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Informing Early Intervention Through an Occupational Science Description of Infant–Toddler Interactions With Home Space

Doris Pierce, Veronique Munier, Christine Teeters Myers

KEY WORDS

- environment
- motor skills
- play and playthings
- space perception
- spatial behavior

OBJECTIVE. The study provides a substantive description of infant and toddler play with everyday objects and independent negotiation of home space.

METHOD. A grounded theory approach was used to study 18 typically developing children longitudinally from ages 1 to 18 months. Data from 133 home visits included videotaped self-directed play sessions with usual objects, maternal interviews, and observation records.

RESULTS. Infant Space Theory is a substantive theory of infant–toddler interactions with the spaces and objects of the home. This contextualized view of the infant–toddler describes progressions in gaze and visual play, in mapping and ranging home space, in stationary object play, and in the little-described development of mobile object play.

CONCLUSION. Therapists providing early intervention services within the home environment may benefit from the theory in their creation and modeling of naturalistic interventions with infants and families.

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Occupational therapists providing home-based services to infants and toddlers at risk for delays use developmental interventions that make use of the objects and spaces of the home environment. Most of the theories they use, however, are largely decontextualized, providing limited guidance regarding infant–toddler development of usual interactions with the natural environment of the home. This longitudinal study of 18 children, from ages 1 to 18 months, provides occupational therapists with a substantive description of infant–toddler play with everyday objects in the home and independent negotiation of home space. It honors the founding commitment of occupational science to produce descriptions of typical occupations to inform occupational therapy interventions (Clark et al., 1991).

Need for the Infant Space Theory: Naturalizing Occupational Therapy Early Intervention

According to the Individuals With Disabilities Education Act (IDEA), “to the maximum extent appropriate to the needs of the child, early intervention services must be provided in natural environments, including the home and community settings in which children without disabilities participate” (IDEA, 1990). Over the past decade, the policy of natural environments has shaped early intervention services in individual states and within occupational therapy (Hanft & Anzalone, 2001). Opportunities for skill development and learning can be created within everyday life by structuring the environment or using unexpected events (Bruder

& Dunst, 1999/2000; Dunst, Trivette, Humphries, Raab, & Roper, 2001). To offer family-centered interventions in natural environments, therapists must look beyond familiar preplanned activities to integrate intervention into natural learning opportunities offered by everyday contexts.

Many early intervention providers have resisted the shift from clinic-based to home- and community-based practice (Hanft & Pilkington, 2000; Shelden & Rush, 2001). During formal training, opportunities to practice early intervention in natural settings may have been lacking (Hanft & Anzalone, 2001). Knowledge of reflexes and motor and cognitive skills does not provide the degree of insight into the daily occupations of infants and toddlers necessary to the design of powerful naturalistic interventions (Humphry & Wakeford, 2006). The descriptive theory produced in this study, titled the Infant Space Theory, offers therapists an understanding of the typical unfolding of infant-toddler interactions with the objects and spaces of the home, thus assisting them in identifying, using, and demonstrating to family members the wealth of developmental challenges readily available in the home.

Current Perspectives on Infant-Toddler Play Development in the Home

Because it is the occupation in which infants and toddlers spend the majority of their waking hours, play has long been of interest to occupational therapists (American Occupational Therapy Association [AOTA], 2008; Reilly, 1974). Research has shown a clear association between play and development (Hutt & Hutt, 1970; Kalverboer, 1977; Piaget, 1952, 1962), as well as between play and learning (Bruner, 1972; Florey, 1981; Reilly, 1974; Robinson, 1977). To support interventions using or targeting play development, occupational therapists draw on interdisciplinary theories and research, including grand theories of development.

In direct contrast to the more detailed, age-specific, substantive theory produced by the study reported here, the most well-known theories of development can be considered grand theories (Glaser & Strauss, 1967). That is, grand theories of development offer understanding at a level of abstraction that broadly spans ages and contexts. They include, for example, Piaget's (1952, 1962) theories of cognitive and play development and Gesell's (1940) theory of motor development. These perspectives are valued and used by therapists. Reasoning from such a broad view of typical development to early intervention services for a particular child with specific challenges can, however, be difficult.

Play and the Physical Environment

Children's play is best studied in its naturally occurring context (Bronfenbrenner, 1979). In recent centuries, child-

hood play has become increasingly focused on the home (Sutton-Smith, 1996). Although much research documents the relationship between infant development and the social environment, only limited investigation of the relationship between development and infant-toddler interactions with physical or home environments has taken place (Wachs, 1990). Some research indicates the potential importance of this aspect of development. For example, infants constrained from spatial exploration of their home spaces show slowed development (Ainsworth & Bell, 1974; Wachs, 1976, 1979). Also, the complexity, variety, and responsivity of play objects in the home have been shown to affect development (Bradley & Caldwell, 1984; Wachs, 1976, 1978, 1979; Yarrow, Morgan, Jennings, Harmon, & Gaiter, 1982).

The limited research on object play also indicates the potential value of this study's focus on infant-toddler interactions with the home physical environment. Belsky and Most (1981) have described types of object play in infants and toddlers up to age 2, but without diverging far from Piagetian perspectives, by describing typical objects in play, or addressing space use or mobile play with objects. Availability and type of play materials have been shown to be positively related to play complexity in the child (Bigelow, MacLean, & Proctor, 2004; Cherney, Kelly-Vance, Glover, Ruane, & Ryalls, 2003; Fontaine, 2005; Newland, Roggman, & Boyce, 2001; Tomopoulos et al., 2006). Recently, discussions of object play have emanated from research on autism that focuses on play in the home (Baranek et al., 2005; Williams, 2003). Although closest to the intent of the current study, research on object play has not yet yielded a rich enough description of the development of infant-toddler interactions with usual objects in the home to fully support therapists' detailed design of naturalistic early interventions.

Another resource for understanding infant-toddler object and spatial play in the home is anthropological research on material culture. Compared with those of other species, human culture, adaptation, and behavior are highly material. Daily human life and skills are integrally involved with material objects and constructed spaces, including tools, toys, clothing, vehicles, art, food, crops, buildings, roads, machines, books, medicines, manufactured materials, and technology. Not only are interactions with the physical environment an important part of play, play is also the training ground for the adult skills of using, constructing, and otherwise interacting with the objects of the physical world (Baxter, 2006; Bruner, 1972; Cohen, 1987, 2006; Gibson, 1986; Lancy, 1996; Pellegrini & Bjorklund, 2004; Piaget, 1952, 1962).

Decontextualized Views of Skill Development

Research on the development of particular skills important in infant-toddler development has generally been accomplished

and presented separately from the context in which it occurs. This decontextualized understanding of infant–toddler skills can make it difficult for the therapist to create or exploit natural environmental opportunities to develop skills. For example, visual development has been described as localization, fixation, pursuits, and gaze shifts (Erhardt, 1982). Infant–toddler development of mobility is presented as the result of hard-wired motor maturation, with little consideration of environmental opportunities, infant interests, or emerging spatial perception (Gesell, 1940). Visual and motor skills were viewed in this study not as isolated capacities progressing in chronological stages but as aspects of whole play occupations that involve exploring and using everyday spaces and objects (Humphrey & Wakeford, 2006).

Environmental psychologists have described the cognitive mapping skills of adults, but those of children have been little studied (Evans, 1980; Kaplan & Kaplan, 1981). Contemporary research on childhood spatial skill still draws on Piaget's (1952, 1962) theories of childhood spatial representation through the development of schemata, which change with age from more concrete and egocentric to more abstract and less self-referencing (Brown, 2003). Empirical research on spatial skill development has, however, demonstrated that variations in early childhood experience do influence the development of spatial skills (Benson & Uzgiris, 1985; Clearfield, 2004; Sophian, 1986). Gibson's (1986) ecological approach to visual perception, which posits that it is through the interactive, visual, and tactile discovery of affordances of the physical environment that we come to understand our surroundings, was highly compatible with the occupational science approach of this study.

Literature Base of the Study

In keeping with a grounded theory approach, efforts were made to set aside perspectives from the literature during data analysis to maximize original discoveries regarding the development of infant–toddler interactions with the home spatial environment (Cutliff, 2000; Glaser & Strauss, 1967). This brief review of the grand developmental theories, research on play and material culture, and decontextualized views of component skill development does, however, demonstrate the potential of this study to provide a description of the development of play with home objects and spaces in early childhood that complements currently used perspectives on development and further supports the effectiveness of occupational therapists in offering naturalistic early intervention in the home.

Methods of Generating the Substantive Developmental Description

Design. The purpose of this study was to describe infant–toddler interactions with the home physical environment,

from ages 1 to 18 months, in 18 typically developing children. A grounded theory approach of constant comparison was used (Charmaz, 2005; Cutliff, 2000; Glaser & Strauss, 1967). Grounded theory produces substantive descriptions detailed enough to support practitioners, yet broad enough to apply across settings. Multiple strategies ensured trustworthiness: a cross-class and gender-balanced sample, comparative use of a chimpanzee infant sample, piloting, peer debriefing, expert review, prolonged engagement with participants in their homes, several data types, visual modeling, theoretical sampling, and cameo descriptions of each mother–child dyad and their home (Denzin, 1998; Glaser & Strauss, 1967; Strauss & Corbin, 1998). A description of how mothers managed the home environment as a developmental space was previously published from this study (Pierce, 2000).

Participants. The primary sample included 18 typically developing White children and their mothers, living in Southern California and recruited before the infants' birth. Nine male and 9 female infants were admitted to the study to complete a participant grid in which each gender was distributed in proportions reflective of the socioeconomic levels in the population of the United States. In addition, a pilot sample of 4 mother–child dyads and videotapes of wild-living chimpanzee mother–child dyads were used. For the sake of the reader, the children of the study, from ages 1 to 18 months, will all be referred to as *infants*, although *infants and toddlers* would be the more accurate term.

Data Collection. For the primary sample of 18 mother–infant dyads, home data collection occurred monthly, from ages 1 to 18 months, during morning hours and within 1 week of the child's monthly birth date, totaling 313 data collection visits of 30 min to 2 hr. Data from each visit included videotaped, self-directed play sessions with usual objects in the home and yard, fully transcribed maternal interviews, and researcher observation records. Mothers were instructed to allow the child to play independently, in usual ways, and with usual objects. Efforts were made to videotape in the absence of siblings. One child suffered a shaking incident at age 5 months, and her data after that point were excluded.

Data Analysis. Data analysis began with the first data collected and continued beyond the completion of data collection at 2.5 years. Drawing on the strengths of the constant comparative method, the initial draft of the coding scheme was developed by comparing how young chimpanzees and young humans interacted with their physical environments. This strategy provided the researcher with a fresh perspective on the unique characteristics of the human home as a physical environment for infant primate play development.

Before beginning analysis of the primary data, the coding scheme was refined and revised through application to

data from the four human pilot dyads. The video, interview, and observation record data were analyzed using a computer-assisted video analysis system, text-coding software, memo writing, visual modeling, theoretical sampling, and expert review. Analysis of the data transitioned, from beginning to end, from comparisons of extreme difference in the data to comparisons of extreme likeness. In other words, a carefully considered sequence of comparative analyses was performed.

Each comparison was between the full sets of data types from two different data collection visits. Comparisons of data from different dyads at the same or different infant ages, genders, or socioeconomic status were usually used, as well as comparisons of the same infant–mother dyad’s data at different months of age. The sequence of the comparisons, or the analysis path, was driven by key analytic questions of the descriptive theory as it developed and continued until theoretical saturation was reached. Significant transformation of categories during analysis and emergence of original concepts indicated that the grounded theory method had produced a substantive theory.

Limitations. Although a sample of 18 mother–infant dyads was followed longitudinally and in natural context, descriptive studies of this size cannot be assumed to document developmental milestones to the degree of accuracy of a statistical study of a much larger sample. Consideration of these findings in relation to cultures beyond White southern Californian will require a critical awareness of cultural differences. Also, the data were collected during the mid-1990s, and infant–toddler play may have changed since then.

Developmental Description of Infant–Toddler Interactions With Home Objects and Spaces

Infant Space Theory describes four primary aspects of how children from birth to age 18 months develop interactions with the objects and spaces of the home: gaze and visual play, mapping and ranging home space, stationary object play, and mobile object play. Each of the four themes and their subcategories are described in the following sections.

Gaze and Visual Play (Table 1)

Emergence of Gaze Path, Gaze Search, and Gaze Alignment.

The gaze path is the cone of vision that extends from the infant’s eyes to the limits of his or her vision. In the first 2 months, infants noticed objects as they entered the gaze path but did not visually orient to objects.

Mother (M): Right now she’s just in her real visual phase. . . . She likes to see the action. (Maternal Interview [I], Leslie, 2 months)

By age 3 months, most infants in the study used the gaze path to search, scanning earliest for their mothers. Between 4 and 7 months, infants in prone position pivoted to gaze at objects. Around age 6 months, infants began to use more sophisticated ways of aligning or directing gaze. For example, they began to look into the tops of toy boxes. By 8 months, infants moved objects out of the way if they obstructed vision and would look around objects. By 9 months, infants possessed a sophisticated ability to search the environment and select objects or sites for interaction. At 12 months, they aligned their gaze to peer out from inside small spaces, such as a blanket fort. With development, infant gaze became increasingly instrumental.

Solely Visual Objects. Some out-of-reach objects were explored solely through vision. Infant mobiles and highly contrasting patterns, such as backlit miniblinds, held attention in the first few months of life. Between ages 3 and 6 months, infants became interested in moving contrasts, such as leaf arrays, shadow patterns, and television images. Mirror gazing was interesting between the ages 4 and 8 months. Some objects of interest were located at great distance, such as airplanes flying overhead. Memorable neighborhood locations, such as parks, were reportedly recognized by infants age 14 months as they drove past in a car. Although out of reach, solely visual objects still contribute to the infant’s growing knowledge of the landscape.

Vision-Obscured Play. Beginning at ages 5 and 6 months, infants playfully covered and uncovered their faces with blankets, curtains, buckets, and clothing. Soon after crawling and walking were firmly established, they also experimented with traveling with different objects over their heads.

He dons, doffs, dons, and doffs the bucket again. . . .
Carries keys across the room with vision obscured.
Collides with a cabinet. . . . quickly doffs, dons, doffs,
and dons the bucket, looking at the cabinet in front of
him. (Video Transcript [V], Aaron, 14 months)

Using Eyes and Hands Together: Gaze Lead and Seeing Sequence. The developmental literature suggests that infants initially learn to grasp by gazing at their hand, then at the object of interest (Erhardt, 1982). This study showed, however, that in the early months, less intentional object contacts, such as catching fingers in an object, batting at an object, or placing an object in hand by the mother, occurred without gaze and were frequent. By ages 3 or 4 months, object gaze usually led object interaction, and play without visual contact indicated distraction or loss of interest. Infants selected objects by scanning the environment.

Researcher (R): Do you see her start crawling and you know where she’s headed? *M:* Yeah. That she’s interested in something . . . I can usually tell when she spies something. (I, Alison, 8 months)

Table 1. Gaze and Visual Play, Mapping and Ranging Play

		Age (Months)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Gaze and visual play																
<i>Gaze path</i>	Emerge	Control	Scan 3–6. Search for mother			Align	Align: look down		Align: move objects out of the way/ Scan for objects in large baskets							
<i>Visual objects</i>	High contrast		Moving contrasts 3–6 Mirrors 4–8													
<i>Vision obscured</i>						Cover face with buckets, blankets			Cover face while crawling			Cover face while walking				
<i>Gaze lead</i>	Accidental contact		Gaze precedes interaction 3–18													
Mapping and ranging play																
<i>Space use</i>	Wiggle		Prone fan	Shifting circles	Edge crawling 5–10				Edge cruising 8–12			Roaming	Targeted travel 13–18			
<i>Mapping</i>	Recognize activity sites				Recognize specific aspects of a room (window) 6–10 Activity circuit 6–18											
<i>Ranging</i>							Negotiate between rooms		Negotiate hallways		Independent ranging of one floor		Targeted travel 14–18			

Note. Shaded areas represent patterns that develop or are present over more than 2 months.

Gaze also appears to play a role in understanding sequence. Infants often looked back at the spaces and objects they were leaving. When first mobile, they left behind a trail of abandoned objects, a visual reminder of the series of interactions they had just completed.

M: A lot of times if you've picked him up when he's playing, he looks back down to where he was playing. (I, Kevin, 6 months)

Mapping and Ranging the Infant Home Landscape

To fully understand home space use in early infancy, one must realize that infants are most likely to stay in the same area as their mothers or other family members. For the study's infants, the most frequented area was the primary living space, usually a living room or den, followed next by the kitchen and, less frequently, the bathroom or bedroom (Table 1).

Recognizing Activity Sites. In the first months of life, the nonmobile infant does not have an independent ranging pattern but is dependent on others, particularly the mother. Young infants were placed in one of many infant-holding devices available: bouncers, swings, strollers, walkers, carriers, and car seats. They appeared to recognize locations in the home by the activities that regularly occurred at that site rather than by more abstract spatial characteristics. For example, infants showed recognition of the changing table during diapering by immediately looking at, then reaching for, play objects usually found there, such as a toy or a lotion bottle. By age 6 months, infants knew specific aspects of a room's layout, such as which window to look through

to search for the family dog. Young infants also began to show awareness of the larger home space, watching, and later attempting to follow, their mothers as they passed from one room to another. Until at least age 8 months, they had difficulty following a person who passed out of sight.

Space Use Before Standing: Prone Fan, Shifting Circles, Edge Crawling, and Roll Travel. At approximately age 2 months, infants in the study began wriggling in prone position toward objects just out of reach. By 4 months, most infants could progress toward objects. They would frequently switch attention between objects, however, pivoting on their stomachs as they reached. This action resulted in a prone, fan-shaped, space-use pattern. As infants gained agility, they increased both the width of the prone fan and the distance traveled. They would slowly move in prone position toward desired objects, occasionally turning on their stomachs in a partial to full circle to shift attention to a different object, producing the space-use pattern of shifting circles.

M: His head would start one way, and then he'd get all the way around. *R:* He'd sort of turn like a clock? *M:* Yeah. On his belly. Scoot around. And then he'd get going the opposite way. (I, Kevin, 6 months)

At approximately age 5 months, infants moved from the center to the edges of the room, where more interesting objects were available. There, they belly crawled in a straight line from object to object at the periphery of the room, stopping for interactions. These brief pursuit lines, of 1 to 4 feet in length, produced the spatial pattern of edge crawling from 5 to 10 months. Some infants between 4 and 8 months, seemingly impatient with the slow pace of crawling, used rolling to cross open spaces. Roll travel was first used for its

own sake; then, around 6 months, to reach a specific target. As crawling speed increased, roll travel disappeared.

Activity Circuit. For infants from ages 6 to 18 months, mothers could easily predict the child's "activity circuit" (I, Alison, 10 months) or a sequence of locations of particular play interest that were likely to be included in self-directed play.

Crawling on his belly. He makes his rounds of the living room and kitchen, stopping at the glass (mirror reflection of him in the darkened glass) entertainment center, the metal trash can that blocks his access to the electrical cords in the back of it, the bookshelf where he pulls down books, the telephone cord stapled to the wall around a door, the fireplace tools, and a vase on the hearth. (Observation Record [OR], Kevin, 8 months)

Space Use After Standing: Edge Cruising, Roaming, and Targeted Travel. Once pulling to stand, infants played on low surfaces such as coffee tables, couches, or toy bins. Infants often took their first supported steps along the faces of these objects. Reaching the end of the surface, infants would drop to the floor and crawl to the next object.

Series of supported standing transfers . . . coffee table, infant swing, researcher's case, and others. Later, she works along the side of an overstuffed chair, along the wall, and down onto the floor to go around a door. (OR, Belle, 9 months)

Once able to walk without support, the infants' space use pattern was no longer shaped by room edges. They roamed, making long excursions between rooms, circling and zigzagging, seemingly without a particular destination in mind. They occasionally carried something or stopped for an object interaction but appeared at this age to enjoy traveling for its own sake. As the roaming phase faded, space use became increasingly targeted. Rather than opportunistically engaging objects they encountered, infants began to preselect destinations. By age 1 year, infants in the study were requesting to go outdoors. By 18 months, infants in the study were intentionally traveling to locations out of sight to engage in a planned interaction.

Once again, this subject spent the primary portion of our session outside and headed downhill on a walk . . . [leading her mother and I] two city blocks . . . There is no passing the real favorites for exploration, such as the ornamental berries, a set of steps to walk down with a rail, a place where there is a dog in the yard, a drain spout that will come loose if you pull on it. (OR, Alison, 18 months)

Activity Paths. As the infants' spatial experience expanded, paths began to link the activity sites and activity circuits located in different rooms. Shortly after age 6 months, infants began negotiating between connecting rooms, such as the

kitchen and the living room. Crawling infants often followed sounds from one room into another, seeking out individuals rather than objects. By approximately 9 months, infants could recall the locations of objects and negotiate hallways to reach them. By 12 months, most infants traveled independently over most of one floor of the house. They began moving with increasing speed through the house, stopping periodically for interaction. They demonstrated the development of activity maps by identifying specific spaces in the house with activities that usually took place there: going to the refrigerator to request a snack or carrying a toothbrush to the bathroom. Around 14 or 15 months, infants would go to search for objects requested of them, such as shoes for going outside. By 18 months, infants began to transport objects to another room for planned object combinations and traveled through the house to put objects away.

Kevin is covering a lot of space during the session now, zooming down the hall when he sees the light on the floor that means the bedroom doors are open, going to the sliding doors to look at the dog and fill his dish, pulling books down from the shelves. . . . Hiding in curtains, climbing into toy box. Putting blocks into sorting bucket, placing clean bowls out of dishwasher into the cupboard where he plays. (OR, Kevin, 15 months)

Stationary Object Play (Table 2)

Infants interacted with the physical environment while either stationary or mobile. In both cases, the environment offered surfaces, single free objects, combinations of a surface and a free object, and combinations of free objects for interactions. First stationary play is described, then mobile play.

Play With Surface Textures. Passive sensing of blankets and the cloth coverings of infant holding equipment were the infants' simplest and earliest contacts with the physical environment. By age 3 months, infants had begun to touch the glass of windows and mirrors and the surface of bathwater. When exploring surfaces, infants frequently tested surface texture between their fingertips while watching carefully. Once mobile, they would occasionally pause to feel the surface of a couch, wall, window, or floor with bare feet. This occurred in later months only in the case of unusual surfaces, such as the wet plastic of a baby pool.

Combining Surface and Single Free Object: Pull-Ins and Pounding. Pull-ins were the earliest form of independent grasp, as prone infants used reflexive grasp to scoop a blanket or toy across a surface to their mouths. The pull-in was rare after age 7 months. The blanket pull-in, a prone infant pulling on a blanket to obtain an object on the blanket, was the earliest example in the data of the instrumental use of one object to affect another. Probably first produced by accident, this action quickly became an intentional strategy. By 6

months, infants had developed both the grasping ability and the arm control required to pound an object on a surface, most commonly the tray of their highchair or walker. By 8 months, however, most infants lost interest in pounding.

Free Object Play Beginnings: Grasp, Reach, Bat, and Shake. Earliest assisted object grasp consisted of holding a parent's shoulder, hair, jewelry, glasses, or an object placed in the infant's hand. Infants were aware of these objects but did not retain them long. In the third or fourth month, infants batted at objects hanging from a bouncy seat toy bar, occasionally grasping them. They could more easily grab a blanket; tangle their fingers in open knits; or grasp thin, rod-shaped items such as plastic rings. By age 6 months, they could shake rattles, reorient a pacifier, bring objects to mouth, and even pass objects between hands at midline. Around 8 months, many of the study's infants were picking up tiny objects, such as bits of lint. Manipulating straps and strings was important from 6 to 9 months. Few commercial toys offered this sort of hand experience, but highchair straps, telephone cords, and shoelaces proved fascinating. Creating noises by crumpling paper and shaking rattles was also popular at this age.

Stationary Free Object Play: Mouthing, Donning and Doffing, Articulating Objects, and Comfort Objects. The predominance of object mouthing in the early months was remarkable but occurred for different reasons. In the first 3 months, mothers believed that infants were sucking on their hands or pacifiers for comfort, based on contextual cues such as the imminence of naptime. At 5 through 7 months, infants usually mouthed a series of objects in quick succession. After 12 months, infants occasionally used their mouths to carry objects in crawling and enjoyed making noises into a cup or tube. Between 5 and 16 months, object teething could be distinguished from exploratory play by its urgency, the infant's distress, and placement of the object at the location of emerging teeth.

Although infants began cooperating with dressing as early as age 8 months, it became a play activity much later. At 14 months, many of the infants in the study were initiating donning their shoes. Between 14 and 18 months, infants became interested in putting on and taking off clothing, sunglasses, their parents' shoes, and other items.

Articulating objects, or objects with attached but moveable parts, were precursors to object combinations. Common articulating objects were busy boxes, switchboxes, inclusion balls, doors, and adult technology. Infants played with these objects from ages 6 to 14 months. Inclusion balls, of interest between 3 and 7 months, were inflatable clear-plastic shapes that contained movable objects accessible only by sight. At approximately 9 months, infants manipulated interior doors, at first for the sake of the movement, later to close themselves

and others in and out of spaces. In the same way, infants enjoyed closing cupboard doors and hinged container covers beginning at 13 months. Infants showed great interest in computers, stereos, televisions, telephones, and other types of adult technology. Different infants in the study demonstrated the ability to turn the stereo on and off at 9 months, use the television remote control at 11 months, and insert videotapes at 17 months. The telephone was the most frequently used object for imitation play.

When feeling tired or insecure, some infants in the study sought out a specific blanket for comfort. They did not gaze at it, attempt to explore its properties, or combine it with other objects. They simply held it or tested its texture. Stuffed animals adorned the rooms of infants but received little play attention.

M: She's really not [interested in stuffed animals]—my mom even got her some at Christmas, thinking she would love them. And she kind of said, "Oh, hi," and went on with her usual activities. (*I, Alison, 18 months*)

Stationary Multiple Object Play: Taking Out/Apart, Putting In/Together. Bilateral holding of an object was common between ages 3 and 6 months. Later, it diminished in favor of unilateral holding, except for objects that were large or difficult to hold. From 5 to 9 months, infants transferred a free object between hands and switched hands to cruise along furniture. Young infants would occasionally play with two objects without combining them, as their attention switched from one to the other. Slow switching, in which gaze turns to the next object while the hand retains contact with the previous object, was common in the early months. In later months, it indicated distraction.

Beginning at age 4 or 5 months, infants took great pleasure in tearing paper goods such as magazines and tissues. This was the earliest form of object disassociation and remained interesting until approximately 10 months. Eight-month-old infants destroyed block towers and took apart pop beads. Beginning at 6 months, infants removed objects from open storage spaces, such as shelves, baskets, cupboards, and drawers, and tipped small containers to dump their contents. By 8 months, most infants were emptying the kitchen plastics cupboard. After pulling objects out, infants often chose to sit and manipulate them on the floor. Later, infants would use a supported stand to empty toy bins and bookshelves. By 9 months, the infants of the study could search through a large basket of toys for a desired object.

R: Does she pull them down and turn them so they'll fall out? Or does she take them out one by one? *M:* She spills them. She likes to spill. There's a bucket, another bin inside that little sink area over there, and it's full of

Table 2. Stationary and Mobile Object Play

		Age (Months)							
		1	2	3	4	5	6	7	8
Play with surface texture									
<i>Body</i>	Face sensing 1–4		Foot sensing 2–7			Foot sensing with intention 6–8			
<i>Hand</i>			Texture test 2–8		Touch glass 3–8		Splash water 4–8		
						Texture test for unusual textures 6–8			
Combining surface and single object play									
<i>Pull-in</i>	Pull-in blanket 1–7		Pull-in object 3–6						
<i>Pounding</i>							Pound objects against a surface 6–8		
Free object play beginnings									
<i>Grasp</i>	Grasp parent's hair		Hold, bat at objects 2–4		Grasp blanket		Pass objects in hands 4–6		Bring objects to mouth
				Tangle fingers in knits		Shake a rattle		Crumple paper 6–9	
								Grasp strings, straps 6–8	
								Pick up tiny objects, fuzz	
Stationary free object play									
<i>Mouth</i>	Mouth hands or pacifier 1–2		Bring objects to mouth 3–4		Explore orally 5–7				
		Mouth for comfort 2–7							
								Teething triggers interest in mouthing 5–16	
<i>Don/doff</i>									Cooperate with dressing 8–10
<i>Articulated objects</i>	Busy box 1–6		Inclusion ball 3–7				Switch box 6–14	Busy table 7–10	Interior doors, cupboard doors, hinged corners of containers 8–12
Stationary multiple object play									
<i>Hold</i>			Bilateral hold of one object 3–6				Unilateral hold except for very large objects or objects with multiple features 6–18		
<i>Attend</i>	Slow switching of attention between objects 1–6						Emergence of simultaneous attention to multiple objects		
<i>Disassociate</i>					Destruct paper goods 4–10		Remove object from grouping 6–9	Destruct block tower	
								Dump stacked rings 8–9	
<i>Apply</i>									Pound 2 objects together 8–10
<i>Stack/nest</i>									Pile and unpile flat objects 8–11
<i>Place in containers</i>									
<i>Fill/empty</i>									
<i>Fit together</i>									
<i>Activity centers</i>									
Mobile surface play									
<i>Small spaces</i>							Play under furniture 5–9		
<i>Climb</i>							Clamber 6–8	Climb stairs 8–18	
<i>Jump</i>									
Mobile play combining surface and single free object									
<i>Propel</i>							Drop	Throw	Propel/follow/propel
<i>Drive</i>							Drive stable objects (books, containers) 6–8		Small objects/toy cars 8–10
								Push toy with assistance	
Mobile free object play									
<i>Roll</i>					Blanket roll				
<i>Carry</i>					Roll carry	Crawl carry (without apparent intention) 5–11			
<i>Ferry</i>									

Note. Shaded areas represent patterns that develop or are present over more than 2 months.

puzzles . . . She likes to dump the whole thing out, and then she chews on the little wood pieces. And then she likes to go to the next little cupboard with all the dishes. . . . She pulls the books down. (I, Leslie, 10 months)

Commercial toys designed to develop object combinations, although present in most homes, were not frequently selected by infants in self-directed play. By age 7 months, however, most infants could remove shapes from an open shape sorter bucket. By 8 or 9 months, infants emptied stacking rings and puzzles. Taking out and taking apart was the basis for the later emergence of putting in and putting together. Storage centers represented, by far, the most productive situation for the development of object combinations. The kitchen plastics cupboard was the most frequent play location in the study. Commercial play centers, such as play kitchens and play tool benches, presented similar conditions, although they offered fewer objects and were usually enjoyed later, at around 14 months. By 9 months, infants began to occasionally replace objects in the storage area that they had just enjoyed emptying. From 10 to 13 months, infants matched containers and lids, placing first one object and later a series of objects into a container before closing it with a lid. Spreading a cloth over an object was observed once at 16 months.

By age 13 months, infants tried to associate parts of a toy, such as putting an engineer character into a toy train, and coordinating household objects, such as inserting keys into keyholes. At 11 months, infants in the study began nesting and unnesting sets of similar objects such as coasters and cups, starting with only a couple of pieces. This play was most frequent around 13 months and increased in complexity through 16 months. It also provided the basis for stacking play. Balancing multiple objects on top of each other continued to be of interest until 18 months, showing increases in the narrowness of objects stacked and the number of objects combined.

By age 15 months, infants demonstrated forethought concerning the outcome of their actions. By 18 months, there was a clear increase in instrumental object use, such as a 15-month-old using a rolling pin on play dough and a 16-month-old using a shovel to fill a bucket with sand.

Mobile Object Play (Table 2)

In the past, infant-toddler developmental research usually addressed what infants could do in standardized positions and settings rather than in the varied types of self-directed and mobile play that typically occur within the home. The prevalence of mobile object play is a primary discovery of the study.

Surface Play: Jump and Dance, Small Spaces, and Climbing. Once mobile, the ways in which infants interacted with

surfaces became more various and sophisticated. Jumping on the floor or on springy flat surfaces such as beds or trampolines was enjoyed by many infants. A few were observed jumping from small heights onto soft surfaces such as beanbag chairs. Many infants had the opportunity to jump in a jumper before they could walk. Dancing was also popular from standing to age 18 months.

Infants explored the fit between spaces and their bodies. They entered small spaces, peered around, and angled their gaze to look out. Getting under furniture was the earliest type of small space play. Extracting themselves required more skill than getting in: Infants between 5 and 9 months old often got stuck. Beyond 9 months, infants enjoyed going into closets, into cupboards and forbidden corners behind stereos or televisions, and behind curtains and furniture. They delighted in blanket and pillow forts constructed by older siblings, as well as commercial tents and playhouses.

In its earliest form, climbing play was observed in 6-month-old infants clambering over low raised surfaces, placing hands first on the surface and, at a slightly later age, following with knees. Infants clambered over prone parents and couch pillows and into low cupboards. This clamber grew into stair climbing around age 8 months. By 14 or 16 months, some infants were climbing up a flight of stairs independently with supervision and walking down holding an adult's hand. Homes offered many climbing opportunities: onto and off of furniture, steps, and counters and in and out of cupboards, bathtubs, highchairs, strollers, and cars. Once infants could walk, they climbed on furniture and counters. With each new climbing object, infants would first learn to climb up and later to climb down. Outdoors, hills and inclines were enjoyed, with a preference for going downhill. By 12 months, infants were negotiating small infant slides, and by 14 months, some used full-sized slides. Climbing play formed a significant portion of infant object play, rivaling even combinatory play in frequency. As in other forms of object play, climbing became increasingly targeted with age and was used to reach objects as high as on top of a refrigerator by the time one of the infants was 15 months old.

Mobile Play Combining Surface and Single Free Object: Propelling and Driving. *Propelling* refers to the infant's efforts to drop, throw, and otherwise launch objects through space. After age 6 months, infants were dropping objects for the fun of retrieving them. Dropping quickly grew into throwing out of bouncers, highchairs, and other devices, usually after brief mouthing and handling of the object. The sound of the object hitting the floor held great interest. Around 8 or 9 months, infants propelled objects and then crawled after them to propel them again. This repeated throwing play peaked around 11 months. After 12 months, infants actively

selected specific surfaces as targets for throwing, preferring the loud noise and bounce of tile flooring. Infants also showed interest in kicking at around 16 months.

Driving refers to the infant's pushing, pulling, and riding of objects through home space. This began at age 6 months with sliding stable objects across the floor while crawling, such as books, magazines, or baskets of laundry. Once infants began pulling to stand, around 8 months, they engaged in supported standing drives, often of kitchen chairs. Infants began using commercial push toys independently at 10 months, at first leaning slightly into the toy, launching across the room in a straight line with long fast strides and gently colliding with a wall, couch, or other barrier. After approximately 1 month of experimenting with push toys, infants learned to reposition themselves on the opposite end of the push toy to move away from barriers, pushing back in the direction from which they came. They usually remained within one room, and the resultant space-use pattern roughly resembled a star. At approximately 13 months, infants could steer around barriers and began driving through the house. Interest in push toys was maintained through 18 months, and the play increased in complexity. Smaller objects, such as hand-sized cars, were also pushed across surfaces within reach as early as 8 months. By 12 months, infants were crawling behind a hand-sized car and later driving it along nonfloor surfaces, such as walls, couches, or the edge of a bathtub.

Mobile Free Object Play: Blanket Roll, Roll Carry, Crawl Carry, Standing Carry, Ferry, and Targeted Carry. At age 4 months, some infants would hold a blanket while rolling, becoming wrapped. Some infants intentionally performed these blanket rolls that combined object manipulation and movement. Infants who used rolling to travel, between 4 and 7 months, sometimes rolled a short distance with a hand-sized toy. In both the roll carry and the later crawl carry, infants showed little awareness of the object being transported. It was abandoned along the way. Infants incorporated carries with every new development in mobility. Standing carries were usually of a single easily held object and lasted longer than crawl carries. As standing became more competent, infants tested their skills by attempting to carry very large objects.

Infants ferried objects to individuals beginning at age 11 months, with a peak at 14 to 15 months. In the youngest ferries, the child was reluctant to give up the object. Later, infants would carry one object or a series of objects to adults, sometimes requesting shared play, as with books, or assistance with the object, such as turning on a talking doll. Carries became increasingly targeted with age: first transporting an object to a destination, later taking an object to a location where a specific action was planned, then carrying an object to a series of sites for similar repeated engagements.

Carry bowl of cereal out of kitchen to dining chair. Eat. Put on table and climb up on chair. Sit on chair and eat. Manipulate papers on table. Climb down. . . . Go to table. Climb up, eat cereal, moving self and bowl to different chairs. Take bowl to living room, down steps. Carry bowl back to sit on steps, beside small toy, eating. Move toy up step. Set bowl beside toy. Eating. Take bowl to mom. (V, Jared, 17 months)

Because of the increased difficulty, mobile object combinations were not as frequent as stationary combinations and occurred later in development. A few of the infants were observed carrying groupings of small or flat objects, and many used containers, most often with handles, to carry objects. Multiple object propelling usually involved very small objects, such as small stones or a container.

R: Oh, look at all the plastic Easter eggs! *M:* Yes. He loves those. He takes them in and out of the net, takes them apart. . . . He likes taking it to the kitchen floor and dumping them, because they bounce. (I, Kevin, 16 months)

A Central Dynamic: The Motor Lens

Infant Space Theory details the interactive relationship between infants' active search for challenge and their growing motor abilities. Attracted to novel experiences, infants push their motor abilities to the limit. In turn, emerging motor skills make intriguing new interactions possible. Once crawling, many new objects become available to a young child. With pull to stand, another level of the home is offered. With walking, the whole house and yard became a play space. This is not a simple result of the opening of motor skill. Rather, motor skill development is also driven by the infants' efforts to engage the next object just out of reach. The motor lens is a dynamic and ever-opening window on fresh interactions with the physical environment that interactively drives visual, spatial, and object play development.

Supplementing Developmental Theory Through Description of Infant–Toddler Occupations

This study supplements age and stage theories of development that focus on the intraindividual emergence of cognitive, motor, or other skills by detailing developmental patterns of infant–toddler object and space use within the context of the home. The study also complements the social constructivist approach to development and emphasizes the shaping of development through social and cultural processes (Humphrey & Wakeford, 2006) by describing the developmental influences of interactions with the

physical environment. Key discoveries of this research that especially address gaps in the developmental literature include the role of vision and gaze in play development; the ways in which young children develop negotiations and understandings of the spaces of their everyday lives; the frequency with which young children select everyday household objects for play over commercial toys; how object combinations develop using usual home objects; and especially the ever-present but little-researched development of infant–toddler mobile object play, including jumping, dancing, small space play, climbing, throwing, driving, carrying, and ferrying.

This study also contributes to the development of occupational science by describing an important pattern in the typical development of infant–toddler occupations, as well as demonstrating how descriptions of typical occupational patterns can be pragmatically relevant to a specific area of occupational therapy practice (Clark et al., 1991; Higgs & Titchen, 2001; Hoshmond & Polkinghorne, 1992). In reviews of the development of occupational science, Infant Space Theory has been cited as an example of descriptive occupational science (Hocking, 2000; Molke, Laliberte-Rudman, & Polatajko, 2004).

Applying the Infant Space Theory in Naturalistic, Home-Based Early Intervention

As a substantive theoretical description of typical infant–toddler play in the home, Infant Space Theory supports occupational therapists in providing naturalistic early intervention for young children with developmental challenges. It does so in several ways: (1) providing an intermediate level of abstraction between grand developmental theories and the needs of a specific child, (2) supporting naturalistic interventions, (3) enhancing family centeredness, and (4) increasing the fluidity and freedom of the therapist’s provision of interventions.

More Detailed Description of Infant–Toddler Play With Objects and Spaces

A therapist is currently required to develop interventions by reflecting on the needs of a specific infant or toddler with disability within very broad theories of development, such as Piaget’s (1952, 1962) theories of cognition and play or Gesell’s (1940) motor development stages. Infant Space Theory eases the therapist’s efforts to compare a child’s developmental status to grand theories by providing an intermediate level of abstraction that is more detailed and age specific. By using this substantive theory, the therapist can more finely discriminate in thinking about the current developmental capacities of a particular client. The described play

interactions also suggest a wealth of appropriate play challenges that could be used as interventions, thus easing the cognitive demands on therapists that are inherent in generating multiple engaging play opportunities per child per day.

Using Natural Play Opportunities

Infant Space Theory can strengthen the therapist’s ability to provide early intervention that makes use of and enhances natural context. This detailed description of how infants and toddlers typically develop interactions with the spaces and objects of the home equips therapists with new insights into how to work directly with those objects and spaces as interventions. This contextual perspective also assists therapists in identifying barriers in the home or in care routines that may be restricting developmental opportunities and creating adaptations that may increase the richness of daily play for a child. Even the spatial contexts of clinical and educational spaces used in early intervention could be examined for possible improvements as natural settings for play development that more closely resemble the home environment.

Family-Centered Interventions

Infant Space Theory assists the therapist in working in a family-centered way (Dunst, Trivette, & Deal, 1988; Humphry & Wakeford, 2006). Speaking with families in terms of the development of typical play occupations as they occur in the context with which family members are fully familiar, rather than in terms of decontextualized components such as visual or motor milestones, helps family–therapist collaboration in many ways. The therapist becomes more understandable as he or she explains the interventions recommended for the child. The interventions are easily demonstrated and mapped onto objects and spaces that remain in the home. The goals of typical play development, such as ranging through the house or carrying objects from one place to another, are grounded in everyday experience and are abilities that family members value. Using a detailed understanding of typical play development in the home, the family and therapist can more easily develop a collaborative vision of their goals in regard to how they would like to see the child progress. The greater the strength of this collaboration is and the more effectively the therapist uses the natural objects of the home in intervention, the more likely it is that the family will enhance the development of the child through the many small play opportunities that can be easily woven into daily life.

Fluid Interventions

Infant Space Theory also supports therapists in early intervention to work in a way that is freer and more fluid. Equipped with this disciplinary knowledge of occupational

development in home context, therapists do not have to plan and transport multiple activities for each child served in the home. Using this theory, they can identify, use, and progress through the many object and spatial play opportunities naturally available in the home.

For example, within gaze and visual play, therapists might attend more closely to positioning for vision, visual offerings of the environment, and opportunities to develop more sophisticated gaze search and alignment in a child. In terms of ranging and mapping home space, several changes in intervention could occur. Therapists might increasingly follow (rather than lead) the child, move away from the blanket in the middle of the room, and use in intervention more typical developmental spatial patterns, such as recognizing activity sites, playing along the edges of rooms, moving through a play activity circuit, entering and leaving small spaces, and facilitating independent negotiation of the home landscape. Within stationary object play, therapists could incorporate the many typical objects for single and combinatory object play that can be found in the rich play spaces of the home. Instead of commercial toys, therapeutic tools can be any aspect of the home space that offers an incentive for exploration (e.g., blinds and curtains, books on a shelf, hallways). Therapists could easily include the rich, active, and newly described aspects of the typical development of mobile object play in interventions, such as dancing, climbing, driving, carrying, and ferrying.

Using the concept of the motor lens, therapists may also teach families to use novelty as embedded in daily activities and routines to encourage movement and exploration of space. Experiences such as exploring plastic containers in a kitchen cabinet while a parent cooks dinner, pulling tissues out of a box during family grooming activities, and reaching for the family dog's tail while playing on the floor have aspects of novelty, movement, and spatial awareness inherent in the motor lens. All of these potential applications of Infant Space Theory can be expected to strengthen the power of intervention, support naturalistic and family-centered intervention, and make therapy sessions more engaging for the child, the family, and the therapist as well.

Conclusion

The Infant Space Theory produced by this study of how 18 typically developing children interacted with the objects and spaces of their homes from ages 1 to 18 months has the potential to support occupational therapists in providing effective, naturalistic, and family-centered early intervention. Further research could refine this developmental description through a larger sample study or studies of the emergence of these occupational patterns in children of

different cultures, with specific disabilities, or in settings beyond the home. ▲

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