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## Memory and representation in young children with Down syndrome: Exploring deferred imitation and object permanence

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### Abstract

Deferred imitation and object permanence (OP) were tested in 48 young children with Down syndrome (DS), ranging from 20 to 43 months of age. *Deferred imitation and high-level OP (invisible displacements) have long been held to be synchronous developments during sensory-motor "Stage 6" (18–24 months of age in unimpaired children).* The results of the current study demonstrate deferred imitation in young children with DS, showing they can learn novel behaviors from observation and retain multiple models in memory. This is the first demonstration of deferred imitation in young children with DS. The average OP level passed in this sample was A-not-B, a task passed at 8–12 months of age in normally developing infants. Analyses showed that individual children who failed high-level OP (invisible displacements) could still perform deferred imitation. This indicates that deferred imitation and OP invisible displacements are not synchronous developments in children with DS. This asynchrony is compatible with new data from unimpaired children suggesting that deferred imitation and high-level OP entail separate and distinctive kinds of memory and representation.

This study addressed the relationship between imitation from memory (deferred im-

itation) and object permanence in young children with Down syndrome. Although object permanence has been investigated numerous times in this population (Cicchetti & Mans-Wagener, 1987; Dunst, 1981, 1988, 1990; Dunst & Rheingrover, 1983; Kahn, 1978; Mervis & Cardoso-Martins, 1984; Morss, 1983, 1984; Pasmak & Pasmak, 1987; Sloper, Glenn, & Cunningham, 1986; Wishart, 1986, 1987; Wishart & Duffy, 1990), this is the first study designed to test deferred imitation in young children with Down syndrome.

In classic developmental theory, there is thought to be a deep kinship between deferred imitation and a high level of object permanence ("Stage 6" invisible displacements). Both provide a measure of recall not simply recognition memory: To succeed, infants must generate actions on the basis of stored representations of perceptually absent realities. Both are thought to derive from a common source, the emergence

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of a representational intelligence (Piaget, 1952, 1954, 1962). It has long been held that deferred imitation and high-level object permanence (OP) emerge in tandem at about 18 to 24 months of age in unimpaired children.<sup>1</sup>

Recent data and theory have shown that some developmental synchronies described by Piagetian theory do not obtain, but that others certainly *do* (e.g., Astington & Gopnik, 1991; Bates & Snyder, 1987; Curcio & Houlihan, 1987; Fischer & Bidell, 1991; Flavell, 1982; Gopnik & Meltzoff, 1986, 1987, 1992; Hirschfeld & Gelman, 1994; Uzgiris, 1987). Although contemporary researchers now speak of “asynchrony across domains” and “synchrony within domains,” predicting in advance of the data, where the “domain” boundaries are has proven to be a challenge.

Pending a new developmental theory that makes such predictions and provides explanations for them, experimental work is needed to uncover which particular abilities are empirically related in development. This paper focuses on the relation between high-level OP and deferred imitation. There is near-universal consensus that success on Stage 6 OP tasks (invisible displacements) requires memory and representation for absent objects and that deferred imitation requires memory and representation of absent acts. Are these both part and parcel of one domain or developmental level (representational vs. sensory-motor), and are they developmentally synchronous? Does one ability systematically emerge before another? Is there no systematic ordering between them and only individual variation? Does the relationship vary across different populations? These questions can begin to be addressed by testing OP and deferred imitation in the same individuals.

1. OP development consists of a series of levels. Piagetian theory makes a specific and powerful prediction: A certain level of OP understanding, invisible displacements, emerges in synchrony with deferred imitation. Other more primitive levels of OP are thought to emerge in conjunction with more primitive levels of imitation (e.g., Piaget, 1962; Uzgiris & Hunt, 1975).

The first motivation for this study was to investigate deferred imitation in children with DS. Regardless of one's theoretical stance, it is acknowledged that deferred imitation is a powerful form of social learning, a kind of no-trial learning where the actions of the other are appropriated to the self. Because the imitative re-enactment takes place after a memory delay when the social act is no longer visible, deferred imitation also taps memory. A fuller understanding of the mental and social capacities of children with DS will be obtained by cataloging their capacity for deferred imitation. At present, this capacity is sometimes inferred from indications that young children with DS can learn sign language (Abrahamsen, Cavallo, & McCluer, 1985; Miller, 1992). Acquisition of sign language requires visual and gestural memory abilities. However, signs are taught using not only observational learning and imitation, but also a mixture of other training, shaping, and molding procedures. Thus, true observational learning and deferred imitation can be surmised but are not unequivocally demonstrated by reports of sign language. An organism could be taught to use signs through means other than imitation.

The second motivation was the opportunity for contributing to the debate about developmental synchronies/dissociations that has emerged in modern developmental theory, especially for infancy. Whereas unimpaired infants develop so quickly that two target skills may seem to co-occur, children with DS develop in a slower (but organizationally similar) manner (Beeghly & Cicchetti, 1987; Beeghly, Weiss-Perry, & Cicchetti, 1989, 1990; Cicchetti & Mans-Wagener, 1987; Dunst, 1990; Dunst & Rheingrover, 1983; Hill & McCune-Nicolich, 1981; Motti, Cicchetti, & Sroufe, 1983; Sigman & Ungerer, 1984). This potentially allows us to see dramatic dissociations between skills and abilities that are not tied by necessity but are only contingently related in normal development. There is the potential for discovering wide gaps, if they exist—gaps of months or years that would be more subtle in unimpaired children. Thus,

claims about developmental universality and causal connectivity can be addressed by tests with this population.

The third motivation was more applied. It would be informative for teachers and parents if it could be demonstrated that children with DS have strengths in imitating from memory. A reason that deferred imitation has not been tested in young children with DS is that paradigms typically involve verbal directions or prompts such as, "Do you remember what I showed you? You do it." New procedures not relying on language have recently been developed to assess deferred imitation in preverbal infants (e.g., Meltzoff, 1985, 1988a, b, 1990). Thus the third goal was to adapt these infant tests for use with young children with DS and potentially other language-delayed populations.

## Methods

### Subjects

A total of 48 children with DS served as subjects. According to school records and parental reports of karyotyping, the sample was composed of 46 cases of the trisomy 21 type of DS and 2 cases of the translocation type. All children were home reared. The sample was composed of two subgroups used to test specific theoretical predictions (described later). The "young" group consisted of 24 children ranging from 20 to 24 months of age ( $M = 21.92$  months;  $SD = 1.00$ ). The "old" group consisted of 24 children ranging from 25 to 43 months of age ( $M = 32.32$  months;  $SD = 6.10$ ; Table 1). Five additional children were tested but dropped from the study: one because of procedural error and four because of lack of cooperation (usually they persisted in throwing the testing materials).

Subjects in both the younger and the older group were randomly assigned to an imitation (experimental) and a control group, each counterbalanced for sex. The control group was further subdivided into a baseline- and activity-control group (described in Procedures), each of which was again balanced for sex.

The subjects were recruited by contacting Early Intervention Programs in Washington, Texas, California, and British Columbia. The principal testing site was at the Child Development and Mental Retardation Center, University of Washington, Seattle, but some children were drawn from other sites because we sought a very large  $N$  within tightly prescribed age limits. Descriptive statistics for various subject characteristics and demographic factors are provided in Table 1, including the parent's socioeconomic status (SES; Hollingshead, 1975), the children's weekly hours of participation in intervention programs, birthweight, and number of younger and older siblings. Analyses revealed no significant differences on any of these characteristics between the imitation or control groups.

### Materials

Six objects were used as test stimuli. All had been previously used by Meltzoff in tests of unimpaired infants (Hanna & Meltzoff, 1993; Meltzoff, 1988a, b). Four of the six objects had been specially constructed in this laboratory, and therefore were novel objects to the subjects.

1. The dumbbell object consisted of two wooden cubes (2.5 cm), which were connected by two plastic tubes (length 7.5 cm). The thinner tube fit inside the wider one. The target act was pulling apart the object.
2. The head-touch panel consisted of a flat wooden box with a nonreflecting, translucent orange plastic panel (4.3 cm  $\times$  19 cm  $\times$  26.7 cm). The target act was leaning forward and touching the orange panel with the forehead, which activated a bulb inside the box that illuminated the orange panel.
3. The buzzer box consisted of a black box (16 cm  $\times$  16.5 cm) tilted off the surface of the table so it faced the child. The top surface contained a small round hole (9 mm) with a slightly recessed button. The target act was pushing the button with

