Erez Miller

Task Mastery And Peer Relations In Children With Down Syndrome And Heart Disease

Descriptors: mental retardation, Down syndrome, chronic diseases, young children, early childhood development, task mastery, peer relations

Abstract
Congenital heart disease (CHD) is present in 40% to 60% of infants with Down syndrome (DS). We examined the effects of CHD on cognitive (specifically, task mastery) and social (specifically, peer relations) development among young children with DS. We compared children with DS and CHD (n=17) and children with DS but without CHD (n=31) in preschool classrooms. Children were observed at ages 3 and 5, using the Bronson Social and Task Skills Profile (Bronson, 1985). The main results indicate that children with DS and CHD displayed significantly lower abilities of task mastery at age 5 compared to DS children without CHD. In addition, CHD predicted 30.2% ($p<.001$) of the variance in task mastery at age 5 among children with DS and CHD. The meaning and implications of these results for parents and professionals are discussed.

Introduction

Down syndrome (DS) is the most common cause of mental retardation. Current estimates indicate that it occurs in 0.96-1.5 per 1000 live births (Stoll et al., 1990; Tubman et al., 1991). It is also one of the most prevalent diagnoses seen in developmental and genetic clinics (Van Dyke, 1989). This syndrome has been associated with a wide range of characteristic physical features as well as with various health-related problems, such as ear, nose, and throat problems (e.g., Van Dyke, 1989). Two of the most common health problems reported in the literature regarding this population are cardiac defects and their more severe form – congenital heart disease (CHD). The estimated frequency of cardiac defects among infants DS in the United States ranges from 40% to 60% (Rogers & Roizen, 1991; Rowe & Uchida, 1961). Researchers in other countries have reported similar estimates (Mathew et al., 1990; Parisi-Buckley, 1984; Stoll et al., 1990; Tubman et al., 1991).

CHD poses a serious developmental risk factor for children with DS. It is one of the major contributors to mortality among these children, especially when combined with pulmonary vascular disease (Tubman et al., 1991; Van Praagh et al., 1996). Nevertheless, the life expectancy of many children with DS and CHD does not differ from other children with DS if they survive the first 4 or 5 years of life (Eyman, Call & White, 1991), especially if they undergo surgical repair (Baird & Sadovnick, 1987; Mathew et al., 1990). However, CHD affects not only life expectancy and the child's physiological functioning, but is also associated with other developmental domains such as cognition and behavioral adjustment.

The well-known connection between DS and heart disease has prompted the development and use of screening tests for newborns with this syndrome. This early screening is necessary because of the high prevalence of severe congenital cardiovascular defects among these children. The early screening is also necessary to prevent the development of irreversible pulmonary vascular disease at an early age, to which children with DS and CHD are at greater risk (Clark, 1996a; Thiene, Ventriglia, & Frescura, 1996).

Effects of Down syndrome on development

An extensive literature exists on the development and developmental challenges of children with Down syndrome (e.g., Carr, 1970, 1995; Cicchetti & Beeghly, 1990). In the first few months of life, these children appear to develop similarly to their non-disabled peers, although there are some indications that infants with DS show some delays as early as six weeks of age (Carr, 1970). Such developmental delays have been reported in cognitive and psychomotor development (Carr, 1970; Connolly, Morgan, & Russell, 1984; Sharav & Shlomo, 1986; Tingey et al., 1991); speech and language development (ranging from a few months to several years, depending on the child's age) (Miller, 1987; Stoel-Gammon, 1990); motor skills (Henderson, 1985); and adaptive behavior (Dykens, Hodapp, & Evans, 1994).

Direct and indirect effects of congenital heart disease (CHD) on development

Congenital heart disease has also been known to affect children's physiological, cognitive, motor and behavioral development, as well as school functioning, in various ways and put them at risk for developmental delays. These effects and some of their implications will be discussed in this section.

It is important to note that most of the extensive literature on the effects of CHD on children's development focuses on children with CHD but without chromosomal anomalies. CHD has been reported to affect physical growth (Bayer & Robinson, 1969; Mehrizi & Drash, 1962); cognitive development (Silbert et al., 1969; Yang, Liu, & Townes, 1994); motor development (Silbert et al., 1969); and behavior (Utens et al., 1993). Furthermore, heart disease can also have a deleterious effect on children's functioning at school. For instance, Wright and Nolan (1994) found that children who were diagnosed with severe CHD performed more poorly on standardized tests of reading, spelling and arithmetic (even after undergoing early surgery) than their peers with mild or no heart disease. These results were significant even when the children's socioeconomic status, maternal education, and gender were controlled. The lower academic performance of the children with severe heart disease was attributed primarily to their lower cognitive functioning.

Heart disease can also influence other aspects of the child's school experience and school functioning. For example, a severe heart condition can contribute to overall physical fatigue, which may interfere with the child's cognitive functioning – specifically, the capacity to process information and concentrate at school. Fatigue may also limit the amount of time children with heart disease can participate in activities, thus limiting their opportunity to be involved in social interactions. Since experience in interaction with peers is associated with greater social competence (Howes, 1987), limited ability to engage in activities may eventually hinder the development of social skills. Our current understanding of the peer relationships among children with chronic illnesses, however, is obfuscated by many of the methodological and conceptual problems that often plague studies in this field (e.g., the lack of control groups that are appropriate for the study's design) (Spirito, DeLawyer, & Stark, 1991). Nevertheless, there is some support for the connection between poor peer relations and the restriction of physical activity resulting from the child's illness (Bywater, 1981; Tropauer, Franz, & Dilgard, 1970).

Further, some researchers have suggested that CHD may also affect development indirectly, by affecting family adjustment and parent-child relationships (Goldberg et al., 1991). A child's cardiac condition may induce a high level of protectiveness by parents, who may restrict their child's activities beyond what is required by the medical condition (Cayler, Lynn, & Stein, 1973; Goldberg et al., 1990; Reed et al., 1984; Silbert et al., 1969). This high level of protectiveness may foster greater dependence than is age-appropriate (Garson et al., 1978). Furthermore, children whose exposure to and interaction with a range of stimuli are limited may be

delayed in developing cognitive strategies for successfully completing challenging tasks (Barrera, Watson, & Adelstein, 1987). Thus, the impact of the child's cardiac disease on the family environment may put the child at high risk for cognitive, behavioral, and psychological maladjustment (Casey et al., 1996; Utens et al., 1993).

Over the last 100 years, knowledge of the medical aspects of CHD in children with DS has continued to expand (Pueschel, 1996). Very few researchers, however, have investigated the effect of CHD on the development of children DS. Those studies on children with DS and CHD indicate that DS children with moderate to severe CHD may have somewhat delayed development, especially in the areas of motor skills, social and adaptive skills, and cognition (Cullen et al., 1984; Schnell, 1984). As far as we know, no study has examined the effect of CHD on emotional development among children with DS.

The home environment in which children with DS and CHD develop may also be less optimal than that of their peers without CHD. Barrera and colleagues (1987) found that while the caretaking environment of children with Down syndrome with and without CHD was fairly similar in early infancy (age 3–4 months), there was a marked difference between the two groups a year later. When the children were 16 months old, the caretaking environment of children without CHD was significantly better, reflecting greater maternal responsiveness and involvement, better organization of the environment, a wider variety of stimuli, and fewer restrictions on the child.

Given current legislation in the U.S. (PL 105-117) and in Israel (Special Education Law, 1988), young children with DS often attend school-based programs during their preschool years, yet no investigator has analyzed the effect of CHD on the school or preschool functioning of children with DS. Understanding the relation between CHD and the classroom behaviors of children with Down syndrome is critical for parents, teachers, pediatricians, and other service providers. Should children with DS and CHD have specific educational needs, early intervention programs and Individualized Education Plans (IEPs) must be adjusted to address those needs, thus enabling children with DS and heart disease to benefit fully from their early education experiences.

Academic competence and peer relations are often intricately intertwined when measuring the young child's functioning in school. When teachers of early elementary school children were asked to describe a competent or successful child in their classroom, they emphasized the child's social, cognitive and academic skills. Specifically, they described children who:

(a) interact well with peers and adults; (b) approach tasks and complete them successfully; and (c) demonstrate appropriate academic skills (Hauser-Cram et al., 1991). These abilities require adequate levels of self-regulation, social skills, and motivation to learn.

Studies of the school functioning of young children with DS have revealed a consistent pattern, as such children appear to perform more poorly in mastering tasks than their typically developing peers. For instance, in comparison to typically developing children, Bronson, Hauser-Cram, and Warfield (1997) found that 3-year-old children with DS demonstrated lower levels of task mastery (e.g., using fewer strategies, and completing a lower proportion of the tasks successfully by themselves) in their preschool classrooms. Similarly, Ruskin and colleagues (1994) reported some delays in task mastery behavior among young children with DS with a mean chronological age of 22.6 months, compared to a group of typically developing children who were matched by mental age. They found that while both groups displayed a similar quality of play with toys, children with DS were less engaged in the task than their typically developing peers.

There is, however, less consistency in the reports on the success of peer relations among children with DS. Comparing young children with DS to typically developing children, Bronson, Hauser-Cram, and Warfield (1997) found that 3-year-old children with DS demonstrated typical social skills in their preschool classrooms. In contrast to these findings, Sinson and Wetherick (1981) found that 3- and 4-year-old preschool children with DS in "mainstreamed" classrooms did not engage in nonverbal interaction (mutual gaze) with typically developing peers, which resulted in social isolation.

With the emergence of research on young children with DS in a school setting, investigators have most often focused on how these children are similar to and diverge from typically developing children. To date, the extent to which CHD may relate to social and academic classroom behaviors in children with DS has not been investigated. Therefore, this study was designed to examine task mastery and peer relations among children with DS and heart disease in early childhood education settings. Based on the literature on children with CHD, we hypothesize that children with DS and CHD will demonstrate poorer classroom functioning than children with DS only. Specifically, we hypothesize that children with DS and CHD, in comparison to children with only DS, would demonstrate lower levels of task mastery and peer interaction skills in their preschool classroom.

Method

Sample

The sample for the study was part of a larger investigation of the development of children with disabilities and their families, the Early Intervention Collaborative Study (EICS) (Shonkoff et al., 1992). The sample was recruited between November 1985 and December 1987, from all families with children with DS who enrolled in one of the participating early intervention (EI) programs in Massachusetts and New Hampshire.

The study sample included 48 children with DS, whose diagnosis was confirmed based on a review of their medical records by project physicians, and on chromosomal analyses. The mean child age at study entry was 3.4 months (SD=2.0). Table 1 presents the demographic characteristics of the children and families in the sample. Over half of the children were girls (58.3%). Most of the children were Euro-Americans (85.4%), and almost one half (47.9%) came from a family with an annual income (at study entry) of over $30,000. The annual income of the majority of this study's sample fell within the range of median annual income for American households for those years (Bureau of the Census, 1990). On average, mothers in the sample had completed 14.3 years of education, and the majority of them were married (87.5%). There were no statistically significant differences between the group with symptomatic CHD and the group with non/asymptomatic CHD with respect to children's gender, ethnicity, family income, mother's educational attainment, or the mother's marital status.

Many of the children in the sample exhibited additional health conditions, as determined by reviewing their medical records. More than half of the sample was born with some type of heart defect (60.4%; n=29), a rate that is similar to epidemiological reports by others (Rowe & Uchida, 1961; Rogers & Roizen, 1991).

Table 1
Child and Family Demographic Characteristics During Infancy by CHD Status (n=48)

	n=31	n=17
Child and Family Characteristics	Non/Asymp. CHD n (%)	Symptomatic CHD n (%)
A. Child Characteristics		
Female	18 (37.5)	10 (20.8)
Male	13 (27.1)	7 (14.6)
Children with heart defect(s) in infancy (mild and severe)	18 (37.5)	11 (22.9)
Ethnic Group		
Caucasian	25 (52.1)	16 (33.3)
Hispanic	1 (2.1)	0 (0.0)
African-American	3 (6.3)	0 (0.0)
Multiracial/other	2 (4.2)	1 (2.1)
B. Family Characteristics		
Family income		
<$10,000	3 (6.3)	4 (8.3)
$10,000-19,999	6 (12.5)	0 (0.0)
$20,000-29,999	8 (16.7)	3 (6.3)
$30,000	14 (29.2)	9 (18.8)
Mothers' mean no. of years of education	14.6 (SD=2.5)	13.9 (SD=1.9)
Mothers' marital status		
Married	28 (90.3)[a]	14 (82.4)
Separated	1 (3.2)	0 (0.0)
Unmarried	2 (6.5)	3 (17.6)

[a] Mothers' marital status: Percentages are reported from the total N of each group

In this investigation, we defined "heart disease" as a cardiac condition that resulted in manifested symptoms for at least three consecutive months during the first five years of life. Children with symptomatic heart disease suffered at some point, or were at the risk for, congestive heart failure (CHF) or cyanotic heart disease (CYHD). The latter condition suggests lack of sufficient oxygenation of the blood, which may affect cognitive and motor development. Children with symptomatic heart disease were also likely to show symptoms of pulmonary hypertension, the development of

which might be an indicator for an increased need for surgery. One of the indicators of increased risk of CGF or CYHD was the need for cardiac medications. The only exception for inclusion in this group was of children with severe respiratory disease(s), whose symptoms were clinically similar to those of cardiovascular disease. Therefore, any one of the following indicators was used in this study for categorizing a child as having symptomatic heart disease: (a) the use of cardiac medication (digitalis, diuretics); (b) cardiac surgery; (c) reports of pulmonary hypertension or congestive heart failure. Based on this definition, over one-third of the sample (35.4%; n=17) had symptomatic heart disease.

The rest of the sample was defined as having non/asymptomatic heart disease (n=31). Children in this group were either never diagnosed as having any cardiac defect(s), or only had a mild heart condition (such as a heart murmur). Such mild conditions were either: (a) asymptomatic during the first five years of the child's life or (b) resulted in some symptoms, but these symptoms did not last for three consecutive months.

Procedure

The participants were evaluated five times during the study – three times at home and twice in school. The first home visit took place within six weeks of the child's entry into an early intervention program. Two members of the research staff, who were blind to the study's hypotheses, conducted the child assessment and interviewed the mother. During the interview, data were collected on the child's health status, as well as basic family sociodemographic information.

Following the first home visit, the researchers obtained birth records, hospital discharge summaries, and primary care and consulting physicians' reports. This information continued to be collected until the child was 5 years old, and was used to divide the study participants into two groups as described above. A pediatrician affiliated with this study confirmed group membership.

The second and third visits to the child's home were conducted when the child was 3 and 5 years old, respectively. During these visits, staff members administered the Bayley Scales of Infant Development, Mental Scale (Bayley, 1969) (at age 3) and the McCarthy Scales of Children's Abilities (McCarthy, 1972) (at age 5).

Children were also observed in their classrooms at ages 3 and 5. The first visit to each child's school took place within six weeks of starting preschool, when the children were approximately 3 years old. This time

was selected specifically to allow children to become familiar with and adapt to their classroom, while still allowing for observation to take place as the children began the preschool experience. The second classroom visit was made when each child turned 5. The same procedure was used during each visit. Staff members visiting the school were not aware of the goals of the study or the child's assessment or demographic information. If the child was having an "atypical day" (due to illness or an unusual classroom schedule), another classroom visit was scheduled.

During the classroom visits, the Bronson Social and Task Skills Profile (Bronson, 1985) was used to observe behavior in the classroom where each child spent most of his/her day. The total number of observed classrooms at each time point was 48 (i.e., each study child was enrolled in a different classroom). The average class size was 9.4 (SD=3.6; range=4-23) when the children were 3 years old and 8.6 (SD=3.2; range=3-17) when the children were 5 years old. The proportion of children with IEPs (Individualized Educational Plans) in the class was fairly high at both age 3 (0.7) and age 5 (0.7). The average teacher/child ratio was one teacher for every three children.

Instruments

The Bronson Social and Task Skills Profile (BSTSP; Bronson, 1985) was used to collect information in the classroom about the child's task mastery and relationship with peers. The BSTSP is an observation tool, based on an information-processing model. The instrument focuses on the types of activities the child chooses to engage in, the child's attempts to reach mastery and social goals, the strategies used to attain these goals, and whether these attempts are successful. Four areas of behavior are recorded during the observation: mastery-task engagement, social interaction with peers and with adults (usually the classroom teachers), and the child's overall use of time (proportion of observation time engaged in activities such as goal-directed mastery and interaction with others). Only activities that the child performs independently are recorded. Observers were trained both in the classroom and by using videotapes. The training continued until observers reached at least 90 percent agreement on every observation variable. The range of inter-observer agreement on the various observation categories range from r=.99 (Cohen's Kappa=.92) to r=.84 (Cohen's Kappa=.73). Checks on interrater reliability were conducted throughout the study.

This analysis focused on two of the four areas of behavior assessed by the BSTSP: peer relations and task mastery. We used six variables from the BSTSP to assess peer relations in the classroom: proportion of time spent,

during observation, in interaction with peers; the rate (per minute of interaction with peers) that the child tried to influence or approach a peer; the rate (per minute of interaction with peers) that the child successfully influenced or interacted with a peer; the rate (per minute of interaction with peers) that the child used planning strategies for interacting with peers; the rate (per minute of interaction with peers) that the child employed social strategies to accommodate the needs of peers; and the rate (per minute of interaction with peers) that the child was approached or influenced by other children.

Task mastery variables, also derived from the BSTSP instrument, were the percent of time spent in working on tasks independently (e.g. without ongoing guidance from the teacher), the proportion of independent tasks the child completed successfully (such as a puzzle), the rate (per minute of time in tasks) that the child used planning strategies (such as gathering necessary materials), and the rate (per minute of time in tasks) that the child monitored his/her own mastery of the task (e.g. self-corrected an error).
During the home visits, children were assessed using the McCarthy Scales of Children's Abilities (McCarthy, 1972). This instrument is a well-standardized measure of young children's cognitive abilities. It provides a general measure of intellectual capacity, termed the "General Cognitive Index" (GCI).The Cronbach's alpha reliability coefficient for the McCarthy Scales of Children's Abilities in the present study was .88 when the participants were 3 years old (n=45), and .95 when the participants were 5 years old (n=47). The developmental level of a few of the children in this study (n=3) was too delayed at age 3 to be assessed by the McCarthy Scales of Children's Abilities. These children were assessed using the Bayley Scales of Infant Development, Mental Scale (Bayley, 1969).
Because differences in classroom behaviors could be due to differences in cognitive status, analyses were conducted to determine if the two groups (those with and without CHD) differed significantly in cognitive performance at ages 3 or 5 years. There were no significant differences between the groups in cognitive performance scores at either age.

Results
We observed a total of 48 children in 48 different classrooms. In this investigation, we were primarily interested in behavior differences in the classroom between children with DS with and without CHD. However, we first investigated whether children with CHD were placed in different classrooms than those that included children with non/asymptomatic CHD. Specifically, we compared the groups on two classroom characteristics, class size and the proportion of children with special needs in the classroom, because these characteristics have been found to relate to

children's classroom behaviors in prior studies (Bronson, Hauser-Cram, & Warfield, 1997; Hauser-Cram, Bronson, & Upshur, 1993). No significant group differences at either age 3 ($t=1.0$, $p=.34$) or age 5 ($t=-1.0$, $p=.35$) were found between children with and without CHD on the two classroom variables.

We next tested for *a priori* gender differences in classroom behaviors at ages 3 and 5. There were no significant differences between boys and girls on any of the classroom behaviors that we measured. Next we tested for group differences in preschool enrollment between children with symptomatic CHD and non/asymptomatic CHD at ages 3 and 5. The results indicate that there were statistically significant differences between the groups: children with symptomatic CHD were enrolled fewer hours per day ($M=2.6$) than children with non/asymptomatic CHD ($M=3.4$) ($t=2.2$, $p<.05$) at age 3. This difference continued at age 5, when children with symptomatic CHD were enrolled for fewer days per week ($M=4.2$, $M=4.6$; $t=2.2$, $p<.05$) and for fewer hours per day ($M=2.7$, $M=3.6$; $t=2.7$, $p<.01$) than the non/asymptomatic children, respectively.

To determine if children with DS and CHD differed from those without CHD on the set of observed classroom social behaviors and the set of task mastery behaviors at each age (3 and 5 years), MANOVA procedures were used. Table 2 presents the means and standard deviations of the components of the classroom behavior indices (relationship with peers and task mastery). Table 3 displays the results of MANOVA analyses, comparing the classroom behaviors of children with and without symptomatic CHD.

Table 2
Group means and standard deviations of peer relations and task mastery behaviors of children with and without CHD at ages 3 and 5

	Age 3				Age 5			
	Non/Asymp		Symptomatic		Non/Asymp		Symptomatic	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Peer Relations								
Rate[a] attempted social control	**0.99**	0.77	**0.92**	0.85	**1.44**	0.78	**1.31**	0.74
% of social control success	**0.69**	0.26	**0.75**	0.24	**0.64**	0.27	**0.69**	0.14
Rate social strategies	**0.03**	0.06	**0.01**	0.02	**0.07**	0.09	**0.06**	0.06
Rate influenced by others	**0.78**	0.66	**0.93**	0.71	**1.13**	0.85	**0.99**	0.42
Rate hostile to peers	**0.10**	0.02	**0.02**	0.04	**0.00**	0.01	**0.00**	0.00
% of time social with peers	**0.16**	0.09	**0.18**	0.12	**0.17**	0.1	**0.17**	0.07
Task Mastery								
% of tasks completed independently	**0.05**	0.06	**0.05**	0.05	**0.56**	0.47	**0.23**	0.20
Prop. of tasks completed successfully	**0.26**	0.41	**0.29**	0.47	**0.56**	0.45	**0.24**	0.44
Rate used planning strategies	**0.17**	0.78	**0.07**	0.26	**0.05**	0.12	**0.00**	0.01
Rate used monitoring strategies	**0.05**	0.17	**0.02**	0.06	**0.02**	0.03	**0.01**	0.03

Note. [a] "Rate": Rate per minute of time engaged in the activity

Table 3
MANOVA analysis of classroom behaviors of DS children with and without CHD at ages 3 and 5 years

	Age 3		Age 5	
	Multivariate	Univariate	Multivariate	Univariate
Peer Relations	***F*(6,41)=0.75**		***F*(6,41)=0.54**	
Rate[a] attempted social control				
% of social control success				
Rate social strategies				
Rate influenced by others				
Rate hostile to peers				
Time: % social with peers				
Task Mastery	***F*(4,35)=0.70**		***F*(4,43)=2.75***	
% of tasks completed independentl				*F*(1,46)=7.15 **
Prop. of tasks completed successfully				*F*(1,46)=5.79 *
Rate used planning strategies				*F*(1,46)=2.83
Rate used monitoring strategies				*F*(1,46)=0.27

Note. [a] "Rate": Rate per minute of time engaged in the activity
* p≤.05 ** p≤.01
We conducted four MANOVA analyses for this sample: focusing on peer relation behaviors at age 3 and age 5, and on task mastery behaviors at age

3 and age 5. The results show there were no significant differences at age 3 on either outcome, but significant differences in task mastery behaviors, however, emerged at age 5 between children with and without symptomatic CHD (multivariate $F(4,43)=2.75$, $p<.05$). This overall difference could be attributed specifically to two mastery behaviors: the percentage of tasks that the child completed by himself or herself (univariate $F(1,46)=7.15$, $p<.01$), and the proportion of tasks that the child completed successfully (univariate $F(1,46)=5.79$, $p<.05$). Both findings favored children without CHD.

Next we tested whether children's heart disease predicted task mastery performance or interaction with peers at ages 3 and 5, above and beyond the influences of cognitive performance and enrollment intensity. Hierarchical regression analyses were conducted.

First, we created two composites for classroom behavior outcomes: one for task mastery behaviors and the other for peer interaction. Both composites were based on specific behaviors measured by the BSTSP (Bronson, 1985) (see Table 3). The peer interaction composite consisted of six items: four items were based on the rate (per minute of interaction with peers) that the child: (1) tried to influence or approach a peer ("rate attempted social control"); (2) planned strategies for interacting with peers ("rate social strategies"); (3) was approached or influenced by other children ("rate influenced by others"); and (4) was aggressive or rejective toward peers ("rate hostile to peers"). Two additional items, the percent of time spent during observation in interaction with peers ("percent of time in interaction social with peers"), and the percent of interactions in which the child successfully influenced or interacted with a peer ("percent of social control success"), were also included in this composite.

The task mastery composite consisted of the following four behaviors: (1) the percent of time spent in independent mastery ("% completed tasks independently"), (2) the proportion of independent tasks the child completed successfully ("prop. of tasks completed successfully"), (3) the rate (per minute of independent task involvement) that the child used planning strategies ("rate used planning strategies"), and (4) the rate (per minute of independent task involvement) that the child used monitoring strategies ("rate used monitoring strategies"). Since the behaviors included in each composite were measured using different scales, all items were standardized (using Z-scores) and then added to create each composite.
Using hierarchical linear regression analyses, four equations were tested for two outcomes (the peer interaction and the task mastery composites) measured at two ages (3 and 5 years). At age 3, each equation entered

cognitive performance first, followed by enrollment intensity (i.e., hours per week). In order to investigate the effect of heart disease on classroom behaviors above and beyond these predictors, the child's CHD status was entered last into each equation. At age 5, we first entered into the model the child's earlier performance (measured by age 3 task mastery composite or peer interaction composite, respectively). It was followed by the child's cognitive performance at age 5, the number of hours per week that the child attended preschool at that age (enrollment intensity), and finally the child's CHD status. Table 4 presents the results of the hierarchical linear regression analyses. As expected from the MANOVA results, CHD did not predict children's classroom behaviors at age 3. Cognitive performance, however, was a predictor of age 3 task mastery. At age 5, children's peer relations were predicted by their cognitive performance but not by their CHD status. Finally, Table 4 shows that the presence of heart disease in children with DS predicted 30.2% ($p<.001$) of the variance in task mastery at age 5, beyond the child's task mastery performance at age 3, cognitive performance at age 5, and the number of hours per week the child attended preschool at age 5. Thus, the presence of heart disease in children with DS during early childhood is associated with lower task mastery skills at age 5.

Discussion

Despite the prevalence of DS among persons with mental retardation, and the high frequency of cardiac defects and heart disease among those with DS (Clark, 1996b), little is known about their functioning and behavior in the classroom setting. This study was, to our knowledge, the first investigation of the behaviors of children with DS and symptomatic CHD in the classroom. The results of this study shed some light on the effect of symptomatic heart disease on the classroom behaviors of young children with DS. Clearly, there is a need for future studies to explore the replicability of our findings.

Our results indicate that peer interactions of children with DS are not affected by the presence of symptomatic CHD, at either age 3 or 5. The existing literature on the development of children with DS offers little

Table 4

Hierarchical Linear Regression Analyses of Classroom Behaviors at Ages 3 and 5

Note. †p<.10 * p≤.05 ** p≤.005 *** p≤.001

Predictors	Age 3				Age 5			
	Task Mastery		Peer Relations		Task Mastery		Peer Relations	
	Beta	$R^2\Delta$	Beta	$R^2\Delta$	Beta	$R^2\Delta$	Beta	$R^2\Delta$
Age 3 performance	---	---	---	---	.017	.000	.260†	.067†
Cognitive performance	.319	.101*	.165	.027	.290†	.078†	.452	.174**
Enrollment index	.055	.003	-.071	.005	-.107	.011	.017	.000
CHD Status	-.018	.000	.049	.002	-.609	.302***	-.172	.025

insight into the potential effects of CHD on peer relations in this population. Many of the children in this study were in classrooms that had a fairly high percentage of children with disabilities (M=0.7, SD=0.3 at ages 3 and 5), and there were no placement differences between children with and without symptomatic CHD. Given the small class size (M=9.4, SD=3.8 at age 3; M=8.6, SD=3.2 at age 5) and high teacher-child ratio (M=0.3, SD=0.1 at ages 3 and 5) in most classrooms observed in this study, it is possible that peer interaction was somewhat constrained, regardless of children's cardiac status. It is important that future studies compare the peer interactions of children with and without symptomatic CHD in classrooms with higher proportions of typically developing children.

Important differences between children with and without CHD emerged in task mastery behaviors. Our findings indicate that although there were no significant differences between DS children with or without symptomatic heart disease in task mastery behaviors at age 3, differences were quite pronounced by age 5. The most probable explanation for the similarity in task performance of the two groups at age 3, in contrast to the marked difference between the groups two years later, is that the frequency of the behaviors measured in the task mastery composite was quite low for both groups. When children began to demonstrate a higher frequency of task mastery behaviors at age 5, the differences between the groups became

more apparent. In particular, children with symptomatic CHD completed fewer tasks independently, and had a lower proportion of tasks completed successfully. Furthermore, regression analysis revealed that CHD symptomatology predicted 30% of the variance in children's task mastery scores at age 5, above and beyond the children's prior task mastery performance, cognitive performance at age 5, and the number of hours per week the child attended preschool at age 5. These results are supported, to some extent, by the Ontario Child Health Study on children with chronic illnesses (but no chromosomal anomalies) (Cadman et al., 1987). This study reported that up to 42% of children with disabilities who were also chronically ill had school problems (such as repeating a grade or using remedial educational services).

By the late 1980s, when the participants in this study were recruited, most children with DS were routinely screened and (if necessary) treated for congenital heart disease. There are, therefore, at least two explanations for the differences in task mastery performance at age 5 between symptomatic CHD and non/asymptomatic CHD children with DS: direct (primary) and indirect (secondary) effects of the children's chronic illness (Thompson & Gustafson, 1996). For instance, heart disease could have directly affected children's task mastery performance by affecting their central nervous system (CNS) until the heart condition was treated medically and/or surgically (e.g., DeMaso et al., 1990; Yang, Liu, & Townes 1994). In this sample, there were no significant differences between the two groups in overall cognitive performance, but it is possible that some specific cognitive differences will emerge in time. Future studies could investigate this hypothesis by exploring connections between the profile of cognitive abilities and task mastery behaviors in DS children with and without symptomatic CHD.

Symptomatic heart disease could also have an indirect (or "secondary") impact on the child. For example, parents of children with symptomatic CHD might be protective of their child beyond what was required by the medical condition (cf. Cayler, Lynn, & Stein, 1973; Goldberg et al., 1990; Reed et al., 1984; Silbert et al., 1969). Therefore, it is possible that children with DS and symptomatic CHD had fewer opportunities to *independently* explore their environment, as suggested by the differences in the home environment reported in the study by Barrera, Watson, & Adelstein (1987). Piaget's constructivist theory suggests that children have an innate motivation to explore and manipulate their world. Through their actions on and manipulation of their environment, children continuously refine and reconstruct their schemas, thus advancing to higher, more sophisticated cognitive levels (Piaget, 1970). If parents restrict the activities and

exploration of the environment of children with symptomatic CHD, these children are more likely to demonstrate delays in effectively and successfully mastering tasks. In fact, Goldberg and colleagues (1990), reported that mothers of nondisabled children with CHD were more restrictive during an interactive task mastery activity than mothers of children with cystic fibrosis or healthy children. Overprotection can also foster greater dependence in the child (e.g., Garson et al., 1978), resulting in lower task persistence and the need for more help from others to accomplish tasks.

Additionally, severe heart disease may also increase school absences (Thompson & Gustafson, 1996). In this investigation, we found that children with symptomatic CHD were enrolled in preschool for fewer hours each week than children with non/asymptomatic CHD. Hours enrolled in preschool, however, did not predict task mastery. Unfortunately, we did not have reliable data on absences. Lower school attendance due to absences required by frequent or prolonged hospitalizations could also have an indirect effect on the child's mastery of tasks.

Despite the apparent strength of the main findings of this study, they should be interpreted with caution, as several limitations need to be taken into consideration. For example, there is no consensus on how to define severity of CHD, and various studies have employed different operational definitions of this condition. Thus, the criteria that we used for dividing the sample into symptomatic and non/asymptomatic groups (i.e., the use of cardiac medication for 3 consecutive months or longer, undergoing cardiac surgery, or experiencing either pulmonary hypertension or congestive heart failure) may limit the comparability of our symptomatic CHD group to other studies. It is also important to note that even though all the children with symptomatic CHD exhibited a number of clinical symptoms that warranted inclusion in the same group, there was quite a diversity among them from a clinical perspective (J. P. Shonkoff, personal communication, December 1, 1997). A review of the medical records of each child in the "symptomatic CHD" group revealed that this group was quite heterogeneous, in terms of the duration of the symptoms, their onset (e.g., a few months after birth or at a later time during early childhood), whether the child underwent surgery, and at what age surgery was performed. However, due to the small sample size, these differences could not be examined as to their specific impact on classroom behaviors.

Another limitation of this study is its non-experimental design, since children were not assigned randomly to their classrooms. Although we found that children with and without CHD were assigned to classrooms

with similar structural arrangements (i.e., class size, teacher-child ratio), more subtle differences in classroom ecology could exist. Therefore, it is not possible to postulate any definite causal relationship between CHD symptomatology and classroom behaviors. It is likely that classrooms differ in their curriculum and approach to inclusion of children with disabilities. The literature suggests that such differences can have a strong impact on the types of activities the child engages in, and thus affect the child's observable behaviors (Bronson, Hauser-Cram, & Warfield, 1997; Hauser-Cram, Bronson, & Upshur, 1993; Sainato & Lyon, 1989). The non-random assignment of children to various classrooms has one advantage, however. It reflects the educational settings in which these children are typically placed by school personnel.

The findings of this study have several implications for teachers of children with DS and symptomatic CHD. Teachers should be provided with accessible information on the child's cardiac condition, and how it might affect the child's functioning in the classroom. Educators should encourage greater independence, persistence, and sense of accomplishment in mastering tasks among these children. They should instruct parents in helping the child with CHD adjust to the classroom setting, especially if the child has missed school due to hospitalizations. Finally, teacher-training programs in special education should include discussions on the possible implications of CHD on the learning and task mastery of children with DS, especially since CHD appears in such high frequency in this population.

This study also has important implications for parents. Parent advocacy groups and early intervention programs could arrange for parents of children with both DS and chronic diseases to get together and learn from each other about coping successfully with the special needs of children with both a disability and chronic illness. Parent organizations could also provide their members with information on the development and learning of children with DS and CHD. Since most of the information on heart disease among persons with DS is situated within the medical literature (e.g., Marino & Pueschel, 1996), parents and parent organizations could request that more information about the development and learning of children with DS and CHD be accessible to laypersons. Finally, parents could periodically consult with their pediatrician or pediatric cardiologist about their child's actual physical abilities. While it is important that the child with heart disease would not overexert himself or herself, it is also important that children with both DS and CHD receive adequate support in increasing self-reliance. These children should be encouraged to independently explore their environment, complete everyday tasks, and build on their successes and accomplishments. It is possible that such early

experiences would subsequently help children with Down syndrome and congenital heart disease function better in the classroom.

Bibliography

Baird, P. A. & Sadovnick, A. D. (1987). Life expectancy in Down syndrome. *Journal of Pediatrics*, 110, 849-854.

Barrera, M. E., Watson, L. J., & Adelstein, A. (1987). Development of Down's syndrome infants with and without heart defects and changes in their caretaking environment. *Child: Care, Health and Development*, 13(2), 87-100.

Bayer, L. M. & Robinson, S. J. (1969). Growth history of children with congenital heart defects. *American Journal of Diseases of Children*, 117, 564-572.

Bayley, N. (1969). *The scales of infant development*. New York: Psychological Corp.

Bronson, M. B. (1985). *Manual for the Bronson Social and Task Skill Profile*. Chestnut Hill, MA: Boston College.

Bronson, M. B., Hauser-Cram, P., & Warfield, M. E. (1997). Classrooms matter: Relations between the classroom environment and the social and mastery behavior of five-year-old children with disabilities. *Journal of Applied Developmental Psychology*, 18, 331-348.

Bureau of the Census. (1990). *Statistical abstract of the United States, 1990* (110th ed.). Washington, DC: U.S. Department of Commerce.

Bywater, E. M. (1981). Adolescents with cystic fibrosis: Psychosocial adjustment. *Archives of Disease in Childhood*, 56, 538-543.

Cadman, D., Boyle, M., Szatmari, P., & Offord, D. R. (1987). Chronic illness, disability, and mental and social well-being: Findings of the Ontario Child Health Study. *Pediatrics*, 79, 805-813.

Carr, J. (1970). Mental and motor development in young mongol children. *Journal of Mental Deficiency Research*, 14(3), 205-220.

Carr, J. (1995). *Down syndrome: Children growing up*. London, Cambridge University Press.

Casey, F. A., Sykes, D. H., Craig, B. G., Power, R., & Mulholland, H. C. (1996). Behavioral adjustment of children with surgically palliated complex congenital heart disease. *Journal of Pediatric Psychology*, 21(3), 335-352.

Cayler, G. G., Lynn, D. B., & Stein, E. M. (1973). Effects of cardiac 'nondisease' on intellectual and perceptual motor development. *British Heart Journal*, 35, 543-547.

Cicchetti, D. & Beeghly, M. (Eds.) (1990). *Children with Down syndrome: A developmental perspective*. Cambridge, England: Cambridge University Press.

Clark, E. B. (1996a). Access to cardiac care for children with Down syndrome. In: B. Marion & S. M. Pueschel (Eds.), *Heart disease in persons with Down syndrome* (pp. 145-150). Baltimore, MD: Paul H. Brookes Publishing.

Clark, E. B. (1996b). Developmental aspects of congenital heart disease in children with Down syndrome. In B. Marion & S. M. Pueschel (Eds.), *Heart disease in persons with Down syndrome* (pp. 49-53). Baltimore, MD: Paul H. Brookes.

Connolly, B. H., Morgan, S. B., & Russell, F. F. (1984). Evaluation of children with Down syndrome who participated in an early intervention program. *Physical Therapy*, 64, 1515-1518.

Cullen, S. M., Cronk, C. E., Pueschel, S. M., Schnell, R. R., & Reed, R. B. (1984). Social development and feeding milestones. In: S. Pueschel (Ed.), *The young child with Down syndrome* (pp. 227-252). New York: Human Sciences Press.

DeMaso, D. R., Beardslee, W. R., Silbert, A. R., & Fyler, D. C. (1990). Psychological functioning in children with cyanotic heart defects. *Developmental and Behavioral Pediatrics*, 11, 289-294.

Dodge, K. A., Pettit, G. S., McClaskey, C. L., & Brown, M. M. (1987). Social competence in children. *Monographs of the Society for Research in Child Development*, 51(2), 1-85.

Dykens, E. M., Hodapp, R. M., & Evans, D. W. (1994). Profiles and development of adaptive behavior in children with Down syndrome. *American Journal on Mental Retardation*, 98(5), 580-587.

Eyman, R. K., Call, T. L., & White, J. F. (1991). Life expectancy of persons with Down syndrome. *American Journal on Mental Retardation*, 95, 603-612.

Garson, A., Benson, R. S., Ivler, L., & Patton, C. (1978). Parental reactions to children with congenital heart disease. *Child Psychiatry and Human Development*, 9(2), 86-94.

Goldberg, S., Washington, J., Morris, P., Fischer-Fay, A., & Simmons, R. J. (1990). Early diagnosed chronic illness and mother-child relationships in the first two years. *Canadian Journal of Psychiatry*, 35(9), 726-733.

Goldberg, S., Simmons, R. J., Newman, J., Campbell, K., & Fowler, R. S. (1991). Congenital heart disease, parental stress and infant-mother relationships. *Journal of Pediatrics*, 119(4), 661-666.

Hauser-Cram, P., Bronson, M. B., & Upshur, C. C. (1993). The effects of the classroom environment on the social and mastery behavior of preschool children with disabilities. *Early Childhood Research Quarterly*, 8, 479-497.

Hauser-Cram, P., Pierson, D., Walker D. K., & Tivnan, T. (1991). *Early education in the public schools: Lessons from a comprehensive birth-to-kindergarten program.* San Francisco, CA: Jossey-Bass.

Henderson, S. E. (1985). Motor skill development. In: D. Lane & B. Stratford (Eds.), *Current approaches to Down's syndrome* (pp. 83-114). London: Cassell.

Howes, C. (1987). Peer interaction of young children. *Monographs of the Society for Research in Child Development*, 53(1, Serial No. 217).

Marino, B. & Pueschel, S. M. (Eds.) (1996). *Heart disease in persons with Down syndrome.* Baltimore, MD: Paul H. Brookes.

Mathew, P., Moodie, D., Sterba, R., Murphy, D., Rosenkranz, E., & Homa, A. (1990). Long-term follow-up of children with Down syndrome with cardiac lesions. *Clinical Pediatrics*, 29(10), 569-574.

McCarthy, D. (1972). *McCarthy scales of children's abilities.* New York: Psychological Corp.

Mehrizi, A. & Drash, A. (1962). Growth disturbances in congenital heart disease. *Journal of Pediatrics*, 61, 418-429.

Miller, J. (1987). Language and communication characteristics of children with Down's syndrome. In: S. Pueschel, C. Tingey, J. E. Rynders, A. C. Crocker & D. M. Crutcher (Eds.), *New perspectives in Down syndrome* (pp. 233-262). Baltimore, MD: Paul H. Brookes.

Parisi-Buckley, L. P. (1984). Cardiac assessment. In: S. M. Pueschel (Ed.), *The young child with Down syndrome* (pp. 351-364). New York: Human Sciences Press.

Piaget, J. (1970). *Genetic epistemology.* New York: W. W. Norton & Co.

Pueschel, S. M. (1996). Historical perspective of heart disease in persons with Down syndrome. In: B. Marion & S. M. Pueschel (Eds.), *Heart disease in persons with Down syndrome* (pp. 1-7). Baltimore, MD: Paul H. Brookes.

Reed, R. B., Pueschel, S. M., Schnell, R. M., & Cronk, C. E. (1984). Interrelationships of biological, environmental and competency variables. In: S. M. Pueschel, (Ed.). *The young child with Down syndrome* (pp. 285-302). New York: Human Sciences Press.

Rogers, P. T. & Roizen, N. J. (1991). A life-cycle approach to management of Down syndrome. In: A. J. Capute & P. J. Accardo (Eds.), *Developmental disabilities in infancy and childhood* (pp. 441-454). Baltimore, MD: Paul H. Brookes.

Rowe, R. D. & Uchida, I. A. (1961). Cardiac malformation in mongolism, a prospective study in 184 mongoloid children. *American Journal of Medicine*, 31, 726-735.

Ruskin, E. M., Mundy, P., Kasari, C., & Sigman, M. (1994). Object mastery motivation of children with Down syndrome. *American Journal on Mental Retardation*, 98(4), 499-509.

Sainato, D. M. & Lyon, S. R. (1989). Promoting successful mainstreaming transitions for handicapped preschool children. *Journal of Early Intervention*, 13(4), 305-314.

Schnell, R. R. (1984). Psychomotor development. In: S. M. Pueschel (Ed.), *The young child with Down syndrome* (pp. 207-226). New York: Human Sciences Press.

Sharav, T. & Shlomo, L. (1986). Stimulation of infants with Down syndrome: Long-term effects. *Mental Retardation*, 24(2), 81-86.

Shonkoff, J. P., Hauser-Cram, P., Krauss, M. W., & Upshur, C. C. (1992). Development of infants with disabilities and their families. *Monographs of the Society for Research in Child Development Monograph* (Serial No. 230).

Silbert, A., Wolff, P. H., Mayer, B., Rosenthal, A., & Nadas, A. S. (1969). Cyanotic heart disease and psychological development. *Pediatrics*, 43, 192-200.

Sinson, J. C. & Wetherick, N. E. (1981). The behavior of children with Down syndrome in normal playgroups. *Journal of Mental Deficiency Research*, 25, 113-120.

Spirito, A., DeLawyer, D. D., & Stark, L. J. (1991). Peer relations and social adjustment of chronically ill children and adolescents. *Clinical Psychology Review*, 11, 539-564.

Stoel-Gammon, C. (1990). Down syndrome: Effects on language development. *Journal of the American Speech-Language-Hearing Association*, 32, 42-44.

Stoll, C., Alembik, Y., Dott, B., & Roth, M. P. (1990). Epidemiology of Down syndrome in 118,265 consecutive births. *American Journal of Medical Genetics Supplement*, 7, 79-83.

Thiene, G., Ventriglia, F., & Frescura, C. (1996). Heart and lung pathology in Down syndrome. In: B. Marino & S. M. Pueschel (Eds.), *Heart disease in persons with Down syndrome* (pp. 111-125). Baltimore, MD: Paul H. Brookes.

Thompson, R. J. & Gustafson, K. E. (1996). *Adaptation to chronic childhood illness.* Washington, DC: American Psychological Association.

Tingey, C., Mortensen, L., Matheson, P., & Doret, W. (1991). Developmental attainment of infants and young children with Down syndrome. *International Journal of Disability, Development and Education*, 38(1), 15-26.

Tropauer, A., Franz, M. N., & Dilgard, V. W. (1970). Psychological aspects of the care of children with cystic fibrosis. *American Journal of Diseases of Children*, 119, 424-432.

Tubman, T. R., Shields, M. D., Craig, B. G., Mulholland, H. C., & Nevin, N. C. (1991). Congenital heart disease in Down's syndrome: Two years prospective early screening study. *British Medical Journal*, 302(6790), 1425-1427.

Utens, E. M. W. J., Verhulst, F. C., Meijboom, F. J., Duivenvoorden, H. J., Erdman, R. A. M., Bos, E., Roelandt, J. C., & Hess, J. (1993). Behavioral and emotional problems in children and adolescents with congenital heart disease. *Psychological Medicine*, 23, 415-424.

Van Dyke, D. C. (1989). Medical problems in infants and young children with Down syndrome: Implications for early services. *Infants and Young Children*, 1(3), 39-50.

Van Praagh, R., Papagiannis, J., Bar-El, Y. I., & Schwint, O. A. (1996). The heart in Down syndrome: Pathologic anatomy. In: B. Marino & S. M. Pueschel (Eds.), *Heart disease in persons with Down syndrome* (pp. 69-110). Baltimore, MD: Paul H. Brookes.

Wright, M. & Nolan, T. (1994). Impact of cyanotic heart disease on school performance. *Archives of Diseases in Childhood*, 71, 64-70.

Yang, L. L., Liu, M. L., & Townes, B. D. (1994). Neuropsychological and behavioral status of Chinese children with acyanotic congenital heart disease. *International Journal of Neuroscience*, 74, 109-115.