# Ayres Sensory Integration® for Addressing Play in Autistic Children: A Multiple-Baseline Examination

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**Importance:** Play is an area of difficulty for autistic children, and occupational therapy practitioners need evidence to guide interventions to improve play for this population. Ayres Sensory Integration® (ASI) intervention has not yet been studied for its impact on play outcomes.

**Objective:** To examine the impact of ASI intervention on play types in autistic children.

**Design:** Nonconcurrent, multiple-baseline design across subjects.

**Setting:** Outpatient occupational therapy clinic in New England.

**Participants:** Three autistic children, ages 5, 6, and 6 yr.

**Intervention:** Twenty-four ASI sessions.

**Outcomes and Measures:** Frequency of play type was coded using partial interval coding. Progress monitoring used Goal Attainment Scaling.

**Results:** All three participants demonstrated changes in the frequency of specific types of play, but changes varied among them.

**Conclusions and Relevance:** Findings suggest that ASI intervention may alter a child's patterns of play.

**What This Article Adds:** This study is the first to examine the impact of ASI on play and the third that documents the feasibility of single-subject research for studying ASI. If confirmed in future studies, ASI could become an evidence-based intervention for improving play, an important outcome for autistic children and the profession of occupational therapy.

**Positionality Statement:** This article uses the identity-first language *autistic people.* This nonableist language describes their strengths and abilities and is a conscious decision. This language is favored by autistic communities and self-advocates and has been adopted by health care professionals and researchers (Bottema-Beutel et al., 2021; Kenny et al., 2016).

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Autistic children demonstrate difficulties with varied forms of play (American Psychiatric Association, 2013; Hancock, 2020; Kasari & Chang, 2014; Thiemann-Bourque et al., 2019; Westby, 2022; Wilson et al., 2017). Play has been categorized in many ways (Thiemann-Bourque et al., 2019; Westby, 2022). *Object play* can be sensorimotor (or exploratory), relational, functional, or symbolic. *Sensorimotor,* or *exploratory, play* examines play objects using the senses. *Relational play* occurs when children combine and relate objects to each other (e.g., stacking, putting one object into another). *Functional play* describes actions where play items are used as they were intended (e.g., talking into a play phone). *Symbolic play* includes the use of pretense; often, the terms *symbolic play* and *pretend play* are used interchangeably. The most consistently reported differences in the play of autistic children include limited symbolic play and greater repetitive play (Thiemann-Bourque et al., 2019).

Studies of play with autistic people have frequently examined the types of play that children engage in, the frequency of varied types, and their developmental appropriateness, often in comparison with the types of play of typically developing children (Westby, 2022).

For decades, studies have suggested that autistic children may select objects for play because of their sensory features and that sensorimotor play may occur with the greatest frequency (Dominguez et al., 2006; Holmes & Procaccino, 2009; Holmes & Willoughby, 2005; Williams, 2003). At young ages, exploratory play behavior may be similar between autistic and nonautistic children, at least partially because the types of play that are common to young age groups are within the developmental reach of autistic children (Baranek et al., 2005). Studies vary in their findings related to functional play, with some showing minimal to no differences between autistic and nonautistic children (Naber et al., 2008; Thiemann-Bourque et al., 2019; Williams, 2003). However, other studies suggest that autistic children spend less total time in functional play compared with matched controls and that their play is also less varied, more repetitive, and of poorer quality (Jarrold et al., 1993, 1996; Lewis & Boucher, 1988; Westby, 2022; Williams, 2003). Differences may be due to variations in samples and matching procedures. A diminished ability to pretend play is commonly reported (Jarrold, 2003; Westby, 2022). However, multiple studies have documented that autistic children are capable of pretending (Hobson et al., 2009; Jarrold et al., 1993; Lewis & Boucher, 1988; Libby et al., 1998). Symbolic play has been the most studied type of play of autistic children, and deficits are most evident during free play (González-Sala et al., 2021; Westby, 2022). Play abilities may be less sophisticated in those who eventually receive a diagnosis of autism (Manning & Wainwright, 2010; Wilson et al., 2017).

Beneficial outcomes of play include developing motor, cognitive, social, and emotional skills—competencies that can lead to the enhanced confidence and resiliency needed for navigating life's challenges (Yogman et al., 2018). Improvements in play may also lead to improved function in other areas, such as language, coping, creativity, flexibility, emotion regulation, or neural growth (Doernberg et al., 2021; Kasari et al., 2012; Montgomery, 2014; Toth et al., 2006; Yogman et al., 2018), and some have argued for the importance of enhancing play as an outcome in its own right (Fahy et al., 2020; Ray-Kaeser & Lynch, 2017).

Occupational therapists hypothesize that the play differences of autistic people may be related, in part, to the dyspraxia and sensory processing difficulties commonly reported in this population (Baranek et al., 2019; Bodison, 2015; Dowell et al., 2009; MacNeil & Mostofsky, 2012; Miller Kuhaneck & Britner, 2013; Roley et al., 2015). Therefore, intervention to address sensory processing concerns could theoretically improve play as well. The child-directed Ayres Sensory Integration® (ASI) intervention is commonly used by occupational therapy practitioners; ASI is hypothesized to lead to improvements in sensory processing and praxis and, through these improvements, to greater functional participation in everyday occupations requiring attention, organization, posture and balance, eye–hand coordination, and motor planning, such as play (Ayres, 1972). Studies that adhered to the ASI Fidelity Measure© for intervention (Parham, Cohn, et al., 2007; Parham et al., 2011) have documented a variety of positive outcomes from ASI, including attainment of individualized goals, improvements in behavior, improvements in motor skills, and reductions in assistance required for self-care (Andelin et al., 2021; Schaaf et al., 2018; Schoen et al., 2019; Watling & Hauer, 2015). However, there is insufficient investigation of play outcomes after ASI within the published literature. Therefore, the purpose of this study was to examine the effect of ASI on autistic children's play.

# Method

## Design

Given that autistic children present with unique profiles, a single-subject research (SSR) approach was selected. Although the withdrawal design is considered the gold standard in SSR, neural plasticity—the proposed mechanism of change in ASI—has a lasting effect, thus making this design inappropriate. Therefore, a nonconcurrent, multiple-baseline design (Coon & Rapp, 2018; Watson & Workman, 1981) across participants was implemented that allowed for examination of ASI in the typical setting in which it is provided and within the natural occurrence of children being referred for and receiving services (Bulkeley et al., 2013). The study was approved by the Sacred Heart University Institutional Review Board (No. 161108A) and followed conventions for SSR (Ganz & Ayres, 2018; Horner et al., 2005; Kratochwill et al., 2013; Tate et al., 2016).

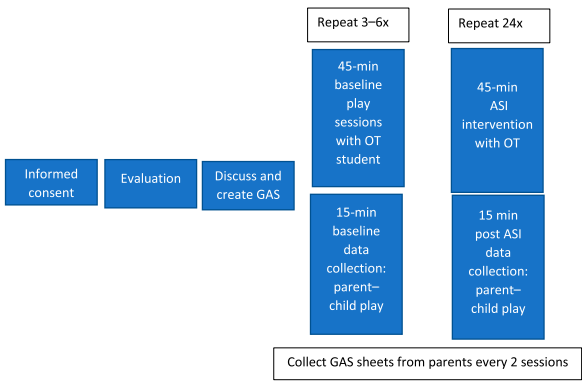
## Procedure

A visual representation of the study procedures is provided in Figure 1.

### *Recruitment*

Inclusion criteria included English-speaking autistic children ages 3 to 6 yr without a seizure disorder or

**Figure 1. Study procedures.**




*Note.* ASI = Ayres Sensory Integration®; GAS = Goal Attainment Scaling; OT = occupational therapy.

motor disability. This age range was selected because it is when many children are first diagnosed as having autism spectrum disorder (ASD; Fountain et al., 2011) and have not yet begun outpatient occupational therapy services. Participants were recruited via email, paper flyers, and contacts through local occupational therapy practitioners. For each child, one parent or caregiver was required to participate and remain consistent throughout the study. Recruitment yielded 3 father–child dyads. Evaluation and treatment were provided free of charge.

### Evaluation

After obtaining informed consent and documentation of an ASD diagnosis, an occupational therapy evaluation was completed to document each participant's specific difficulties with sensory processing, as recommended in the occupational therapy practice guidelines (Watling et al., 2018). Parents completed a demographic sheet and five published assessment tools: either the Home Form of the Sensory Processing Measure (SPM; Parham, Ecker, et al., 2007) or the Sensory Processing Measure–Preschool (SPM–P; Kuhaneck et al., 2010), Vineland Adaptive Behavior Scales (VABS; Sparrow et al., 2005), Parent Stress Index (PSI; Abidin, 1995), Parenting Sense of Competence Scale (PSOC; Gilbaud-Wallston & Wanderson, 1978), and a self-efficacy scale created by Hess et al. (2004). In addition, during completion of the occupational profile, parental concerns and reasons for choosing ASI intervention for their child were investigated. Thereafter, the children completed three assessments, including the Beery–Buktenica Developmental Test of Visual–Motor Integration (VMI; Beery et al., 2010), clinical observations of motor skills and play, and a human figure drawing. The combined results from the SPM or SPM–P, VMI, human figure drawing, parent interview, and clinical observations were used to document developmental skills and the presence of sensory processing difficulties before study onset. All evaluative findings were used to guide intervention. Table 1 provides participant SPM, SPM–P, and VMI scores.

### Goal Development

After an initial evaluation, the parent met with the occupational therapist to discuss evaluation results and collaborate on identifying desired goals to guide intervention, either in person or by phone conferencing. Goals were scaled using Goal Attainment Scaling (GAS; Kiresuk et al., 1994), which has been used successfully in other studies of ASI (Mailloux et al., 2007; Schaaf et al., 2014).

### Baseline Phase

The baseline phase consisted of three to six free-play sessions with each child over 2 to 4 wk. The child was invited to play with a standard set of toys (described in the following text) for 45 min. The research assistant (RA) was an occupational therapy graduate student who provided supervision and interacted only when approached by the child but did not teach, model, demonstrate, or guide. The purpose of the play sessions was to ensure that the child experienced the same amount of time with a novel adult as during the intervention phase. This step was implemented to reduce the possibility that differences noted during measurement were due to fatigue, the novelty of playing in the clinic space, or interacting with a novel adult.

### Intervention Phase

Intervention consisted of a minimum of 24 45-min sessions of ASI with a trained occupational therapist (Heather M. Kuhaneck). Sessions were individualized to address the child-specific patterns of difficulty identified through evaluation. All children took part in activities that provided multisensory input and challenges to praxis. Participants engaged in child-directed activities in collaboration with the occupational therapist. The therapist sought to create the just-right challenge for each child, so that each could learn new skills through play, without frustration or failure.

### Outcome Measurement

Each dyad, which included the child and the child's father, would play during the 15 min immediately after either free play or ASI intervention sessions. The fathers were instructed to play with their child in the way they typically would, using whichever toys they liked. These play sessions were recorded for later coding and analysis.

**Table 1. Participant Initial SPM *T* Scores and VMI Scores**

| | SPM Scales | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Participant | SOC | VIS | HEA | TOU | BOD | BAL | PLA | TOT | VMI |
| Sam | 66 | 68 | 64 | 55 | 63 | 51 | 63 | 62 | 0 |
| Callie | 62 | 57 | 43 | 64 | 48 | 57 | 53 | 56 | 92 |
| Karl | 80 | 72 | 64 | 63 | 50 | 67 | 76 | 67 | 0 |

*Note.* Data are SPM *T* scores (40–59 = typical; 60–69 = some problems; and 70+ = definite difficulties). VMI scale scores have a mean of 100 (*SD* = 15). BAL = Balance and Motion (Vestibular); BOD = Body Awareness (Proprioception); HEA = Hearing; PLA = Planning and Ideas (Praxis); SOC = Social Participation; SPM = Sensory Processing Measure, Home Form; TOT = Total Sensory Systems; TOU = Touch; VIS = Vision; VMI = Beery–Buktenica Developmental Test of Visual–Motor Integration.

### Fidelity Checks

As previously recommended (Perepletchikova, 2011), a trained ASI Fidelity Measure rater, who met the qualifications and demonstrated reliability using the ASI Fidelity Measure (Parham et al., 2011), examined a random sample of 30% (16 sessions) of the intervention sessions for fidelity. The Fidelity Measure assesses therapist qualification; structural elements of the therapy space, including essential equipment and environmental affordances for safety; documentation practices; provider–client communication; and 10 process elements that measure the therapeutic strategies used when delivering ASI. The 10 process elements, which record the degree to which each element is present, are rated on a scale ranging from 1 (*No, I don't think the therapist intentionally uses this strategy*) to 4 (*Certainly, I think the therapist intentionally uses this strategy*), with a score of 32 (80%) or higher considered as meeting fidelity for ASI. Of the 16 sessions rated for fidelity, 1 was rated 38 out of 40 (95%), 6 were rated 39 out of 40 (98%), and 9 were rated 40 out of 40 (100%), indicating that all sampled intervention sessions met the criteria for fidelity to ASI intervention.

### Parent Education

Parent education, considered an important part of ASI (May-Benson et al., 2014; Parham et al., 2011), is typically one-on-one communication with the therapist. For this study, the aim was to provide standardized parent education and allow both parents of each child to receive the education; thus, a prerecorded online webinar with 42 PowerPoint Office Mix slides was created and provided. The content covered sensory integration theory and the intervention approach. Parents were able to view and listen to the prerecorded webinar at a time and place of their own choosing. Approximately 6 wk into the intervention phase (12 sessions), parents were invited to observe the intervention sessions. However, to be family centered, observation was not required.

### Setting and Materials

All sessions occurred in an outpatient occupational therapy clinic. Free-play sessions always occurred in a small space with only those toys brought for the session; the people present included the child, one occupational therapy graduate student, and one videographer. The standard set of toys—including items such as puzzles, coloring books, pop beads, bubbles, and a fishing game—were placed on the floor. This space also included an adult-sized desk and chair. ASI sessions occurred in multiple rooms throughout the clinic. Equipment included all of the typical materials commonly available in an outpatient therapy clinic providing ASI intervention (May-Benson et al., 2014; Parham et al., 2011). ASI sessions included the child, one occupational therapist who delivered the intervention, and the videographer. On occasion, the child's father would be present to observe the intervention session. Measurement sessions occurred in a room with toys provided for parent–child play. The room was equipped with a standard set of toys, including stuffed animals, dolls, cars, ride-on trucks, dress-up materials, puppets, play groceries, and Mr. Potato Head toys (Kuhaneck et al., 2022). All toys for the parent–child play sessions were provided in duplicate so that imitation with identical materials could readily occur. People who were present during the measurement sessions included the child, the child's father, and the videographer.

## Data Collection

We developed coding categories and descriptions on the basis of prior research that used coded play with time sampling (Baranek et al., 2005; Kasari et al., 2006; Libby et al., 1998; Ungerer & Sigman, 1981). Across at least two decades of studies using varied and multiple methods for assessing play, one common approach has been time sampling with play coding schemes (Baranek et al., 2005; Dominguez et al., 2006; Libby et al., 1998; Wilson et al., 2017). Prior research has categorized play using variations of the following terms in different combinations: *sensorimotor* or *exploratory, relational, functional,* and *symbolic* or *pretend.* In addition, object play, functional play, and pretense or symbolic play have been divided and subdivided into more specific categories of actions to investigate more narrow research questions related to a specific type of play. For the purpose of this study, specific categories of play were assembled from prior literature, adding categories and expanding where appropriate, such as focusing on manipulative play and imitative play as potential outcomes of interest in a study of ASI.

Videos of parent–child dyad play sessions were coded for play type by a trained research assistant who was blinded to phase and session order, using partial interval time sampling with 30-s intervals. Eight different play categories were coded: pretend, intermediate pretend, manipulative, imitative, interactive, room exploration, sensory, nonplay, and clean up. To be coded as pretend, it needed to be clear that the child was using an object to stand in for something else—that they were imagining absent objects, verbalizing pretend, or attributing properties to a toy (e.g., opening a toy pot and smelling the "food" within). Any behaviors that appeared to be imaginary play but were not confirmable by the rater because of the lack of vocalizing were coded as intermediate pretend. Manipulative play was coded if the child was grasping and moving toys or objects with the hands and fingers; for example, if the child was building, drawing, twisting, turning, or spinning objects. Manipulative play could be either functional or relational object play but had to include fine motor manipulation. Imitative or interactive play was coded when the child directly imitated something that the father did immediately after the father's action. Room exploration was coded

when the child was searching through the bin of toys or actively looking around the play area for the next play activity. Sensory play was coded when children sought out specific movement or play activities that provided sensory input, such as jumping, pushing buttons for toys that made noises, or generating sensory experiences such as making noises while looking at themselves in a mirror. Nonplay was coded if the child was staring into space and not moving, standing in one place and rocking back and forth on the feet, flapping hands and wrists, or wandering about the room nonpurposively. Within nonplay, a clean-up category was coded when the child was putting toys away or moving them out of the way. Intervals could be coded with more than one type of play. For example, if a child was pretending with small toys and objects and manipulating them during the pretend, that interval would be coded for both pretend and manipulative play.

### *Social Validity*

Postintervention, the parents completed a survey to examine social validity. A tool by Berger et al. (2016) was adapted by shifting item wording from future tense (i.e., intervention will) to past tense (i.e., intervention did). Parents used a Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) to rate 20 items related to the acceptability of interventions and perceptions of effectiveness. With a mean score of 6 on a 7-point scale, the parents of all 3 participants rated the intervention positively in terms of their perceptions of effectiveness and fit with their families.

### *Procedural Integrity and Interobserver Agreement*

Procedural integrity checks were completed for control variables for each evaluation, free play session, and measurement session (Ledford & Wolery, 2013) by the primary investigator (Kuhaneck) or the RA. Control variables included, for example, that the correct people were present for the session, the correct toys were present, the proper space was used, the parent and child played for the correct amount of time as measured by a timer, and the play session was filmed unobtrusively. Procedural variations included three parent–child play sessions that excluded one of the typically included toys at a parent's request, one session that was cut short in length because of a toileting issue, and occasional nonplay interaction that occurred between the child and the videographer (e.g., during the course of play, the child bumped into the person filming or the person filming had to move out of the way), and, because the study was implemented at an operational outpatient clinic, occasional interruptions occurred where additional adults or children entered the room briefly.

Before coding the parent–child play sessions, an RA demonstrated 92.5% interobserver agreement (IOA) with Kuhaneck using training tapes and 90% IOA with a second RA. All play sessions were coded in random order with the RAs, who were blind to session order and phase. IOA of play codes between the two RAs was examined in 30% of the sessions across phases and participants. After coding the 19 parent–child play sessions individually, the RAs achieved 90% IOA.

## Participants

All 3 autistic children were diagnosed by a medical professional and were ages 5 to 6 yr. None had an active seizure disorder or any other diagnosis that might impair movement. There were two boys, Sam and Karl, and one girl, Callie. Table 2 lists the participant characteristics. As is common with autistic children, considerable variation was noted among participants in functional level, communication skills, and initial play ability.

Sam was age 5 yr and had no significant medical history or medication use. He received applied behavior analysis (ABA), speech therapy, relationship development intervention, and non-ASI occupational therapy services at school. Sam's father was age 47 yr, his mother was age 36 yr, and both parents had graduate degrees. The family self-identified as Asian. The evaluation identified Sam's primary issues regarding sensory processing as limited body awareness and balance and intense sensory seeking for movement, including spinning and jumping. He also demonstrated frequent flicking of any long, thin-shaped objects. He had difficulty with multiple-step activities and copying from a model. He was easily distracted by background noises, and he frequently repeated sounds himself. His play was extremely repetitive, primarily sensorimotor in nature, and frequently included songs. He was more imitative with his father than with the therapist during his initial evaluation.

**Table 2. Participant Characteristics**

| Child | Age, yr | Reported Ethnicity | F/M Education | Language Spoken | Child Gender | VABS Play | VABS Gross Motor Skills |
|---|---|---|---|---|---|---|---|
| Sam | 5 | A | G/G | E | Ma | 4 | 10 |
| Callie | 6 | C | HS/UG | E | Fe | 13 | 12 |
| Karl | 6 | A | G/G | E | Ma | 6 | 9 |

*Note.* VABS scores have a mean of 15 (*SD* = 3). A = Asian; C = Caucasian; E = English; F = father; Fe = female; G = graduate degree; HS = high school; M = mother; Ma = male; UG = undergraduate degree; VABS = Vineland Adaptive Behavior Scales.

Callie was age 6 yr and was not on medication but had hip dysplasia as an infant. Callie's father was age 36 yr, with some college-level education, and her mother was age 37 yr with a college degree. The family self-identified as Caucasian. Callie's evaluation results identified tactile defensiveness, with specific difficulties related to foods and clothing, and dyspraxia evidenced by poor coordination, sequencing, and activity refusal or avoidance. Her preferred types of play were limited, and she frequently verbalized ideas for play that were motorically too difficult for her to perform. When unable to implement her idea successfully, she would become frustrated or angry and often blamed an adult or the play object. She would try to control all aspects of play interactions and attempted to dictate what her play partner could and could not do. She also used verbalization to stall when activities were motorically difficult.

Karl was age 6 yr, had no significant medical history or medications, and received ABA therapy 4 hr/day and speech therapy 1 hr/wk. Karl's father was age 61 yr and self-employed, his mother was age 51 yr, and both parents had graduate degrees. The family self-identified as Asian. His primary sensory processing issues included sensory defensiveness and vestibular sensory seeking with low tone and extremely limited postural endurance. His play was repetitive and sensorimotor in nature. He demonstrated a preference for toys with auditory input and movement activities that required little physical effort. For example, he preferred movement equipment that provided complete postural support.

### Data Analysis

Visual analysis is the primary and standard method of examining outcome variables in single-subject research (Ledford et al., 2018). Visual analysis is considered most appropriate when there is an unstable baseline, delayed changes in trend, or greater variability in overlap between the beginning of the intervention phase and the end (Manolov et al., 2016). Furthermore, because the effects of ASI were hypothesized to show greater changes over time and immediate effects were not expected, visual analysis was most appropriate for this study. Frequency data were graphed for each participant using the conventions proposed by Carr (2005) and Coon and Rapp (2018; see Figures A.1–A.5 in the Supplemental Appendix, available online with this article at https://research.aota.org/ajot). The resulting line graphs were visually analyzed using standard criteria, including examination of between-phase changes, for level, trend, immediacy of effect, and consistency (Fisher et al., 2003; Gast & Ledford, 2014; Kazdin, 2011; Kratochwill et al., 2013). Level was compared using the mean of the data points in each phase, as well as the median, because the median can be a better estimate when there is variability in the data (Engel & Schutt, 2013). Trend was compared using the Nugent (2010) method to draw a line from the first to last data point in the phase.

There are multiple methods of examining effect size using data overlap, and there is not yet agreement on which effect size metric is preferred (Carr et al., 2015; Chen et al., 2016; Lenz, 2013). In addition, some authors have suggested that none of the methods have high discriminability for successful interventions and that disagreement with visual analysis may occur, depending on the metric chosen and the patterns of data (Chen et al., 2016). Therefore, they are best thought of as complements to visual analysis (Maggin et al., 2019). The percentage of nonoverlapping data (PND) is the most extensively reported metric, and it has been examined specifically for data sets from autistic people (Carr et al., 2015). Therefore, the PND was selected for this study to include a measure of effect size. The PND compares the most extreme value in the baseline, in the intended direction of change, with the data points in the intervention phase (Maggin et al., 2019). If the baseline data point equals or exceeds the intervention data point, those points are considered overlapping data. The PND is then the number of nonoverlapping data points in the intervention phase divided by total intervention phase points. The PND requires an understanding of the hypothesized direction of change with intervention. On the basis of the children's age, the typical developmental sequence of play, and the preference for sensorimotor play in autistic children, the hypothesized directions of change were for sensorimotor play to decrease in frequency, but for imitative, manipulative, and pretend play frequency to increase. Because exploration was coded as the children looked through the play materials to find something to play with, and the toys were held consistent throughout the study, exploratory play was hypothesized to decrease over time as the children became accustomed to what was available to them.

## Results

### Attendance and Duration of Intervention

The 3 father–child dyads varied in their attendance, and all 3 had cancellations with rescheduling. Sam had eight sessions rescheduled for various reasons that were often employment or family related. The rescheduled visits were primarily during the end of his intervention period, in particular, once school had started again for the fall. Sam's eventual course of intervention lasted 6 mo. Callie had four sessions rescheduled because of snow, illness, or a family vacation. One visit was eliminated because Callie's mother came instead of her father. Callie's eventual course of intervention lasted 4 mo. Karl had three sessions rescheduled because of illness and one because of a family vacation. His eventual course of intervention lasted 4 mo. Both Callie's and Karl's families decided to continue intervention poststudy.

### Frequency of Play Type

Visual analysis suggested a change in the pattern of frequency of play type over time for all participants (see Figures A.1–A.5). All 3 children showed improvement in mean level of manipulative play across phases. The level of Sam's, Callie's, and Karl's mean percentage of intervals for manipulative play increased from 38% to 60%, 68% to 75%, and 36% to 44%, respectively. Two of the 3 children demonstrated a decrease in mean level of frequency of sensorimotor play, with Sam's, Callie's, and Karl's mean percentage of intervals for sensorimotor play changing from 51% to 60%, from 14% to 3%, and from 37% to 29%, respectively.

Generally, the nature of the changes was unique to each child. Sam demonstrated the most variability in some aspects of his play behavior, with his most limited engagement in pretend play. Sam's mean level of imitative play increased from 25% to 54% of the intervals, and his manipulative play increased from 38% to 60% of the intervals. Although Callie demonstrated variability in her play with her father, there appeared to be a relationship between changes in her manipulative play and pretend play, such that as she was trending toward greater manipulative play, her pretend play was trending downward. Over time, she demonstrated both fewer intervals with pretend play and more consistent bouts of manipulative play, which included building, drawing, and sedentary fine motor activities. Karl demonstrated minimal pretend play that remained consistent throughout the study, as well as inconsistent imitative play with a slight increase shown in trend. Karl's mean level of imitative play increased from 9% to 15% of intervals. (Table 3 shows the changes in level for all participants.)

There are some differences of opinion as to the interpretation of values for nonoverlap of data effect sizes. Some recommend that values between .50 and .70 indicate a moderate effect and that values greater than .70 indicate a large effect (Kazdin, 2021). However, others suggest that effect sizes of .90 and greater indicate very effective treatments, whereas those from .70 to .89 indicate moderate effectiveness, those between .50 and .69 are debatably effective, and values less than .50 are regarded as not effective (Scruggs & Mastropieri, 1998). Using Kazdin's (2021) interpretation, 2 children demonstrated moderate effect sizes in changes in frequency of one type of play, and 2 children demonstrated large effects in changes in frequency of one type of play. Sam is the only child who experienced substantial effects in changes in frequency in two play types. (Table 4 provides information on the percentage of nonoverlapping data for each child and each type of play.)

## Discussion

The "active ingredient" in ASI is proposed to be child engagement in multisensory activities that improve the child's ability to plan, move, and interact effectively in the environment (Ayres, 1972). Effects from ASI are often discussed in terms of proximal or distal outcomes. *Proximal outcomes* are those areas related to the body and sensorimotor functions, whereas *distal outcomes* are functional skills related to participation challenges (May-Benson et al., 2018). This study examined the effect of ASI on play, a distal outcome.

For all 3 children, the frequency of play type changed over the course of intervention. The most consistently noted change was an increase in the frequency of intervals with manipulative play. Manipulative play relies heavily on motor skills. This finding is not unexpected, because motor skills are theorized to improve with ASI, and prior research has suggested that they do (Andelin et al., 2021). Furthermore, just as each child demonstrated different initial abilities in play, sensory processing, and adaptive functioning on initial evaluation, their paths toward change were also unique. For example, Callie did not increase her frequency of imitative play, whereas Sam and Karl both did. Callie's limited engagement in imitative play may have been related to her difficulties with praxis and preferring to be the one calling the shots rather than imitating, because it is not uncommon for autistic people to demonstrate what can be called bossy or controlling behaviors (Overskeid, 2016), and these types of behaviors have been related to a tendency for systematizing (Baron-Cohen, 2008). Sam's increased level of change in imitative play may have been due to his father's persistence in working with him to imitate, which is described in a separate publication (Waldman-Levi & Kuhaneck, 2023). It is notable that Sam and Karl, who started the study with low levels of pretending, displayed only minimal change in this domain. Pretend play is known to be difficult for autistic children (Douglas & Stirling, 2015) and, as a distal outcome, perhaps required a greater duration or dosage of intervention. It is interesting that this was noted anecdotally for Karl, who remained in intervention after the end of the study and was observed to begin

**Table 3. Changes in Level of Mean (and Median) Percentage of Intervals**

| | % of Interval for Play Category, *M* (*Mdn*) | | | | |
|---|---|---|---|---|---|
| **Child** | **Sensorimotor** | **Room Exploration** | **Imitative–Interactive** | **Manipulative** | **Pretend** |
| Sam | +9 (+33) | +1 (0) | +29 (+26) | +22 (+24) | −2 (0) |
| Callie | −11 (−13) | −24 (−22) | +0.3 (0) | +7 (10) | −2 (−7) |
| Karl | −8 (−13) | +7 (+8) | 6 (+3) | +8 (+3) | −1 (0) |

*Note. Mdn* = median.

**Table 4.** Percentages of Nonoverlapping Data

| Child | % Nonoverlapping Data in Play Category | | | | |
|---|---|---|---|---|---|
| | Sensorimotor | Room Exploration | Imitative–Interactive | Manipulative | Pretend |
| Sam | 0.16 | 0.00 | 0.56 | 0.72 | 0.00 |
| Callie | 0.75 | 0.83 | 0.08 | 0.08 | 0.29 |
| Karl | 0.38 | 0.04 | 0.38 | 0.42 | 0.00 |

pretending within the 2-mo period after data collection ended. The necessary duration of intervention to produce an observable impact on pretend play requires further study.

## Limitations

Nonconcurrent, multiple-baseline designs have been argued to be limited in their ability to determine history effects (Carr, 2005; Harvey et al., 2004). However, others have suggested that this design rules out many threats to internal validity because participants are not contemporaries and, therefore, extraneous variables are not likely to affect each participant similarly (Christ, 2007; Watson & Workman, 1981). The 3 participants in this study came from different towns and different schools, and they participated in different therapies and activities, so the same effect across all 3 is unlikely.

Variations in child observation may also be a limitation. There was variation in the amount of time each father observed ASI. This could have led to unknown differences in how a specific father played with his child, and fathers who observed more intervention might have more readily emulated the behaviors of the therapist while playing. In addition, when a father observed ASI, this added an additional adult in the room, which also may have altered the child's behavior during the treatment. It is unclear how the father's observation may have affected measurement in the play session that followed. Last, during free-play sessions, there was a new adult observing and supervising the participants, and it is also unclear how this occurrence may have influenced the measurement sessions with the father–child play sessions.

We designed the measurement scheme, and this may also present a limitation of this study. However, it may also be a strength in relation to the study of play within occupational therapy, because it specifically addressed aspects of play that are of interest to our profession. Although newly developed, the method did result in appropriate levels of IOA and was based on prior research.

The greatest limitation for this study was the varied length of intervention phase that occurred because of scheduling challenges. Although all participants received at least 24 sessions, it is unknown whether the total length of intervention or the time elapsed between sessions influenced outcomes. Sam missed and rescheduled the most sessions, and he made the least progress over all. Because the occupational therapy profession requires salient information about the required total dosage and duration of ASI related to effectiveness, this should be studied further.

## Implications for Occupational Therapy Practice

This study has the following implications for occupational therapy practice:

- ASI may lead to increased play engagement for autistic children, first evident in the motor aspects of play.
- Changes in play among autistic children after ASI are likely to be highly variable depending on the child's presenting profile.
- Autistic children may need longer duration of intervention to make changes in pretend play.

## Conclusion

The findings of this study suggest that ASI intervention may alter a child's patterns of play and may specifically improve motor play initially. Play is an important feature of childhood and parent–child interaction and provides a multitude of beneficial outcomes. Improved play among autistic children may alter developmental trajectories in a variety of additional areas and, as such, it is an important outcome of occupational therapy intervention. Play is also pleasurable and enjoyable and is important in its own right. This study sought to determine whether ASI intervention could alter play patterns among autistic children, and this aim was achieved. Further research is needed to determine the proper dosage, duration, and frequency of ASI to best affect play.

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