research. Some behavioral characteristics are represented in Tables 1, 2, 3 and 4 that show a mean of 3 sessions (60 observations each session).

Participant 1 (N1) spoke with himself slowly and repeatedly with low attention. He was diagnosed with hyperactivity and demonstrated lack of tolerance sitting on a chair.

As presented in Table 1, the N1 student in the first week (A1) sat 14 (23.3%) of the quantified times on a chair, but this rate increased to 34 (56.7%) when he used a cushion on the chair for sitting. After removing the air cushion, sitting percentage dropped to 23 (38.3%) when he sat on his common chair again. This trend of fall continued until it reached 18 (30%) in final phase (C) by using the ball instead of the chair.

As shown in Table 1, 27 (45%) task-related behaviors of N1 during baseline (A1) included on-task behaviors which increased to 50 (83.3%) when he sat on a cushion. His on-task behaviors decreased again in A2 to 39 (65%) and finally reached 49 (80%) when he sat on a ball at the last phase.

Table 2 reveals a sitting percentage of the N2 student in different phases. The sitting ratio of this student was 52 (86.7%) in the first phase, and this rate slightly increased during B phase to 55 (91.7%), but when the student sat on his chair, the ratio of sitting fell to 47 (78.3%) which was less than in the first phase. In the last phase, the student showed progress in seating behavior when he recorded 58 (96.7%) for ball sitting.

As can be seen from Table 2, the N2 student revealed the highest level of on-task behavior at 55 (91.7%) in C phase, but the lowest rate of on-task behavior at 34 (55%), as shown in the Table 2 belonging to the A1 phase while he sat on a chair for the first time. The second rate of on-task behavior, as is obvious from the diagram, is 41 (66.7%) for the cushion device and, with a slight drop, the third rate fits in A2 with 38 (63.3%) for the second period sitting on a chair.

Participant number 3 (N3) was an 8-yr-old boy with

**Table 1:** N1's in-Seat and On-task/Off-task Behavior

Phase of the study	In-seat behavior	On-task behavior	Off-task or without purposeful Task				Total off-tasks
			Aimless Walking	Napping	Gazing	Stereotyped movement	
(A1) Chair	14	27	25			7	33
(B) Cushion	34	50	6			2	10
(A2) Chair	23	39	14		4	2	21
(C) Ball	18	49	9				11

**Table 2:** N2's in-Seat and On-task/Off-task Behavior

Type of Chairs	In-seat behavior	On-task behavior	Off-task or without purposeful Task				Total off-tasks
			Aimless Walking	Napping	Gazing	Stereotyped movement	
(A1) Chair	52	34	10		6	10	26
(B) cushion	55	41			3	16	19
(A2)Chair	47	38	8		4	10	22
(C) Ball	58	55			1	2	5

**Table 3:** N3's in-Seat and On-task/Off-task Behavior

Type of Chairs	In-seat behavior	On-task behavior	Off-task or without purposeful Task				Total off-tasks
			Aimless Walking	Napping	Gazing	Stereotyped movement	
(A1) Chair	24	20	33		1	6	40
(B) Cushion	53	35	3	1	18	3	25
(A2) Chair	33	28	9		20	2	32
(C) Ball	32	40	13		4	2	20

**Table 4:** N4's in-Seat and On-task/Off-task Behavior

Type of Chairs	In-seat behavior	On-task behavior	Off-task or without purposeful Task				Total off-tasks
			Aimless Walking	Napping	Gazing	Stereotyped movement	
(A1) Chair	50	47	7		2		13
(B) Cushion	59	58			1		2
(A2) Chair	49	46	2		5		14
(C) Ball	59	59			1		1

visual perceptual problems, communication disorder, and low attention span. He had stereotyped movements and echolalia. He had hyperactivity and rarely tolerated sitting on a chair.

As illustrated in Table 3, the N3 student was on the chair for exactly 24 (40%) in A1 phase, and this proportion improved markedly during B phase when it reached 53 (88.3%). However, this ratio reduced during the second chair sitting period to 33 (55%), and this trend continued until it finished with the lowest relative amount of 32 (53.3%) in the ball sitting phase.

Table 3 demonstrated the improvement of on-task behavior in the segments of B with 35 (58.3%) and C with 40 (66.7%) when the student sat on an air cushion and a ball respectively. The N3 Student sat on a chair in the A1 phase, with 20 (33.3%) less than in the A2 phase with 28 (46.7%), as shown in this table.

The ratio of seating for N4 in Table 4 was about 50 (83.3%) in the A1 phase which reached to more than 59 (98.3%) when the student sat on a Cushion, but again decreased to 49 (81.7%) in the A2 phase, and this ratio rose to 59 (98.3%) during the C phase when the student sat on the ball.

As presented in Table 4, the highest percentage of on-task behavior belongs to the C phase with 59 (98.3%) and the second rate fits in the B part when the N4 student sat on the air cushion with 58 (96.7%). The two phases of A1 and A2 had nearly the same ratio with 47 (78.3%) and 46 (76.7%) respectively with A2 being the lowest rate of all.

The teacher preferred the use of balls and air cushions for students in class according with social validity questionnaire.

## Discussion

This study was done to determine the effectiveness of ball sittings and/or air cushion sittings based on duration of sittings and classroom behaviors of ASD students. The results demonstrated that all participants had made improvements in in-seating times and on-task behaviors which followed diminishing off-task behaviors during the use of air cushions. It has been proposed that vestibular and proprioceptive stimulation in ASD students who use dynamic seating can alter arousal conditions for attention to the tasks [14]. Concerning decreasing off-task behaviors, it might be due to normalizing arousal levels and adjusting sensory information with swinging and bouncing, because students with autism who satisfy physiologically do not need more stimulation to engage in self-stimulatory behaviors [15]. Moreover, it is suggested that movement on air cushions assists to decrease off-task behavior by enhancing sensory stimulation. In accordance with previous researches, Ayres's sensory integration might be a successful strategy for diminishing off-task behaviors (e.g., gazing, stereotypy) and enhancing on-task behavior of preschool children with ASD [9]. Sitting on a ball allows the child to pay more attention to activities while receiving stimulation in a passive form, rather than seeking stimulation from disruptive activities [7].

In all four students, on-task behavior, and in two of them

(N2 and N4) seating times behavior, increased by sitting on therapeutic balls. Therapy balls provide a chance for ASD students to sit and be in motion simultaneously which may satisfy sensory needs. Movement during goal-directed tasks concurrently might decrease off-seat behaviors of the child, which possibly increases participation in class tasks [16]. As suggested by researchers, sensory seeking behaviors are always modified by dealings with activities, surroundings, and inhabitants (Dunn and Brown, 1997). Previous researching by Schilling et al (2003, 2004) also identified considerable changes in in-seat and on-task behaviors in ADHD and ASD respectively when using the therapy ball.

N1 and N3 students revealed a drop in in-seat behavior when they sat on the ball (C phase), in comparison with when they sat on a cushion. This may be due to gravitational insecurity of these two students during sitting on the ball. It should be mentioned that N1 walks with flexed and abducted upper limbs and cannot run in the school yard. N3's balance was inappropriate, and he didn't like harsh vestibular stimulation as well. To keep balance on the ball, muscles must regularly adjust for the body to remain balanced on the ball.

The teacher's reports supported the use of balls and air cushions for some students in class. Accordingly, students were calmer, and the class was quieter compared to pre-intervention situations (use of chair). Since agitation and attention deficiency seem to be due to sensory integration impairment, sitting modification in class is therefore an essential condition for education, especially in students with autism who have a deficiency in this field [18].

Two of the students, N1 and N3, showed increases in on-task behaviors during ball sittings, while sitting times were decreased simultaneously. As revealed in Table 3, N3 with 32 times in-seat behaviors had 40 times on-task behaviors and N1 with 18 times in-seat behaviors experienced 48 times on-task behaviors. These paradox behavior results showed that these two students showed better on-task behaviors in a standing position. In the literature review we found that some children exhibited increased engagement in a standing position. For example one new dynamic seating is a standing desk with Foot Fidget®. In this research a great number of children prefer Foot Fidget® and standing desk compared to other choices and they have more participation in this position [16].

The author proposed increasing the stability of the ball with something under the ball (like tires). These students may benefit from the advantages of the ball as well. Students with ASD are complex and display a wide variety of in-seat and on-task behaviors. The time of study was low (4 weeks), the sample size was small (4 students) and the use of a single classroom for research is another limitation. A longer duration of time needs for further study. A greater sample size needs to be required to add more strength to the results. Working as interdisciplinary teaming for broad investigation is one necessary concern in these schools for take parting students in inclusive schools. Therefore, broader investigations are suggested to confirm these findings. More classes and grades of students should be studied to see if the findings are valid

for different grades and age groups. The use of therapy balls and air cushions for different students (e.g., learning disabilities) may shed light on the effectiveness of these devices. Future researches may include other classroom behaviors and student performance in a variety of educational situations.

## Conclusion

This investigation suggests that dynamic seating in the classroom increases on-task behaviors of almost all students with ASD. Therefore, air cushion seating devices were found appropriate for all students in this research, but results demonstrated unique responses of students with ASD to the use of balls for sitting. One main reason for this uniqueness is role of balance factor for children with balance problems, and it should be examined prior to intervention, because students play almost all the time to adjust disequilibrium tendencies [17]. For some ASD students, the use of ball sitting appeared to be positive to help teachers in class. The teacher reported that therapy balls and air cushions were not only preventing disruption of class conditions, but their use also made students become more courageous about doing their tasks. Teacher recommended these interventions for ASD students to other teachers as well.

In an attempt to establish inclusive education classes for ASD children, we need to change the schools' environment to provide ideal interventions for these students. Because students always spend about 5 hours a day in school over many years, these conditions therefore increase the chances of making perfect and sensory-based changes, to help progressing classroom behavior of these students for better educational achievements. With regards to thousands of special students with difficulty in sitting and classroom performance, these devices may be an optional selection for solving the mentioned class behavior problems.

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