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# Object Play in Infants With Autism: Methodological Issues in Retrospective Video Analysis

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**OBJECTIVES.** Using a taxonomy of object play, this study describes methodological issues in using retrospective video analysis and computer-based coding as a research tool for early identification of autism.

**METHOD.** Home videos of 32 infants with autism ( $n = 11$ ), developmental delay ( $n = 10$ ), and typical development ( $n = 11$ ) were edited and analyzed for duration and highest level of object play in four hierarchical categories (exploratory, relational, functional, symbolic) using The Observer 3.0.

**RESULTS.** The three groups had similar levels of engagement with objects, and no statistically significant differences in duration of exploratory play. Higher levels of play were rarely evident at 9–12 months, however, the highest level achieved (functional play) was apparent only in the typical group.

**CONCLUSION.** This study provides the first naturalistic investigation of object play skills in infants with autism ages 9–12 months. It also demonstrates feasibility for using computer-based coding technology within the context of retrospective video analysis methods. Duration of exploratory play was not a discriminating feature of autism at this early age.

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Play is regarded as a child's primary occupation and fundamental to the development of many skills. Through engagement in play, the infant acquires a basic understanding of the physical world and how to interact with it. Play is also the central focus of social interactions between infants and caregivers (Doctoroff, 1996) and is correlated with some aspects of language development (Kennedy, Sheridan, Radlinski, & Beeghly, 1991; McCune-Nicolich & Bruskin, 1982). Consequently, analysis of how children play can give crucial insight into their symbolic, physical, communicative, and social competencies (Knox, 1997). Such assessment of play in young children may augment the early identification of developmental disorders such as autism that usually remain undetected until the child is older.

Factors inhibiting identification of autism in infants include (1) the lack of a biological marker, (2) the heterogeneity of the disorder and its developmental course, (3) the lack of specific diagnostic criteria appropriate to infancy, and (4) delayed referrals to specialists by professionals to whom parents express concern (Prizant & Wetherby, 1993; Stone, 1997). Autism is typically diagnosed between 2 and 4 years of age and presents with qualitative impairments in social interaction, communication, and repetitive patterns of behavior (American Psychiatric Association [APA], 1994; Filipek et al., 1999). Formal diagnoses before the age of 2 years are difficult because conventional diagnostic criteria require development of cognitive and language abilities not usually apparent before this age. However, many parents report the existence of symptoms when the child is around 18 months of age (Bailey, Phillips, & Rutter, 1996; Stone, Lemanek, Fishel, Fernandez, & Altemeier, 1990), and often have concerns about development as early as the first year of the child's life (Gillberg et al., 1990).

Through analysis of home movies taken prior to the time of diagnosis, several research studies have identified potential early indicators of autism. These studies have found that symptomatology presenting in the first year of life may include deficits in social reciprocity and shared attention, difficulty orienting to social stimuli (e.g., name call), absence of some types of nonverbal communication (e.g., pointing or gestures), gaze aversion, and sensory processing and attentional deficits (Adrien et al., 1991; Baranek, 1999; Osterling & Dawson, 1994).

The aim of this study was twofold: (1) to provide insight regarding the nature of object play and its role in identifying early manifestations of autism, and (2) to address methodological considerations of retrospective video analysis procedures and a computer-based coding program (The Observer 3.0). In this paper, we review the existing literature on object play development as a means to understand early symptoms of children with autism. This literature also guided the creation of a coding scale that allowed for the comparison of object play patterns of typical infants, infants with developmental delay, and infants with autism using retrospective video analysis and sophisticated technological applications for coding.

## Developmental Levels of Object Play

Object play in this study refers to the child's physical interaction with inanimate entities in the environment for the primary purpose of playful engagement, sensorimotor exploration, or symbolic functions, or all three. Thus, use of objects for primarily self-care functions (e.g., eating) are not included in our definition. Currently, there is no universally accepted scale used to identify or categorize object play in children, however, hierarchical taxonomies reflecting various functions of object play are commonly described.

The first level of object play is typically referred to as *exploratory play*. Exploration refers to the way that an infant examines the environment in order to gain information from objects or toys (Power, Chapieski, & McGrath, 1985). Although exploration is one of the first stages of infant development, spurred by the development of visually guided reaching (Doctoroff, 1996), it does not disappear but rather becomes more sophisticated with development. At this level, no apparent functional relationship exists between the infant's actions and the actual object; thus, infants may explore objects by mouthing them or applying simple repetitive manipulations (e.g., banging, shaking, and poking). Several researchers have expanded upon the construct of exploratory play to distinguish between random and systematic actions. Distinctions have been made between indiscriminate and discriminate actions (Lifter, Sulzer-

Azaroff, Anderson, & Cowdery, 1993), repetitive sensorimotor play and "true" exploration (Libby, Powell, Messer, & Jordan, 1998), and mouthing and simple manipulation (Belsky & Most, 1981). In all instances, actions upon single objects remain a key determinant of this type of play.

The second level is described as *relational* use of objects. The main feature of relational play is that two or more objects are used in combination with one another, but in a nonfunctional manner with no apparent meaningful basis (Belsky & Most, 1981; Libby et al., 1998; Lifter et al., 1993). When infants engage in relational play, objects are manipulated and associated without regard to the attributes or functions of the objects (Casby, 1992). For example, objects are pushed, stacked, nested, piled, or placed into, or taken out of, a box. Some researchers (Lifter et al.) have further differentiated ways objects are combined or the level of sophistication evident when objects are used together or both.

*Functional* or conventional use of objects in play is influenced by the normative social or cultural properties of objects (Belsky & Most, 1981; Casby, 1992; Libby et al., 1998). Functional play usually incorporates simple "pretend" actions, such as placing a spoon to a doll's mouth in a feeding motion (Charman & Baron-Cohen, 1997). Some investigators include simple pretend play actions under the category of functional play (Casby; Charman & Baron-Cohen; Libby et al.) or by creating a more complex level that signifies a shift from nonpretense to pretense play (Belsky & Most, 1981). Others have divided such acts according to whom or what the object is being related (Lifter et al., 1993).

Finally, *symbolic play* is a complex set of play actions that incorporates items, attributes, or contexts not actually present, or the substitution of objects. Symbolic play becomes increasingly complex as the number and type of play schemes expand. There is traditionally a progression from isolated symbolic acts, to single scheme sequences (the child applies a single scheme to various objects), to multischeme sequences (involving two or more interrelated schemes) (Belsky & Most, 1981; Casby, 1992; Doctoroff, 1996; Lifter et al., 1993). Object substitution, in which one object is used to represent another, is the most common feature signifying emergence of symbolic play in typical children.

## Object Play in Children With Autism

Previous research has identified marked differences in object play of young children with autism compared to typically developing children. Children with autism demonstrate atypical play preferences and preoccupation with certain features of objects. They often lack creativity, flexibility,

and diversity of play actions (Baranek, Reinhartsen, & Wannamaker, 2000). Relative to peers with typical development or mental retardation, young children with autism use less appropriate, less varied, and more repetitive play (Stone, Lemanek, Fishel, Fernandez, & Altemeir, 1990) and persist in lower-level sensorimotor play (Libby et al., 1998). In addition, they have a limited capacity for imitation (Riguet, Taylor, Benaroya, & Klein, 1981), and produce fewer novel pretend play acts (Charman & Baron-Cohen, 1997). Deficits in higher-level symbolic play are more likely to be apparent in structured versus unstructured situations (Riguet et al., 1981; Stone et al., 1990). Unfortunately, the majority of existing prospective studies on play involve preschool-age children with autism, and thus have limited generalizability to the infancy period. An exploration of lower levels of play in children with autism below 18 months of age is needed.

Four predominant neuropsychological theories of autism shed light on play deficits exhibited by children with autism. Some theories propose that specific impairments in the social-cognitive abilities lead to an absence of higher levels of play or unusual behaviors. For example, theory of mind (Baron-Cohen, Leslie, & Frith, 1985) posits that because children with autism have difficulty taking another's perspective, the meaning of social-communicative interchanges is missed, resulting in impoverished play, that lacks symbolism and consists of solitary isolated activities with little play directed toward others. Intersubjectivity theory (Hobson, 1993) maintains that disruptions in the early processes of affective engagement lead to an absence of necessary social experiences in infancy and therefore, lack of development of the cognitive structures needed for social understanding. Both theory of mind and intersubjectivity theory would predict deficits in higher levels (i.e., symbolic) of object play in children with autism in the second year of life, but they do not necessarily speak to the earlier forms of object play.

In contrast, weak central coherence theory (Happé, 1997) argues that autism involves a piecemeal processing style resulting in an inability to perceive complex stimuli as meaningful wholes. Thus, a tendency to focus on parts of play objects and to display unusual preoccupations with objects occurs. Based on this theory, it is assumed that children with autism display more repetition of the same play behaviors, and therefore are expected to remain in lower levels of object play (e.g., simple manipulation) rather than independently move on to higher levels. It is unlikely that central coherence can be easily tested in children with autism until after infancy, at which time higher levels of play begin to emerge in typical development.

Executive dysfunction theory (Ozonoff, Pennington,

& Rogers, 1991) suggests that a lack of planning and flexibility in problem solving and a lack of goal-directed actions result in perseverative and repetitive play behaviors. Thus, children with autism may have the cognitive ability necessary to engage in pretend play acts, but cannot consistently engage in these skills due to lack of organization or planning. Executive functions begin to mature at the end of the first year and the beginning of the second year of life, but emerging differences may be evident in a lack of novel acts with play objects in children with autism during the 9–12-month period.

All four theories above have been developed through empirical studies with older children. Few studies have explored lower levels of play behaviors such as object exploration, simple discrimination, and relational play in infants with autism (Libby et al., 1998). Thus, it remains unclear if lower levels of play are necessary or sufficient for the development of pretense play in children with autism.

## Retrospective Video Analysis

Research methods commonly used to gain knowledge about young children with autism include (a) prospective developmental studies in children with autism over 18 months of age, and (b) retrospective techniques that rely on caregiver questionnaires. Prospective observation of autism below 18 months of age poses challenges due to the lack of identifiable (diagnosed) research participants. Similarly, accuracy of caregiver memories becomes less reliable with the passage of time. Thus, retrospective video analysis is a method that allows for observation of the earliest features associated with autism. In executing research using video observation and analysis, investigators must consider the practicality, as well as the benefits, of this method. With the rise and affordability of home video use, researchers are able to find more participants; however, the study of home videos (retrospective video analysis) offers methodological problems, such as difficulty controlling for sampling variables and quality of tapes (Baranek, 1999). Despite pragmatic constraints, analysis of home movies has strong ecological validity, offering rich insight into actions and the environment in which “real life” takes place. Studying the occupation of object play in the context of retrospective home movies is one such application.

Previous retrospective video studies (Adrien et al., 1991; Baranek, 1999; Osterling & Dawson, 1994) have largely used pencil and paper methods of coding to measure a variety of social-communicative and sensory-motor skills. Although play was not the main focus of the study, Baranek (1999) reported symptoms indicative of autism (e.g., mouthing objects) as well as generalized developmental

delay (e.g., repetitive play) that relate to this topic. The current study attempts to expand upon these findings by analyzing the duration and sophistication of object play in infants with autism in comparison to infants with developmental delays and typically developing infants, and explores the utility of computerized applications for coding. This study also lays groundwork for a future longitudinal study analyzing the developmental trajectories of play and the interactions of child and contextual factors influencing play patterns.

Our overall research question was: How do infants with autism differ from those with developmental delay or typical development in object play at 9–12 months of age? We hypothesized that of the three groups, the group with autism would be least engaged (i.e., have the lowest duration) in purposeful object play, and that the level of sophistication of object play would be highest in the typical group.

## Method

### *Participants*

The 32 participants in this study are identical to those described in previous work (Baranek, 1999). Eleven children had a diagnosis of autistic disorder, 10 children were labeled as developmentally delayed, and 11 were typically developing. Nineteen of the children were boys (10 with autism, 3 with developmental delay, and 6 with typical development). The vast majority (27 out of 32) were Caucasian; ethnic minorities did not differ significantly among groups. The children's ages at the time of recruitment varied from 2 to 9 years; however, retrospective videos for the three groups were matched such that all infants were studied during the 9–12-month period (corrected for prematurity). Children were recruited through various clinics, schools, and parent support organizations. Only those participants with appropriate home movies (i.e., a minimum of 10 minutes of good quality footage at 9–12 months of age) were included in this study. Parents of the children signed an informed consent. At the time of recruitment or video collection, a medical records review, developmental survey, and a developmental assessment using the Vineland Adaptive Behavior Scales, Interview Edition, Survey Form (Sparrow, Balla, & Cichetti, 1984) were conducted by the principal investigator.

The parents of the typical children in this study reported no history of developmental problems. Typical development was confirmed by scores on the Vineland ( $M = 106$ ;  $SD = 7$ ). The children with autism were originally diagnosed with Autistic Disorder by physicians or licensed psychologists and confirmed with the *Diagnostic and Statistical*

*Manual of Mental Disorders (DSM-IV; APA, 1994)* criteria. In addition, the investigators used the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988) to assess severity of autistic symptoms; those with scores below 30 were excluded. To allow for a heterogeneous sample, there were no exclusions based on level of cognitive functioning. Overall standard scores on the Vineland had a mean of 56 ( $SD = 11$ ).

The children with developmental delays ( $n = 10$ ) had documented global delays or known disabilities associated with mental retardation in their medical records. This group specifically included six children with Down syndrome, two with William syndrome, and two with nonspecific developmental delay. Their Vineland standard scores had a mean of 65 ( $SD = 8$ ). Each was assessed with the CARS to rule out significant levels of autistic symptoms; only those with scores below 25 were included. The children with autism and children with developmental delay were also matched according to cognitive levels (IQ) based on medical records reviews, overall developmental quotients from the Vineland, and chronological age at the time of recruitment.

### *Videotape Collection and Editing Procedure*

Home videotapes (VHS or Hi-8 format) were collected from parents of all children. The types of situations on the videos were not restricted and included various special events (e.g., birthdays) and daily occupations (e.g., bath time). Play behaviors were inherently present across situations. An editor, blind to the diagnoses of the children, randomly selected cross-sections of situations for each child at the age range of interest and assembled these into two 5-minute segments. Chosen segments were comparable across groups with respect to average number of events, number of people, structure, and level of restriction (see Baranek, 1999). Research assistants transferred the edited videotapes onto compact discs (Sony CD-R, 650 MB) using Broadway Pro 2.5 (Data Translation, 1997), thus converting the signal from analog to digital. This conversion was done for compatibility with the scoring software (The Observer 3.0) and to preserve the data (i.e., CDs have a longer shelf life than videos).

### *Development of the Object Play Coding Scale*

No available object play coding scale existed for our specific purpose. Given that play is noted to be an elusive construct with no widely accepted definition (Baranek et al., 2000; Parham & Primeau, 1997), creating such a tool was daunting. Two graduate students under the supervision of their research advisor conducted an exhaustive search of the literature with respect to primary empirical studies on

object play in young children and validated play scales. The results of this review were discussed and synthesized by the research team, including three investigators who had extensive clinical and research expertise in autism and play from the fields of occupational therapy, or speech-language pathology, or both. The categories used in our coding scale were synthesized from the existing literature on object play in very young children presented earlier in our introduction (e.g., Belsky & Most, 1981; Casby, 1992; Knox, 1997; Libby et al., 1998; Lifter et al., 1993; McCune-Nicolich & Bruskin, 1982; Power et al., 1985). Four general categories of play (exploratory, relational, functional, and symbolic) most often endorsed in the literature were included in our scale. In addition, findings from specific studies of play in young children with autism were systematically analyzed to refine object play definitions and clarify subtle distinctions between play categories. The object play coding scale was tested on numerous training samples (i.e., similar video segments not included in the study) and definitions were refined in an iterative fashion until adequate reliability was achieved in the final version of the scale.

The four hierarchical, mutually exclusive object play categories (see Table 1) were defined as follows: (a) Exploration of Objects in Play—indiscriminate actions (Level 1) and simple manipulation of single objects (Level 2); (b) Relational Use of Objects in Play—taking objects apart (Level 3) and general combinations (Level 4); (c) Functional/Conventional Use of Objects in Play—play acts directed towards an object (Level 5), self (Level 6), doll (Level 7), or another individual (Level 8); and (d) Symbolic Use of Objects in Play—object substitution (Level 9), agent play (Level 10), and imaginary play (Level 11). In addition, we added a code for No Object Interaction Used in Play (Level 0) and a code for Object Used as a Social Game (Level X) that were not part of the hierarchy but were needed to address instances where no objects were manipulated in play or where objects were used for social purposes only (e.g., peek-a-boo game). This also ensured that every second of video could be coded with this exhaustive list. For our purposes, an object was defined as “any discrete nonhuman entity in the physical environment.” Objects included toys, furniture, and specific items that were not people (e.g., blankets, dishes, stuffed animals, eating utensils, vertical blinds). Animals, parts of a human body (e.g., hair), walls, and floors also were not included (see Table 1).

### *Video Coding Procedures*

The Observer 3.0 (Noldus Information Technology, 1995), a software package designed for the collection, management, and analysis of observational data, was selected for its easy accessibility, level of precision, and common use. A

configuration file establishes the structure of the coding system allowing for specification of the collection method, independent variables, participants observed, and events recorded. Each target behavior (i.e., play code) is assigned a unique key that affords data entry of each code with a single keystroke. The videotape analysis portion of the software package used in this study was composed of The Observer 3.0 and The Observer VideoPro 4.0 (Noldus Information Technology, 1997). The Observer 3.0 contains the behavioral coding programs and project files whereas the The Observer VideoPro 4.0 allows the rater to view and score the video.

Two raters, blind to the diagnoses of the children, coded independently at observation stations each consisting of a computer loaded with the software. The raters were instructed to follow specific operational definitions and coding in the object play coding scale. On the computer screen, the raters viewed the video footage of the child from the CD while entering appropriate play codes into an observational data file. A separate data file was maintained for each video segment on each child. Coding was done using continuous time measured to the nearest 10th of a second (based on our selected configuration). Using a video control panel (on screen) similar to that found on a VCR, the rater was also able to precisely identify the start and end of an interaction within a video clip. The Observer VideoPro 4.0 software allowed the rater to scan forward as well as review a video clip as often as necessary before entering a code or to edit errors. In addition to being able to view a segment in real time, the program allowed viewing frame by frame or by a predesignated time increment.

### *Inter-observer Reliability*

The two raters were trained to use the video analysis software by viewing 10 sample segments of similar children and situations not used in the study. Inter-observer reliability was monitored on an ongoing basis, and raters were required to achieve 80% agreement on three consecutive segments prior to coding the real segments. The primary rater coded all segments, and the second rater coded 25% for reliability. The maximum time discrepancy (i.e., tolerance window) for matches between codes was set at one second. The same code recorded outside of this window was reported as a “window error”; the recording of a different code was reported as a “coding error.” Each of these errors was considered a disagreement. Final inter-observer reliability was calculated conservatively by The Observer 3.0 (i.e., the number of agreements divided by the sum of agreements and disagreements). Results indicated the extent to which two raters obtain similar results when measuring the same behavior on the same occasion. Interrater reliability

**Table 1. Sequence and Definitions of Categories Used in the Object Play Coding Scale**

Category and Level (Typical age of emergence)	Definitions	Examples
<i>Exploration of Objects in Play</i>		
Level 1: Indiscriminate actions (2–10 months)	<input type="checkbox"/> Does not account for functional characteristics; physically manipulates object in unsophisticated ways; treats all objects alike	<input type="checkbox"/> Tactile manipulation; grasping, rubbing, shaking, scratching, banging, poking, mouthing
Level 2: Simple manipulation of single objects (2–10 months)	<input type="checkbox"/> Preserves physical or conventional characteristics; discriminates through visually guided manipulation	<input type="checkbox"/> Rolling a car; pushing a button; riding a rocking horse; opening/shutting a door
<i>Relational Use of Objects in Play</i>		
Level 3: Takes combinations of objects apart (10–18 months)	<input type="checkbox"/> Related objects are separated or taken apart	<input type="checkbox"/> Pulling pop beads apart; taking a lid off a container
Level 4: Presentation/general combinations (10–18 months)	<input type="checkbox"/> Relating objects by putting them together; combining objects not according to their presentation	<input type="checkbox"/> Stacking blocks; putting pieces into a puzzle; scooping/pouring
<i>Functional/Conventional Use of Objects in Play</i>		
Level 5: Object-directed (12–18 months)	<input type="checkbox"/> Actions are directed toward an object	<input type="checkbox"/> Placing a lid on a pot; dumping objects from a truck
Level 6: Self-directed (12–18 months)	<input type="checkbox"/> Familiar actions are directed toward the self	<input type="checkbox"/> Drinking from an empty cup; raising phone to ear and vocalizing
Level 7: Doll-directed (12–18 months)	<input type="checkbox"/> Familiar actions are directed toward doll figures; child is the agent of the activity	<input type="checkbox"/> Feeding a doll with a spoon; combing the doll's hair
Level 8: Other-directed (12–18 months)	<input type="checkbox"/> Familiar actions are directed toward other persons; child is the agent of the activity	<input type="checkbox"/> Extending a teacup to a person's lips, or a telephone receiver to a person's ear
<i>Symbolic Use of Objects in Play</i>		
Level 9: Object substitution (18–30 months)	<input type="checkbox"/> Child represents or substitutes one object for another	<input type="checkbox"/> Substituting a block for a car or a banana as a telephone
Level 10: Agent play (18–30 months)	<input type="checkbox"/> Child moves doll figures as if they are capable of action	<input type="checkbox"/> Moving a figure to load blocks onto a truck; propping a bottle in a doll's arms to feed
Level 11: Imaginary play (18–30 months)	<input type="checkbox"/> Properties are assigned to objects as if they are real; Involves an imaginary object in play or references an object as if it were present	<input type="checkbox"/> Claiming a toy stove is "hot"; pretending a doll is crying
<i>No Object Interaction Used in Play/Unscorable (Level 0)<sup>a</sup></i>		
	<input type="checkbox"/> Child is not engaging with an object	<input type="checkbox"/> Walking and crawling
	<input type="checkbox"/> Child is visually attending to an object without acting	<input type="checkbox"/> Observing an object
	<input type="checkbox"/> Object physically supports a gross motor activity	<input type="checkbox"/> Being pushed on a swing
	<input type="checkbox"/> Child is engaged in an activity of daily living	<input type="checkbox"/> Wiping nose; dressing
	<input type="checkbox"/> The rater cannot accurately judge what is going on	<input type="checkbox"/> Video is fuzzy, out of focus
<i>Object Used as Social Game (Level X)<sup>a</sup></i>		
	<input type="checkbox"/> Child is manipulating an object while interacting in a conventional social game	<input type="checkbox"/> Child is tugging blanket off own head during peek-a-boo

<sup>a</sup>These play categories are separate and cannot be compared to the hierarchical levels of object play; therefore no numeric value is assigned to their categories.

ranged from 77%–100%, with an average interrater reliability of 87%.

### *Transforming Data to a Statistical Program*

Because The Observer 3.0 does not support the more sophisticated analyses ultimately conducted in this study, the coded observational data files were transformed to a Statistical Analysis System (SAS) program. The number of times a play code occurred, the number of seconds it occurred, and the percent of total time (i.e., 10 minutes) a play code occurred were calculated. SAS output was verified

against original data in The Observer 3.0 before conducting the final statistical analyses below.

## Results

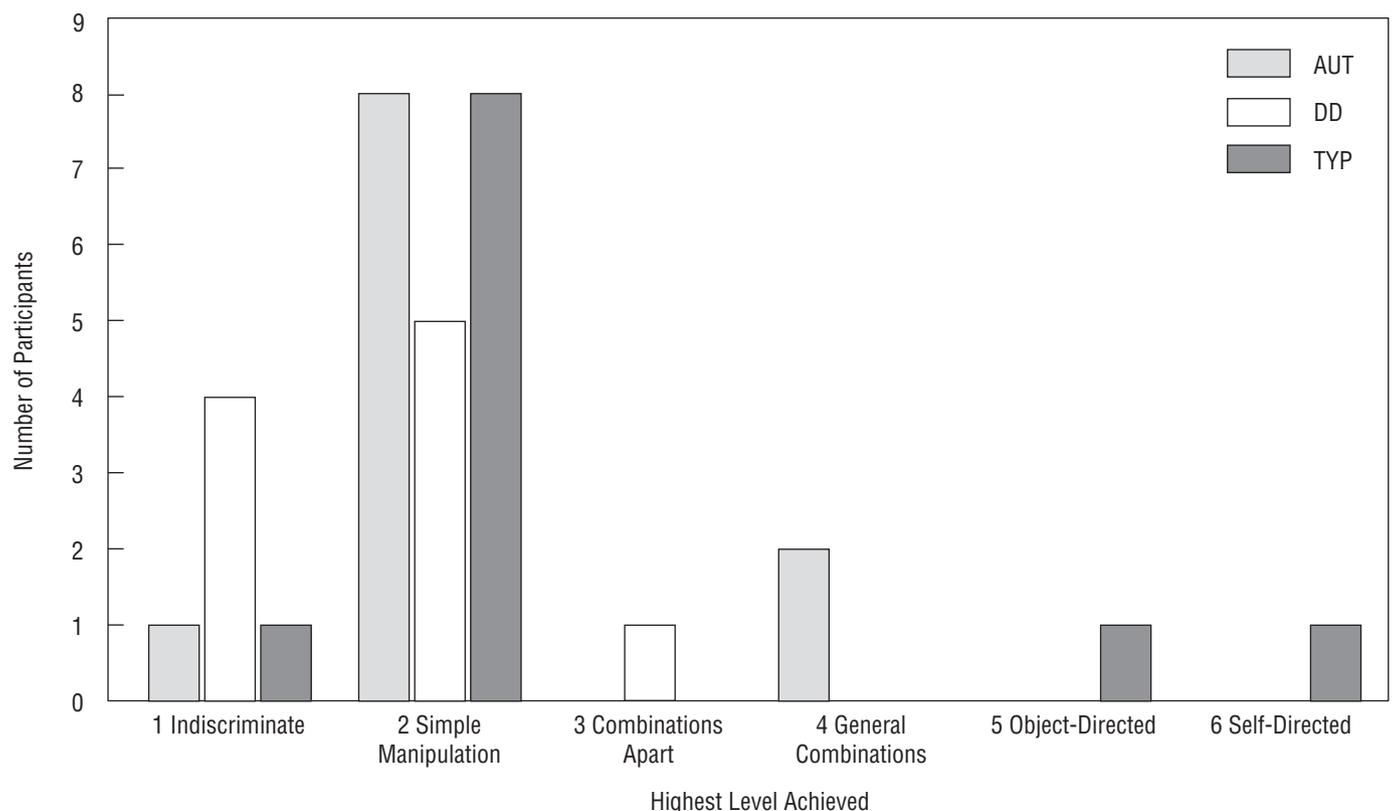
To investigate the ways in which infants with autism or developmental delay and those with typically developing skills may differ in their object play behaviors, the data were examined in several ways. Across the total of 10 minutes of videotape for each child, the duration of play behaviors within each level of play was first calculated and analyzed

(e.g., descriptive statistics, skewness, etc.). Each of the three groups similarly spent about 25% of their total time in some type of object play. As expected, no child at 9–12 months of age engaged in symbolic play; thus, these variables (Levels 9, 10, & 11) were dropped in remaining analyses. No children engaged in functional play at Levels 7 & 8, so these variables were also excluded.

To compare the distribution of play behaviors for each group across the six remaining levels of object play behaviors, a Group (3) by Object Play Level (6) ANOVA (analysis of variance) was computed. The mean overall level of play for each group was 2.18 ( $SD = .98$ ) for the children with autism, 1.70 ( $SD = .67$ ) for the children with developmental delays, and 2.55 ( $SD = 1.51$ ) for the children with typical development. There were no significant differences between the groups across levels of play [ $F(2, 29) = 1.49, p > .05$ ]. In fact, 27 of the 32 children exhibited play at only two levels: Level 1 (indiscriminate actions) and Level 2 (simple manipulation). Specifically, we found that Level 1 play was evidenced by all 32 children at some time in the videos. Level 2 play (simple manipulation) was evident in 9 (of 11) typical children, 8 (of 11) of those with autism, and 6 (of 10) of those with developmental delay. Only five children displayed play behaviors at higher levels; one child with developmental delays exhibited Level 3 behaviors (takes combinations of objects apart); two chil-

dren with autism exhibited Level 4 behaviors (presentations/general combinations), and two children who were typically developing displayed Level 5 or 6 behaviors (functional: object directed or self-directed). Thus, although no statistically significant difference was found, only the children with typical development displayed any object- or self-directed functional play behaviors. Figure 1 provides a visual display of the highest levels of play achieved proportionally by each group.

To examine possible differences that may have occurred between the groups in amount of time (duration in seconds) spent playing with objects versus not interacting with objects, the General Linear Model (GLM; Trochim, 2001) procedure was used. Because so few children exhibited behaviors above Level 2 (Exploratory—Simple Manipulation), and the data were significantly skewed for Level 2, the procedure looked only at three dependent variables in the ANOVA. There were no statistically significant differences among groups for No Object Interaction (Level 0) [ $F(2, 29) = 0.78, p > .05$ ], Exploratory—Indiscriminate Actions (Level 1) [ $F(2, 29) = 0.21, p > .05$ ], and the overall duration of Exploratory Play (Levels 1 and 2 combined) [ $F(2, 29) = 0.58, p > .05$ ]. The combined means for Exploratory Play (Levels 1 and 2) were 138 seconds ( $SD = 49$ ) for the autism group, 132 seconds ( $SD = 75$ ) for the developmentally delayed group and 157 ( $SD = 46$ ) for the typical group.



**Figure 1. Highest object play level achieved per individual across groups.**  
**Note.** AUT = autism, DD = developmental delay, TYP = typical development.

## Discussion

Consistent with the focus of this issue of *AJOT*, our discussion will address the theoretical and clinical implications of our research findings, as well as the methodological issues we encountered in using retrospective videotapes and The Observer 3.0 system in conducting our research.

### Discussion of Findings

Using retrospective video analysis methods, this study provides the first investigation of object play in infants with autism at 9 through 12 months of age. It also demonstrates feasibility for using computer-based coding technologies as an alternative to the paper-and-pencil methods traditionally used in retrospective video methodology, affording a finer-grained analysis. Our findings indicated that on average, all three groups of children were engaged in some type of object play approximately 25% of the time videotaped. Furthermore, duration of time spent in exploratory play (Levels 1 and 2 combined) was similar across groups indicating well-established repertoires of indiscriminate exploratory play and to a lesser extent, simple manipulation play in the majority of children. Thus, exploratory play as a broad category did not uniquely distinguish autism at 9–12 months of age.

Although skewed distributions among our small sample precluded the parametric analysis of durations of higher level play categories (i.e., relational, functional, symbolic), we found an emerging pattern for lowest levels of play evident in the group of children with developmental delays. That is, 9 out of 10 children in the developmentally delayed group demonstrated only exploratory play—Levels 1 & 2 in our taxonomy. Two children with autism reached the relational levels of play (Levels 3 & 4) but none reached the higher functional levels of play, whereas two children with typical development reached functional play (Levels 5 & 6), notably without demonstrating presumed earlier-developing relational play on the videotapes. Although these findings are not inconsistent with social-cognitive theories of autism that predict deficits in functional play (other-directed acts), it is too early to entertain such hypotheses until longitudinal analyses of trajectories into the second year of life are accomplished. Such analyses could determine whether or not object play deficits become more salient with age (as children with autism progressively diverge from peers in their social understanding), and whether or not earlier levels of play are necessary or sufficient precursors or both for later known deficits in symbolic functions. For example, do infants with autism (a) develop functional play skills in a typical sequence but at a delayed rate, (b) develop

functional play skills typically and then lose them, or (c) fail to develop functional play altogether?

One limitation of this study was the small number of infants in each group, raising the question of insufficient power to detect true differences in object play at this age. It is difficult to locate sufficient numbers of participants that both meet diagnostic criteria, and have adequate video footage at the targeted ages. With increasing numbers of families acquiring camcorders, this challenge should diminish in future studies.

A second challenge relates to the lack of control over the conditions in which children are videotaped by their parents. For example, several studies (Riguet et al., 1981; Stone et al., 1990) have demonstrated that young children with autism may be capable of higher level play skills under structured experimental situations. Thus, when prompted with objects or gestural cues they are more likely to exhibit skills that are in their repertoires, but not initiated independently. A retrospective study using home movies cannot manipulate such variables experimentally. Adding descriptions of associations between child and contextual variables during naturalistic play situations is one way to add richness to interpretations. In a previous retrospective video study (Baranek, 1999), parents of infants with autism used salient sensory cues to optimize their infant's social engagement. We suspect similar interactions are evident in socially-mediated play situations and these variables may be particularly useful to target in future studies.

Finally, this study looked only at duration and sophistication (level) of object play. Previous research (Baranek, 1999) indicated that mouthing objects (one type of play exploration) was more prevalent in infants with autism than other groups; thus, it is possible that the overall repertoire of exploratory play is limited to certain types of exploration. Our future studies will expand measures to include frequency as well as diversity of play acts that may provide more sensitive measures of play differences in infants with autism.

### *Methodological Challenges of Studying Play Using Retrospective Video Analysis*

The study of play is challenging because a precise definition of play varies across studies and because play is embedded into nearly all aspects of an infant's daily occupational routines. Retrospective video analysis affords an ecologically valid method of studying play in young children with or without disabilities in their natural contexts; however it is not without some challenges. Situations that parents choose to videotape vary substantially and often represent special, favorable events (e.g., holidays, milestones) as much as they represent typical daily play routines—a process that presents

with some inherent biases. Pragmatic constraints such as time, cost, and mechanical problems can limit feasibility of retrospective video methods, regardless of whether paper-pencil coding procedures or a computer-based coding system is used. However, when studying the earliest manifestations of autism, prospective methods are not viable. Therein lies the major strength of retrospective video analysis—the affordance of direct observation of the earliest features of a disorder, long before diagnosis, with a level of precision and objectivity that exceeds what is possible through family recollections based on long-term memories.

### *Methodological Issues Related To Using The Observer*

The Observer 3.0 software is versatile, has many advantages for behavioral research, and has been used in various applications (e.g., Boccia & Roberts, 2000; Hall, 1995). Users can create their own behavioral coding system that can be as simple or complex as needed for their research protocol. They can choose data collection and sampling methods that are specifically matched to their aims (e.g., specifying the duration of the observation session, choosing between continuous versus interval coding, and designating the number of participants for simultaneous data collection). Features such as simple data entry, a notepad to record comments, an online help system, advanced editing capabilities, an exploratory graphics feature, and a customized viewing screen allow for additional ease of use. The Observer 3.0 can read external files containing other types of data for integration of multiple files. It also produces basic statistics, such as reliability coefficients or descriptive statistics (e.g., means, standard deviations).

Overall, our efforts in using The Observer 3.0 were successful and set up a solid foundation for use of this system in future studies. However, we found this process presented challenges to a new user. For example, the equipment and software were expensive as an initial investment. Furthermore, the complexity of this system required extensive training in setting up a configuration file, learning the procedures for recording observational data, and performing data analyses that are unique to the system. This was accomplished through hands-on experimentation and meetings with trained professionals over the course of numerous weeks. Although time demands are not foreign to researchers, paper-pencil coding methods may be more efficient in some cases (e.g., studies with simple coding schemes).

Use of The Observer 3.0 for data collection in our retrospective video analysis study also presented unique problems that may not be experienced with video data acquired prospectively. For example, using The Observer 3.0 with any analog videotape (most common format for home

movies from the past 10 years) first requires that each tape be dubbed with a VITC (vertical interval time code) signal—an invisible clock counter that is written onto the videotape and retrieved during playback of the tape. Because VHS home movies are often suboptimal in quality (due to their age and the number of times they have been copied), there tends to be inconsistent transmission of the VITC signal. Without this signal, it is impossible to collect data directly from the analog videotapes using The Observer 3.0. We therefore found it necessary, though time consuming, to transfer (burn) each tape onto a CD using specialized software, in order to bypass the need for the VITC signal between the tape and The Observer 3.0 system. Coding directly from CDs allowed for a digital transmission that alleviated the mechanical difficulties associated with use of analog tapes. However, digitizing videotapes did not improve picture quality of the original home movies. As digital technology becomes more commonplace, these issues may be easily resolved.

Moreover, we found that the interrater reliability analysis procedure afforded by The Observer 3.0 was somewhat restricting. The statistic calculated and reported is the degree to which observers agreed on coding the *onset* of all behaviors applied in the coding system (Hall, 1995). Thus, the frequency of occurrence of a behavior influenced the percent agreement value. Using a one second tolerance window, we discovered that there was a double penalty if two raters disagreed on the occurrence of a play behavior, even if it occurred for just a fraction of the time within longer intervals of the same code. For example, Rater 1 codes “exploratory—indiscriminate play” for a full 15 consecutive seconds. Rater 2 also codes “exploratory—indiscriminate play” for seconds 1–4, and again for seconds 7 through 15, but entered a different code “functional play” during seconds 5 through 7. Even though both raters agree that exploratory—indiscriminate play is occurring at second 8, an error is calculated at this time because the *onset* of exploratory—indiscriminate play was not coded at the same time by both raters. Finally, although the data analysis procedures available with The Observer 3.0 package allowed us to calculate basic statistics and run analyses for several observational data files simultaneously, we found that we needed to export our data to another software package for more complicated statistical analyses.

### **Implications for Practice**

Occupational therapy practitioners can benefit from knowledge gained through this study in several ways. Play is a childhood occupation crucial for adaptation, well-being, and participation in society, and thus is of primary concern

to practitioners working with young children with developmental disabilities such as autism (Baranek et al., 2000). A detailed analysis of an infant's interactions with objects can provide needed information for early screening of developmental and occupational performance patterns, as well as a foundation for specific interventions to optimize engagement in play.

Retrospective video methods allow a glimpse into the child's natural environment and permit an objective view of play across multiple real-life contexts; these methods can be used in both research and clinical settings to assess children's naturalistic play. This study provides a developmental perspective on emergent object play skills in three groups of infants and provides a taxonomy that can be used reliably to describe specific levels of object play.

Finally, this study demonstrates applications of computer-based coding methods that have utility for future research. Longitudinal studies measuring the developmental trajectories of object play in infants with autism from early to later infancy periods, as well as the complexity of interactions of child and contextual variables supporting play are in progress. Such studies are crucial to finding additional behavioral markers for earlier identification and treatment of children with autism.▲

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## References

Adrien, J. L., Faure, M., Perrot, A., Hameury, L., Garreau, B., Barthelemy, C., et al. (1991). Autism and family home movies: Preliminary findings. *Journal of Autism and Developmental Disorders*, 21(1), 43–49.

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.). Washington, DC: Author.

Bailey, A., Phillips, W., & Rutter, M. (1996). Autism: Towards an integration of clinical, genetic, neuropsychological, and neurobiological perspectives. *Journal of Child Psychology and Psychiatry*, 37(1), 89–126.

Baranek, G. T. (1999). Autism during infancy: A retrospective video analysis of sensory-motor and social behaviors at 9–12

months of age. *Journal of Autism and Developmental Disorders*, 29, 213–224.

Baranek, G. T., Reinhartsen, D. B., & Wannamaker, S. W. (2000). Play: Engaging young children with autism. In R. Heubner (Ed.), *Autism and related disorders: A sensorimotor approach to management*. Gaithersburg, MD: Aspen.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition*, 21, 37–46.

Belsky, J., & Most, R. K. (1981). From exploration to play: A cross-sectional study of infant free play behavior. *Developmental Psychology*, 17(5), 630–639.

Boccia, M. L., & Roberts, J. E. (2000). Computer-assisted integration of physiological and behavioral measures. In T. Thompson, D. Felce, & F. J. Symons (Eds.), *Computer assisted behavioral observational methods for developmental disabilities* (pp. 83–97). Baltimore: Brookes.

Casby, M. (1992). Symbolic play: Development and assessment considerations. *Infants and Young Children*, 4(3), 43–48.

Charman, T., & Baron-Cohen, S. (1997). Brief report: Prompted pretend play in autism. *Journal of Autism and Developmental Disorders*, 27(3), 325–332.

Data Translation. (1997). *Broadway Pro* (Version 2.5) [Computer software]. Marlboro, MA: Author.

Doctoroff, S. (1996). Parent's support of infant's object play: A review of the literature. *Infant-Toddler Journal*, 6(2), 153–166.

Filipek, P. A., Accardo, P. J., Baranek, G. T., Cook, E. H., Jr., Dawson, G., Gordon, B., et al. (1999). The screening and diagnosis of autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 29(6), 439–484.

Gillberg, C., Ehlers, S., Schaumann, H., Jakobsson, G., Dahlgren, S. O., Lindblom, R., et al. (1990). Autism under age 3 years: A clinical study of 28 cases referred for autistic symptoms in infancy. *Journal of Child Psychology and Psychiatry*, 31, 921–934.

Hall, S. (1995). Review of the Observer 3.0. *Journal of Child Psychology and Psychiatry*, 36(8), 1495–1498.

Happé, F. G. (1997). Central coherence and theory of mind in autism: Reading homographs in context. *British Journal of Developmental Psychology*, 15, 1–12.

Hobson, P. (1993). Understanding persons: The role of affect. In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from autism* (pp. 204–227). Oxford, England: Oxford University Press.

Kennedy, M. D., Sheridan, M. K., Radlinski, S. H., & Beeghly, M. (1991). Play-language relationships in young children with developmental delays: Implications for assessment. *Journal of Speech and Hearing Research*, 34, 112–122.

Knox, S. (1997). Development and current use of the Knox Preschool Play Scale. In L. D. Parham & L. S. Fazio (Eds.), *Play in occupational therapy for children* (pp. 35–51). St. Louis, MO: Mosby.

Libby, S., Powell, S., Messer, D., & Jordan, R. (1998). Spontaneous play in children with autism: A reappraisal. *Journal of Autism and Developmental Disorders*, 28(6), 487–497.

Lifter, K., Sulzer-Azaroff, B., Anderson, S. R., & Cowdery, G. E. (1993). Teaching play activities to preschool children with disabilities: The importance of developmental considerations. *Journal of Early Intervention*, 17(2), 139–159.

- McCune-Nicolich, L., & Bruskin, C. (1982). Combinatorial competency in symbolic play and language. In D. Pepler & K. Rubin (Eds.), *The play of children: Current theory and research* (pp. 30–45). Basel, Switzerland: Karger.
- Noldus Information Technology. (1995). *The observer base package for Windows. Reference manual, version 3.0 edition*. Wageningen, The Netherlands: Author.
- Noldus Information Technology. (1997). *The observer support package for video analysis. Reference manual, version 4.0 for Windows edition*. Wageningen, The Netherlands: Author.
- Osterling, J., & Dawson, G. (1994). Early recognition of children with autism: A study of first birthday home videotapes. *Journal of Autism and Developmental Disorders*, 24, 247–257.
- Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1991). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry*, 32, 1081–1105.
- Parham, L. D., & Primeau, L. A. (1997). Play and occupational therapy. In L. D. Parham & L. S. Fazio (Eds.), *Play in occupational therapy for children* (pp. 2–21). St. Louis, MO: Mosby.
- Power, T. G., Chapieski, M. L., & McGrath, M. P. (1985). Assessment of individual differences in infant exploration and play. *Developmental Psychology*, 21(6), 974–981.
- Prizant, B. M., & Wetherby, A. M. (1993). Communication in preschool autistic children. In E. Schopler, M. E. VanBourgondien, & M. Bristol (Eds.), *Preschool issues in autism* (pp. 95–128). New York: Plenum.
- Riguet, C. B., Taylor, N. D., Benaroya, S., & Klein, L. S. (1981). Play in autistic, Down's, and normal children of equivalent mental age. *Journal of Autism and Developmental Disorders*, 11(4), 439–448.
- Schopler, E., Reichler, R. J., & Renner, B. R. (1988). *The childhood autism rating scale*. Los Angeles: Western Psychological Services.
- Sparrow, S. S., Balla, D. A., & Cichetta, D. V. (1984). *Vineland adaptive behavior scales*. Circle Pines, MN: American Guidance Service.
- Stone, W. (1997). Autism in infancy and early childhood. In D. J. Cohen & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (pp. 266–282). New York: Wiley.
- Stone, W., Lemanek, K., Fishel, P., Fernandez, M., & Altemeier, W. (1990). Play and imitation skills in the diagnosis of autism in young children. *Pediatrics*, 86(2), 267–272.
- Trochim, W. M. K. (2001). *General linear model*. Retrieved March 8, 2002, from <http://trochim.human.cornell.edu/kb/genlin.htm>



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