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Preschool Children

Physical Activity, Behavioral Assessment and Developmental Challenges

Leone Colombo
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Nova Science Publishers, Inc.
New York

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Preschool children : physical activity, behavioral assessment and developmental challenges / editors, Leone Colombo and Rachele Bianchi.
p. cm.
ISBN 978-1-61668-350-4 (eBook)
1. Preschool children. 2. Behavioral assessment of children. 3. Child psychology. 4. Early childhood education--Activity programs. I. Colombo, Leone. II. Bianchi, Rachele.
HQ774.5.P74 2009
155.42'30287--dc22

2009041975

Published by Nova Science Publishers, Inc. ✝ New York

CONTENTS

PREFACE

During infancy and preschool age, movement is an integral part of human life. This book discusses the correlation between cognitive and motor functioning in preschoolers, as well as the motor performance differences between boys and girls. Additionally, oral health problems affect children's quality of life by impairing their physical and psychological and social functioning well-being. The main oral health related problem in preschool children is associated with dental pain that may affect sleep, cause difficulty in eating and affect learning. This book explores how the mouth affects quality of life and the epidemiology of dental pain including the determinants of oral diseases. In addition, the authors review strategies to promote oral health in preschool children. Other chapters show methods and techniques used for evaluation of lung function status in preschool children. Those techniques are commonly used in preschool age and make possible not only to help in diagnosis, but also in controlling and monitoring the disease progress or efficacy of the treatment.

Chapter 1 - In this chapter, we discuss three issues in relation to very early literacy acquisition and impairment across cultures. First, we review some environmental influences on literacy development, particularly in the pre-primary school years. Second, we focus more specifically on parental impact on children's literacy acquisition. Finally, we talk about very early markers of literacy impairment.

Chapter 2 - During infancy and preschool age, movement is an integral part of human life. Children use movement to discover both themselves and the world and consequently, the study of a child's motor performance can significantly contribute to the full understanding of his/her entire personality. The research of pre-school aged children's motor performance usually focuses on the motor characteristics that change with growth and differentiate, due to environmental factors or particular features of the children. One of the most widely considered issues is the motor performance differences between boys and girls. The review of the literature revealed conflicting findings. Several researchers suggest that the motor performance of boys and girls is quite similar while others report significant differences even in pre-school aged children. In particular, boys have been found to perform higher than girls in tasks that assess catching, throwing, jumping, kicking and short dashes. On the other hand, girls outperform boys in tasks involving balance, flexibility and fine motor skills. Taking into consideration that at the preschool age, the biological characteristics of boys and girls are similar rather than different, a closer study of the factors that may have caused the aforementioned inconsistency among the research findings was conducted. That study showed that many of the differences are environmentally and culturally induced. It has been

established that in some societies, boys and girls have different already been given different anticipated roles in the first years of their lives, while even when they participate in sports they may have qualitatively different opportunities. Motor assessment tools bias is another significant factor for emphasizing motor performance differences between the two genders. Some batteries include tasks associated with traditionally masculine sports and ignore activities like dance or gymnastics in which girls perform better. Consequently, the motor assessment with those tools may provide findings favoring boys. According to the foresaid, it is concluded that, as long as the motor performance of pre-school aged boys and girls is quite similar, when significant differences between the two genders are reported, they should be interpreted having considered both the cultural context in which the study was conducted and the motor assessment tool that was used. The identification of motor performance differences between boys and girls is only the first step. The knowledge of the reasons that cause those differences and their proper evaluation will help educators to step beyond the description of the gender differences: leading to an attempt to decrease them.

Chapter 3 - Oral health problems affect children's quality of life by impairing their physical and psychological and social functioning wellbeing. The main oral health related problem in preschool children is associated with dental pain that may affect sleep, cause difficulty in eating and affect learning. Sleep impairment and difficulty in eating in children contributes to malnutrition. Knowledge of oral and social problems that trigger pain can be used to establish preventive and treatment priorities.

There is new research on oral impacts in quality of life in preschool children. This chapter will explore how the mouth affects quality of life and the epidemiology of dental pain including the determinants of oral diseases. In addition, the chapter reviews strategies to promote oral health in preschool children.

Among oral health problems that may affect preschool children are dental caries, dental trauma, dental erosion, malocclusion and oral soft tissues lesions. There is a universal decline in the prevalence and severity of dental caries in children. On the other hand, dental trauma, malocclusion and enamel erosion are increasing in preschool children. New data are available on the lifecourse approach to the development of caries and malocclusion. As stated earlier, preschool children may be affected by dental pain from dental caries and traumatized teeth.

Recent reports highlight the clear association between dental caries and gingivitis and social economic status.

Traditional dental prevention carried out by dentists and dental personnel using the High Risk Strategy that targets children considered to be more prone to caries, have been relatively ineffective [1]. We will report on systematic reviews of dental health education. The development of oral health promotion policies for preschool children is especially important due to the possibility of positively influencing the acquisition of healthy behaviors and standards that are sustainable along the life course. Health promotion strategies aimed at the child is a responsibility not only of individuals, but of families and communities.

The main strategies to promote oral health for this group of children should be common risk factor approach (CRFA); integrating oral health promotion with general health promotion directed at diet, cleanliness and prevention of trauma. Public health approaches using the Whole Population Strategies, such as health promoting nurseries and schools, should have the highest priority. Chairside prevention directed at individuals should include improving include diet, particularly in relation to non-milk extrinsic sugars, improve oral hygiene, fluoride application, fissure sealants and mouth guards to prevent dental trauma.

Chapter 4 - There are several models about the mechanism that make pre-school children evolve regarding the quality of their invented spelling. Ehri´s teorical perspective (1997) describes the development of children's spelling skills in terms of their increasing ability to map sounds of words to phonetically appropriate letters. According to this perspective, written language is conceived as an instrument for translating oral language and phonological awareness determines the precision of invented spelling. This model neglects linguistic variables that might influence children ability to analyse the oral and written language and also does not conceive children's reflection about written code as a factor of evolution. The constructivist perspective from Ferreiro (1988), emphasizes the importance of internal conflict between different criterion about the organization of the alphabetic code. For instance, the repetition of the same vowel in syllabic phonetised writing might cause a conflict in children's thinking with another criterion that they attaint, related with the variation of letters within the written word (e.g. Nunes Carraher and Rego (1984) cited a Portuguese-speaking child who spelled urubu 'vulture' as UUU). This conflict might lead children to analyse syllables in their phonemes and became a source for an alphabetic approach of writing. This and other conflicts are the main factor, from the point of view of this theory, for the evolution of children's conceptions about written language. However those mechanisms are described independently of children ability to analyse oral words or the frequency of words and the articulatory properties of phonemes that integrate those words. On the other hand, Polo, Kessler and Treiman (2005), think that that statistical learning skills exists from an early age. These skills are applied in learning to spell, as in other tasks. This perspective emphasizes that children's writing reflects the characteristics of the input to which they have been exposed as they try to find meaningful patterns in regularities of written language. These regularities give children information about graphical as well as phonological patterns of the language in which they reflected their very early spellings. However, this perspective never analyses the nature of children thinking and how that reflects their approach to written language. It is quite important to create a model that integrates these several contribution.

Chapter 5 - A child plays with a toy for 30 minutes before losing interest. While parents of an 8 year old might not be surprised, many parents of an 8 month are not either. Why? Parents and caretakers are often oblivious to the emergent indicators of giftedness.

What are the signs that a child might be gifted? How can developmental milestones be measured in preschool children who are gifted? Why is it even important to answer these questions? Early identification of gifted children in their preschool years will have a profound impact on their development, since many who work with preschool children "are not aware that if appropriate input does not occur during this sensitive period, potential talent may be delayed, reduced, or eliminated" (Biber, 1977). Thirty years after Biber penned those words, gifted preschool children are still misidentified and misunderstood. Too often, gifted children are misidentified as being hyperactive, a behavior problem, or having an attention deficit (Chae, Kim, & Noh, 2003). Unfortunately, identification of gifted preschool children is not as simple as giving a single test. In fact, because no reliable test for giftedness in youngsters yet exists, it is imperative that the behaviors of preschoolers be carefully examined for incipient giftedness. Research into the physical activities and behaviors of preschool children provides markers against which growth and development may be measured.

This chapter will outline the current research into the identification of gifted children based on observable behaviors. Using the authors' research into early indicators of giftedness

in children, coupled with current neurological investigations, the chapter provides an analysis of the attributes of the gifted preschool child.

Chapter 6 - This chapter presents data from a study that examined cognitive and motor functioning in rural Head Start preschoolers. The participants were 122 preschool children enrolled in a county Head Start program. The following tests were administered to the children: Bender Visual Motor Gestalt Test, a short form of the Wechsler Preschool and Primary Scales of Intelligence-Revised, Test of Gross Motor Development-2nd Edition, and the Boehm Test of Basic Concepts-3rd Edition Preschool. Results indicate that these Head Start preschoolers function at a lower cognitive level than average preschoolers, based on comparisons to test norms. However, these preschoolers' gross motor skills were well above average, contradicting prior research that Head Start children also suffer from motor deficits. Correlations between tests and the potential implications of these findings are discussed. While the purpose of Head Start is to help prepare these children for school in order to reduce the likelihood of failure, the present research indicates some specific areas that educators should target within this population. In addition, the advanced motor skills demonstrated by the children in the present study may be utilized in the development of activities and games that promote cognitive development.

Chapter 7 - Introduction: Nevertheless the eyes have a fast development mainly in the early childhood, there are many difficulties in eyes examination, leading to late diagnosis to various conditions. Conventional ophthalmic tests are difficult to implement in preschool children. Digital image processing system might provide important informations about the eyeblink and pupil evaluation. Purpose: To investigate, using a digital image processing system, the eyelid dynamics and the pupillary areas and diameters of normal preschool children. Methods: 50 newborns and 200 preschool children were examined. Images were recorded using a digital camera during three minutes. Complete and incomplete blink rates, opening, closing and complete blink times were calculated. Moreover, pupil diameter and pupil area of the preschool children were evaluated during attentive and spontaneous gaze. Data were expressed in pixels and arithmetic means of each parameter were calculated. Results: The complete eye blink was more common and the blink rate increased with age. The incomplete blink rate was the same for all ages. The eyelid opening and closing times and the complete blink time were similar for both sexes. The closing eyelid time was slower. The mean pupil diameter and area were similar for both eyes, presenting values of 18.5 and 311.7 pixels during attentive and 15.4 and 237.6 pixels during spontaneous gaze, respectively. There were no differences between sexes. However, six-year-old children showed lower pupil diameter and area. Conclusion: The digital image processing system is a very good method to evaluate children and permitted to observe the complete blink rate increases with age. Pupil diameter and area were larger during attention and similar for both eyes.

Chapter 8 - Respiratory system disorders may appear at any age, however in children are relatively frequent. Symptoms such as cough or wheezing may arise from viral or bacterial infections but also may be caused by chronic illnesses. Therefore, assessment of objective measures of lung function is of a great importance.

Preschool children constitute a real challenge in this regard. Most of lung function testing procedures require cooperation during specific respiratory maneuvers necessary to complete the examination. This chapter is designed to show methods and techniques used for evaluation of lung function status in preschool child. The most popular among them – spirometry is presented, the advantages and disadvantages are discussed. A special attention

is paid to a relatively new technique of studying respiratory system properties – the forced oscillation technique and its modification called impulse oscillometry (IOS). Also using interrupter technique to asses resistance of respiratory system is presented. Those techniques are commonly used in preschool age and make possible not only to help in diagnosis, but also in controlling and monitoring the disease progress or efficacy of the treatment.

Chapter 9 – Purpose: The purpose of this study was two fold (1) to describe objective levels physical activity (PA), including sedentary activities (SB) total PA (TPA) and moderate-to-vigorous PA (MVPA) patterns during school hours and (2) to determine the association of body mass index status (BMI) with school hours PA patterns in preschool children.

Methods: The sample comprised 59 preschool children (31 girls) aged from 2 to 5 years old. Weight and height were measured according to standard protocols. Cole's cut off points were used to define obesity status. The children used the accelerometer (MTI/CSA) for 4 consecutive days during school hours.

Results: We found an overweight/obese prevalence of 30%. We only found statistically significant differences between genders at the age of 5 years-old. No statistically significant association was found between BMI and PA patterns.

Conclusion: No statistical significantly differences between gender and BMI were found for these age-groups. Gender differences in MVPA at school are presented in early aged.

Chapter 10 - The behavior of children in a preschool classroom was assessed to evaluate the effectiveness of two classroom management approaches: (a) strategies already employed by the teachers, and (b) the Level System. Strategies already employed by the teachers were those that they currently used in their preschool classroom. This phase was considered the baseline or "A" treatment phase. The Level System is a new program that utilizes strategies including a token economy, stimulating rewards, strategic attention, and labeled praise to manage a range of behaviors exhibited by children in the classroom. This was considered the "B" treatment condition. These two approaches were evaluated using an ABAB sequence where each was employed for a minimum of 17 observations with 4 male 4-year-old participants. Behaviors were assessed using unobtrusive classroom coding of activities and teacher report. Four main findings were obtained: (a) the Level System was more effective in managing disruptive behavior than previously-used classroom management strategies, (b) fewer time outs were given while the Level System was used in the class compared to while the typical classroom management strategies were used, (c) teacher report of satisfaction with the Level System varied, but parents reported high levels of satisfaction with the Level System, and (d) negative effects on "intrinsic motivation" with use of the Level System were not evident.

Chapter 11 - The purpose of this study was to provide nutrition educators with a baseline understanding of how preschoolers' current concepts and knowledge of fruits and vegetables relates with their primary care providers (i.e. parents, grandparents, or foster parents) and childcare providers. The exploratory, theory-based, qualitative study design involved interviews with preschoolers (n=24) and their primary care providers (n=22) and childcare providers (n=2). Maps were used to qualitatively compare similarities in responses to questions regarding fruits and vegetables between a preschooler and her primary care provider and childcare provider. The concepts expressed by the preschoolers were shared minimally with their primary care providers and childcare providers. Further work is needed in understanding how to utilize primary care providers and childcare providers and the

underlying preschool contextual setting to increase preschoolers' concepts and knowledge of fruits and vegetables.

In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 1-18

Chapter 1

LITERACY ACQUISITION AND IMPAIRMENT IN YOUNG CHILDREN

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In this chapter, we discuss three issues in relation to very early literacy acquisition and impairment across cultures. First, we review some environmental influences on literacy development, particularly in the pre-primary school years. Second, we focus more specifically on parental impact on children's literacy acquisition. Finally, we talk about very early markers of literacy impairment.

Environmental Influences on Literacy Acquisition

Environmental factors in relation to children's literacy acquisition include many systems that reinforce and affect one another, following Bronfenbrenner (1979) and McBride-Chang (2004). For example, teachers' approaches and school environment are important aspects of children's literacy development (see McBride-Chang, 2004, for a review). However, here, we confine this discussion to culture, language, and orthography as distal environmental factors and family as proximal environment. This is perhaps reasonable for the preschool population, for whom schooling itself is extremely variable. Indeed even primary school enrollment itself is variable across countries and across gender. For example, whereas China has an approximately 99% rate of primary school enrollment, Bhutan has a rate of only 79% for both boys and girls. In contrast, Pakistan's enrollment includes a substantially higher percentage of boys (74%) than girls (57%); a similar discrepancy exists in Afghanistan (i.e., 74% boys; 46% girls) (UNICEF, 2009).

Literacy acquisition and development differ dramatically across different cultures. For example, Sierra Leone (31%), and Somalia (24%) have among the lowest literacy rates in the world, whereas Iceland, Estonia, and Denmark rank highest (i.e., 100%) in adult literacy rates

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(e.g., McBride-Chang, 2004). One striking contrast for understanding literacy development is that of east asian (including Japanese, Korean, and Chinese children) as compared to western cultures (e.g., Canada, U.K., U.S.). Asian students, particularly those from Korean, Japanese and Chinese societies, also typically have higher academic attainment overall than their counterparts in western cultures (e.g., Chao, 1994; Chao & Sue, 1996; Feldman & Rosenthal, 1991).

Importantly, attribution theory (Weiner, 1985) is one possible way in which to explain the fact that east asian students tend to excel academically. In particular, east asian parents, particularly Chinese parents, tend to attribute poor academic performance to a lack of effort, whereas western culture parents are more likely to attribute children's failure or success to innate ability (e.g., Chang, 1991; Chen, Lee, & Stevenson, 1996; Hau & Salili, 1996; McBride-Chang, 2004; Stevenson, Lee, Stigler, Hsu, & Kitamura, 1990). The implications of these differences in attributions are striking for literacy development. On the one hand, an emphasis on effort encourages the vast majority of children to achieve at higher levels and to adopt an attitude of persistence in learning. On the other hand, for the relatively small minority of children (typically 5-10% across cultures) who are at risk for specific reading difficulties, a lack of acknowledgement of conditions such as dyslexia may discourage reading disabled children further (e.g., McBride-Chang, 2004).

Other features of the cultural environment that can strongly affect children's literacy development include language and orthography themselves. To begin with, spoken language can influence attention to language sound units. For example, English has many consonant clusters, and this may sensitize English speakers to phoneme-level awareness (e.g., McBride-Chang, Tong, Shu, Wong, Leung, & Tardif, 2008b; Ziegler & Goswami, 2005). In contrast, Chinese has no consonant clusters, so some Chinese children may be relatively insensitive to the unit of the phoneme at least partly for this reason (e.g., Shu, Peng, & McBride-Chang, 2008). In addition, lexical tone awareness appears to be more strongly linked to word recognition in Chinese than in English, even in the same children (McBride-Chang et al., 2008b). Similarly, within the same group of Korean children, phoneme awareness is more strongly linked to reading of English than reading of Korean (Cho & McBride-Chang, 2005). There are a number of examples of contrasts in alphabetic-based languages as well (e.g., Caravolas, 2004; Peperkamp, Dupoux, & Sebastián-Gallés, 1999).

Along with language, different orthographies may also lead to differences in reading acquisition. As a striking contrast, English is an alphabetic script represented by Roman letters, and Chinese is a logographic script represented by square linguistic units, i.e., Chinese characters. Whereas there are 26 letters in the English alphabet, there are literally thousands of unique characters in Chinese. This difference in a "set" from which to draw orthographic representations, i.e., 26 letters vs. thousands of character configurations, makes independent literacy acquisition more challenging in Chinese, as compared to alphabetic languages (e.g., Li & Rao, 2000). Such a difference may partly explain the fact that Chinese children begin literacy acquisition training relatively early as compared to alphabet-reading peers in other cultures (e.g., Cheung & Ng, 2003). Indeed, DeFrancis (1984) reported that Chinese learners need to acquire approximately 3500 individual characters just to read a newspaper. This seemingly daunting task of learning to read and writing Chinese may partly explain why the governments and parents in some Chinese societies encourage early training of Chinese literacy. For example, in Hong Kong, formal instruction of Chinese reading and writing start

typically in the second semester of first-year kindergarten when children are approximately 3.5 years old (Hong Kong Education Department, 1996).

The differences in languages and orthographies across cultures possibly sensitize children to different metalinguistic aspects in reading acquisition. For example, in English, letters in each word represent phonemes, whereas in Chinese, words are sometimes composed of two or more characters, and each character typically represents each syllable and each morpheme at the same time. As found in previous studies, phonological awareness is particularly important in promoting reading in English and some other alphabetic languages (e.g., Goswami, 2002), whereas morphological awareness is salient for fostering reading development or discriminating reading impairment in Chinese (e.g., Chow, McBride-Chang, Cheung, & Chow, 2008; Shu, McBride-Chang, Wu, & Liu, 2006). These ideas will be further discussed later in this chapter.

Family Influences on Literacy Development

In addition to the above-discussed broad environmental influences on literacy acquisition as distal factors, we now consider the influence of family on literacy development as an immediate factor. Vygotsky (1978) noted that children could optimally develop in learning with a more skilled partner within their "zone of proximal development" (ZPD). The ZPD is defined as the distance between what the child can do independently and what he/she can do with the "scaffolding," or guidance, of a knowledgeable, skilled partner. In the early years of children's development, these skilled partners are usually family members, especially parents. In childhood, one's attachment to caregivers may be particularly important to literacy development. For example, Bus and IJzendoorn (e.g., 1988, 1992) demonstrated that relative to insecurely attached children, securely attached children were likely to show more interest in literacy, read more frequently, and be more attentive and need less discipline during reading activities. Thus, quality parent-child interactions are key for optimal literacy development.

Indeed, parenting quality, and family resources are important components associated with children's reading acquisition. For example, Lugo-Gil and Tamis-LeMonda (2008) investigated the associations among family resources, parenting quality, and children's cognitive performance longitudinally in a diverse sample of 2,089 children and families in American children's first three years. Family resources were measured in four aspects. These were mothers' own reading frequency, mother's educational level, parental living arrangements, and family income. Parenting quality was assessed first via videotaping of mother-child activities; these activities were then rated using ordinal scales. Children's cognitive performance was measured in various aspects, including vocalizations, use of language skills, memory abilities, problem-solving skills, number generalization, and social skills. The researchers demonstrated that family resources and parenting quality uniquely contributed to children's cognitive performance across each of the first three years. Reciprocal influences among children's cognitive performance, parenting, and family resources were documented over time.

The importance of family environment for literacy development has also been documented in Chinese samples. Li and Rao (2000) found that across the Chinese societies of Beijing, Hong Kong and Singapore, parents' own approaches to reading and writing influence

their children's reading development. In specific, across societies, the age at which parents began informal literacy instruction at home predicted unique variance in children's Chinese word reading skills, even with maternal education and children's age statistically controlled.

These features of parental environment all influence children's literacy acquisition in a rather general way because they focus on general parental emotional climate, attitudes, or approaches to learning. However, what matters most specifically for literacy development may be close particular parent-child interactions as evidenced in previous research (e.g., Aram & Levin, 2001). Below we discuss the associations of parent-child literacy interactions and children's literacy development by focusing on shared reading and shared writing activities.

There are numerous studies focusing on the relations of parent-child interactions to children's literacy development, and many of these have investigated such interactions specifically within a shared book-reading task (e.g., Blewitt, Rump, Shealy, & Cook, 2009; Chow et al., 2008; Sénéchal, LeFevre, Hudson, & Lawson, 1996). In contrast, relatively few studies have investigated the relation between parent-child collaborative writing activities and children's literacy acquisition (Aram, 2007; Aram & Levin, 2001; 2004; Burns & Casbergue, 1992; DeBaryshe, Buell, & Binder, 1996; Korat & Levin, 2001, 2002; Lin, et al., 2009). However, both shared reading and shared writing may be important for overall literacy development in different aspects, as reviewed below.

Parent-child shared book reading is beneficial to children's language and literacy development. However, parents' approaches to the book-reading process matter specifically for the kinds of literacy-related skills that they may foster in young children. An excellent example of developmental trajectories in parental literacy approaches comes from the work of Sénéchal and LeFevre (2002). These researchers investigated the relations among early home literacy experiences, receptive language and emergent literacy skills, and reading performance among 168 middle-class Canadian children in a five-year longitudinal study spanning from kindergarten to third grade. Home literacy experiences were measured in two distinct parental involvement activities, namely, storybook reading as an informal literacy activity and parents' reports of teaching as a formal literacy activity. The results showed that shared book reading in kindergarten years was related to the development of receptive language skills in first grade, and these language skills were further linked to reading development in grade three. However, shared book reading was not associated with subsequent emergent literacy development in first grade. In contrast, parents' involvement in teaching of reading and writing when their children were in kindergarten was related to the children's development of specific emergent literacy skills (i.e., those involving print), but not related to language development in first grade. In addition, emergent literacy skills were directly predictive of word reading in first grade and indirectly predictive of word reading in third grade. Thus, both informal reading and discussion of books as well as an explicit focus on print are longitudinally important for subsequent reading development, though their pathways may be different.

These findings suggest that literacy, language, and fluent reading skills are rooted in various and different aspects of children's early experiences. Parent involvement in these early literacy activities provides some of the fundamentals for children's acquisition of word recognition. Book exposure appears to be an enduring aspect of home experience that tends to contribute to children's reading development (Barker, Torgesen, & Wagner, 1992; Cunningham & Stanovich, 1993). Indeed, across cultures, parents' valuing of books, as

indexed by the number of books they have at home, is a significant predictor even of adolescents' reading comprehension skills, with overall income level of the household statistically controlled (Chiu & McBride-Chang, 2006). This suggests that parents' overall commitment to reading has a lasting impact on children's literacy attainment.

Numerous studies of early literacy development have demonstrated the importance of parents' input for children's achievement (e.g., Evans, Shaw, & Bell, 2000; Frijters, Barron, & Brunello, 2000; Sénéchal, LeFevre, Thomas, & Daley, 1998). For example, Evans et al. (2000) showed that parents' reports of their own teaching were related to children's early literacy skills. Frijters et al. (2000) found that children's interest in literacy was associated with early (print-related) literacy skills, whereas home literacy experiences such as shared book reading were primarily predictive of children's vocabulary knowledge. However, a number of these types of studies on early literacy development and parenting, including the one by Sénéchal and LeFevre (2002), measured only the quantity of shared book reading and teaching of reading and writing, but not the quality of parent-child interactions during storybook reading activities. The qualitative diversity of adult-child interactions during shared book reading may also influence the acquisition of literacy skills.

The technique of shared book reading called dialogic reading developed by Whitehurst and colleagues has been demonstrated to have clear and consistent positive effects on children's language skills, especially vocabulary, in both alphabetic and nonalphabetic scripts (e.g., Blewitt, et al., 2009; Chow & McBride-Chang, 2003; Chow, et al., 2008; Raikes et al., 2006; Whitehurst, et al., 1994). For example, Whitehurst, Arnold, Epstein, Angell, Smith, & Fischel (1988) showed that after a 4-week intervention in which a group of 2-year-old children were read to by their mothers using the dialogic reading technique, these children had higher expressive vocabulary knowledge and demonstrated greater expressive language fluency than did a control group who were read to in a more traditional way, i.e., without using the dialogical reading technique; these gains persisted in a 9-month follow-up assessment.

The dialogic reading technique emphasizes the importance of parent-child conversations during story-book reading. This approach particularly encourages parents to ask and answer open-ended questions, rather than questions that have definite right/wrong answers. Typically, this approach highlights at least three components to facilitate enriched language use in these conversations during the shared story reading. First, parents encourage their children to think about the stories with expanded explanation and elaboration by asking open-ended questions. For example, parents might stop in the middle of the story and ask their children, "What would you do if you were in that situation?" In addition, as parents are talking with their children and processing children's responses to these questions, they repeat, expand, and recast children's speech. In this way, children's conversational input is supported and perhaps reinforced. In addition, parents provide expansions of vocabulary and grammatical constructions, among other aspects of language, as models from which children can learn. An example of a simple expansion is an instance in which, in reply to a child saying "dog," the mother agrees by saying "Yes, that's a big dog!" Thus, a third aspect of the dialogic reading technique is parents' encouragement by providing commentary and feedback on children's speech. For example, a mother might follow her "dog" utterance above by noting "That dog has black spots, as well, just like the dogs in '101 Dalmatians.' Aren't you clever for noticing that dog?" Such exchanges may motivate children to talk further about the story or other ideas of interest. Although similar techniques can be used to talk with young

children in any situation, shared book reading provides one ideal context for doing so. Books contain many ideas, vocabulary, and situations that may not occur in daily life. In this way, books expand conversational topics in numerous ways.

McBride-Chang and colleagues tested the effects of dialogic reading on language and literacy development among Chinese children and found that this technique has consistently promoted vocabulary growth in Hong Kong children (Chow & McBride-Chang, 2003; Chow, et al., 2008; Fung, Chow, & McBride-Chang, 2005). For example, Chow, et al. (2008) investigated parent-child shared book reading and metalinguistic training on language and literacy attainment among 148 Hong Kong kindergartners. Children were randomly assigned to conditions of dialogic reading with morphology training, dialogic reading, typical reading, and a control condition (in which children received no new books to read during the study itself). After a 12-week training period, the dialogic reading intervention group showed significantly better vocabulary knowledge as compared to the typical reading and control groups. Furthermore, the group with dialogic reading and morphology training, which involved having parents encourage their children to recognize and manipulate morphemes in different compound words, showed improved word reading skills as compared to the other three groups. These findings suggest that dialogic reading uniformly promotes vocabulary development. At the same time, however, literacy skills per se, i.e., those involving print, may be better fostered by explicit metalinguistic training.

Echoing these ideas, Reese and Cox (1999) noted that dialogic reading is just one reading style among many shared book reading activities. They argued that this technique appears primarily to benefit language development, especially among younger children and older children with certain developmental delays. At the same time, however, there may exist other reading styles that can facilitate children's literacy skills as well. Therefore, Reese and Cox (1999) experimentally examined the effects of three share-book reading styles on the emergent literacy skills of preschoolers (around 4 years old). These reading styles were characterized as the describer style, the comprehender style, and the performance-oriented style. These styles are intended to describe the parents' role in shared storybook reading. Parents with a describer style mainly focus on describing or labeling pictures by often asking *what* and *how* questions. Parents with a comprehender style, however, concentrate more on story meaning and making inferences and predictions about story events. In this style, parents commonly ask *why* questions. Finally, those with the performance-oriented style read the story uninterrupted and confine discussion of it only to prior to and following the story reading. This incorporates more affective commentary into the shared reading activities.

Results of this study (Cox & Reese, 1999) showed that the describer style of shared book reading resulted in the greatest improvement in children's vocabulary and print skills. However, perhaps more importantly, there was an interaction between reading style and children's initial literacy skills. Specifically, children with higher initial vocabulary levels benefited most in their vocabulary development from a performance-oriented style, whereas a describer style was most beneficial for print skills when children had high initial story comprehension levels.

The interaction results demonstrated by Reese and Cox (1999) go along with Vygotsky's (1978) theory that children's independent skills are vital for their subsequent gains in parent-child interactions. For example, Reese and Cox (1999) found that children with higher initial vocabulary levels benefited most from higher demand reading styles. Thus, in the shared

reading context, it is important to take into account children's initial literacy or language levels when parents read books to their children.

In addition to the importance of parent-child shared reading in fostering children's vocabulary and literacy development, parent-child shared writing can also facilitate literacy skills. However, compared to the relatively numerous studies on parent-child shared reading, research on parent-child shared writing is somewhat sparse. Some early observational studies have shown that children sometimes ask parents about their writing, especially what the parents are writing, and parents are frequently engaged in writing activities together with their children (e.g., Bissex, 1980; Harste, Woodward & Burke, 1984). However, this early research is not clear on the parent-child detailed interaction process and how these joint writing interactions are related to children's independent literacy development.

In one study (Burns & Casbergue, 1992) that looked in more detail into the parent-child interaction process, researchers recorded the joint activities and the context in which parents helped their 3-5-year-old children to write an English letter to others. They also explored how parents' control (i.e., parents' demands on children following of their instructions) was related to children's performance on this task. Ultimately, higher levels of parental control tended to be related to children with higher levels of responses, more communication focusing on spelling, and better conventional letters. In contrast, lower levels of parental control tended to be associated with children exhibiting higher levels of initiations and verbal input, more communication focusing on letter content, and less conventional written products.

Apart from parental control as studied by Burns and Casbergue (1992), DeBaryshe, Buell and Binder (1996) explored parent-child interactions by focusing on social aspects of such interactions. These researchers analyzed parent-child verbal conversations in the same English letter-writing context among 5-6 year-old children and their parents. They found that the more interactive the conversations were between parents and children, the better the quality of the letter products produced was. By conducting qualitative analyses, these researchers further demonstrated that mothers tend to be quite sensitive to children's developmental writing skills. However, both of these studies of parent-child writing interactions (Burns & Casbergue, 1992; DeBaryshe et al., 1996) focused primarily on the products of writing as a paired effort between parent and child. Children's own independent literacy skills were not incorporated into these studies.

Thus, additional studies conducted by Aram, Levin and colleagues have investigated the associations between maternal writing mediation and children's independent literacy acquisition. For example, Korat and Levin (2001) examined the relations among mother-child shared writing, maternal beliefs about pedagogy and child-as-learner, and children's independent writing skills in two socioeconomic status (SES) groups in Israeli. Young children were asked to complete two writing tasks, namely, writing of a party invitation and a shopping list. Moderately high correlations among maternal beliefs, children's autonomy in the interactions, and writing skills were found especially in the low SES group. Korat and Levin (2002) later showed that children's independent writing skills were associated with the amount of spelling/writing discussed in the parent-child interaction.

However, this and other above-described studies examined parent-child writing interactions in rather unstructured writing activities, including writing letters to others, writing party invitations, and writing shopping lists. These studies capturing unstructured writing activities tend to focus on "what to write," e.g., punctuation marks, salutations, or even drawing pictures for writing a letter, but may correspondingly be lacking in testing "how

to write." This "how" aspect is essential to explore given the importance of early writing for literacy achievement, particularly within the context of early formal schooling. In an important study on both the "what" and "how" dimensions of early literacy development, Aram and Levin (2001) studied the associations of maternal mediation of writing with word writing and recognition, phonological awareness, and orthographic awareness in both unstructured party invitations and structured words writing activities among 5-year-old Israeli children and their mothers. From the videotaped maternal writing mediation interactions, two scales of literate mediation capturing the cognitive decoding and encoding processes of writing words and print mediation in relation to mothers' autonomy support were extracted from the videotaped activities. The results showed that the quality of literate mediation and print mediation effectively predicted word writing and recognition, and phonological awareness, but not orthographic awareness, beyond sociocultural factors in these children. Following this study, Aram and Levin (2004) further longitudinally tested the same children's performances on spelling, reading comprehension, and linguistic knowledge. The findings suggested that literate mediation and print mediation in kindergarten significantly predicted spelling and reading comprehension 2.5 years later, even statistically controlling for sociocultural factors and kindergarten measures of linguistic knowledge and word writing. This finding underscores the potentially great importance of parental scaffolding as a key environmental aspect of early literacy development in children.

These self-developed scales of literate mediation and print mediation in Hebrew (Aram & Levin, 2001; Aram & Levin, 2004) capture two different aspects of mother-child shared reading interaction. In general, the Hebrew literate mediation scale focuses on mothers' specific phonemic encoding and decoding components. The ordinal literate mediation scale from lower to higher levels is from a more surface level (e.g., dictating individual letters for children to write) to a deeper level (i.e., facilitating children's efforts to retrieve phonemes and then represent these as letters). In contrast to the literate mediation scale, the print mediation scale captures the degree of autonomy mothers grant to their children in retrieving letter shapes and in producing letters. The scale includes three categories, from mothers facilitating the child's copying of letters, to mothers instructing only when children unable to do independently, to mothers monitoring and encouraging independent writing with the levels ranging from lower to higher.

The benefit of shared writing to literacy development has been documented not only in alphabetic scripts, but also in Chinese, a nonalphabetic script. Lin et al (2009) investigated maternal mediation of Chinese word writing among Hong Kong mother-child dyads from three grades across second year kindergarten, third year kindergarten, and first grade. Based on the work of Aram and Levin (2001; 2004), literate mediation and print mediation scales were modified and adapted for the Chinese script. Lin et al. (2009) analyzed and organized six strategies in literate mediation from lower level to higher levels. These were mothers asking children to copy what the mothers had written, mothers instructing children on stroke formations, mothers visualizing a character or part of a character in comparison to an object, mothers segmenting Chinese characters into various components, mothers explaining phonetic radical (i.e., sound) functions, and mothers making morphological (i.e., meaning) applications and comparisons within and across words and characters. The print mediation scale in this study included four strategies that were largely the same as that from Aram and Levin (2001, 2004). The results showed strong developmental trends in strategy usage. Chinese mothers tended to use more lower level strategies with kindergarten children and

more higher level strategies, such as morphologically-focused strategies, among first graders. In addition, mothers' use of lower-level maternal mediation strategies tended to be negatively associated with children's reading skills, whereas mothers' use of higher-level maternal mediation strategies tended to be positively associated with children's reading skills, even with age, grade, nonverbal reasoning and maternal education variables statistically controlled. This study also demonstrated the importance of parental scaffolding for early literacy achievement in young children, both in terms of mothers' specific strategies and techniques offered and in terms of mothers' autonomy-granting in the writing process.

Thus, the importance of early parent-child shared reading and writing for children's literacy acquisition and development has been documented cross-culturally. These findings indicate that good quantity and quality of shared reading and writing interaction may not only teach children specific contents, but also support them in growing as efficient learners. Moreover, it is also possible that shared writing increases the child's intrinsic motivation to look more deeply into the process of reading and writing and prompts children's learning of metacognitive strategies to facilitate independent learning (e.g., Feuerstein, 1998).

Phonological Sensitivity and Morphological Awareness in Predicting Literacy Development and Impairment

In addition to the importance of exogenous parent-child interaction in fostering children's literacy development, we need to credit at least equal importance to children's endogenous cognitive / metalinguistic skills for understanding literacy development and impairment. Thus, in this section, we discuss early predictors of later reading and markers of reading impairment, including phonological processing, speech perception, and morphological awareness. Phonological processing and speech perception together might more broadly be considered as phonological sensitivity, though there is considerable debate on how to define each of these (e.g., McBride-Chang, 2004; Stanovich, 2000). Here, we talk first about phonological processing as defined by Wagner and Torgesen (1987) and then lower levels of speech under the general concept of speech perception, before moving on to concepts of morphological awareness.

Phonological processing has been conceptualized as encompassing the following three skills: phonological awareness, rapid automatized naming(RAN) and verbal memory (Wagner, & Torgesen, 1987). Phonological awareness and RAN in particularly have been demonstrated to be unique correlates of word reading across cultures in numerous studies (for a review, see McBride-Chang, 2004).

Phonological awareness is awareness of and access to the sound structure of a language (Wagner & Torgesen, 1987). It can be tested at different linguistic levels (e.g., syllable level, onset or rime level, or phonemic level) with several different tasks (e.g., deletion, oddity, counting). For example, in a typical phoneme deletion task, children might be asked to say *cat* without the /k/ sound. In a typical rime oddity task, children are asked to select the given syllable that does not rime with the other two syllables (e.g. for *chair, hair, ball*, the correct answer is *ball*—it doesn't sound like the other two).

Phonemic awareness tasks are more difficult than the measurements of the other two levels (McBride-Chang, 2004), and phonemic awareness develops later than syllable awareness and onset-rime awareness (Goswami, 2002). However, it tends to be among the

best predictors of dyslexia, at least in English-speaking children (Debree, Wijnen, & Zonneveld, 2006; Goswami, 2000). This is because phonemic awareness is important for mapping each letter of the alphabet to a given phoneme in order to decode. For example, understanding that the letter *d* makes the /d/ sound is helpful in learning to sound out new words such as *dad* or *dig*. The consistency with which each letter makes a given sound can help in generalizing letters of the alphabet to new word contexts. However, in general, phonological awareness is not only important for alphabetic orthographies such as German and English but also for relatively opaque scripts such as Chinese, in which the correspondence between phonological sensitivity and orthographic representations is relatively unclear and inconsistent (e.g., Ho & Bryant, 1997; McBride-Chang et al., 2008a; McBride-Chang et al., 2008b; Shu, Peng, & McBride-Chang, 2008).

Chinese is different from English in ways that are relevant for considering phonological awareness in relation to word recognition especially in the following two aspects. First, in Chinese, a character always corresponds to a single syllable, rather than any phoneme-level representations. Second, Chinese is a tonal language, in which different lexical tones within the same spoken syllable represent different semantic meanings. For example, four tones in Mandarin combined with the same spoken syllable /ma/ can represent a number of meanings, e.g., /ma 1/妈 , /ma 2/麻, /ma 3/马 /ma 4/骂 correspond to *mother, numb, horse* and *scold* respectively. Perhaps because of the importance of both the syllable and tonal information in Chinese, several studies have demonstrated that syllable awareness and tone awareness can concurrently and longitudinally predict Chinese character reading and can also be used to discriminate typically developing children and those at risk of dyslexia (Ho & Bryant, 1997; McBride-Chang et al., 2008a; McBride-Chang et al., 2008b; Shu, Peng, & McBride-Chang, 2008) The importance of phonological awareness at these levels may be greatest for preschool Chinese children, who are just learning to map spoken phonological representations to Chinese characters, perhaps without yet a clear representation of orthographic patterns in Chinese.

Another component of phonological processing, rapid automatized naming (RAN), which taps children's recoding skill in lexical access, appears to be important for early reading across languages as diverse as German, Dutch, English, Chinese and Italian. (Brizzolara et al, 2006; De Jong, P.F. & Vrielink, 2004; Georgiou, Parrila, & Liao, 2008; Liao, Georgious, & Parrila, 2008; Wimmer, Mayringer, & Landerl, 2000). In a typical RAN task, a small group of familiar symbols (perhaps 5-8 in all), typically single-digit numbers, simple easily-identified pictures (e.g., sun, cat, car, etc.), or letters of the alphabet are randomly visually presented several times across rows. Children are first asked to identify each symbol slowly, to ensure that each symbol is familiar. Once this familiarity is established, the children are then asked to read them aloud one by one across rows as quickly as they can. Those who are particularly slow to orally identify these symbols tend to be among the poorest readers in a word recognition task across cultures (McBride-Chang, 2004).

Despite the significance of this task for word reading, however, its underlying mechanism is far from understood. Some researchers have argued that RAN tasks tap the ability to develop an arbitrary mapping between sound and print (Manis, Seidenberg, & Doi, 1999). This could potentially explain why RAN is very important for reading in Chinese, an opaque orthography in which the mapping between character meaning and sound are highly unreliable, in addition to its utility in a number of alphabetic languages. Some other

researchers have proposed that RAN is actually an index of fluency and decoding speed, elements that are vital for reading in more transparent scripts such as German (e.g., Wimmer et al, 2000)

Compared to phonological awareness and rapid automatized naming, another phonological processing skill, verbal memory, has received less attention in current research in reading difficulties and development. This is largely due to the fact that verbal memory tasks typically cannot uniquely predict reading independently of phonological awareness and RAN. At the same time, however, it has been shown to be related to reading skill at the word level in some studies (e.g., Wagner et al, 1997). Importantly, among older children, for reading comprehension in the text level, verbal working memory has been shown to be significant for both alphabetic languages and Chinese (Leong, Tse, Loh, & Hau, 2008).

Although dyslexia is defined as a phonological impairment in alphabetic languages (Goswami, 2000), the origin of this phonological deficit is far from understood. Researchers have, therefore, begun to look at the potential role of speech perception for reading because it developmentally precedes phonological awareness. Some studies have focused on speech perception at the segmental or phonemic level and argued that dyslexic children tend to be poor at perceiving rapid transitional sound, especially stop consonants such as /p/,/t/,/d/,and /b/. (e.g., McBride-Chang, 1995; Tallal, 1980). Other researchers have highlighted the significance of speech perception at the suprasegmental level, encompassing prosodic sensitivity, for word reading. For example, since English is one of the most famous stress-timed languages and the metric stress strategy is an important cue for infants' segmentation of the speech stream in English, several studies have documented the role of stress sensitivity on word reading (Wood, Wade-Woolley, & Holliman, 2009).

A typical task to test stress sensitivity in very young children is the metric stress task developed by Wood (2006). In this task, children are first shown a picture of a little dog's room in which there are some objects such as a sofa. Children are asked to correctly name the objects, and their performance in this session is considered as the baseline. Then, children are told that somebody wants to find something but he can not pronounce it correctly, and children should listen to the mispronounced word and point the object out. Mispronounced words in this task are of two syllables and they differ from the normally pronounced ones in metric stress. For example, 'sofa' /ˈsəufə/ is pronounced as [illegible], where the stress is transferred from the first syllable to the second one, and the vowel in the originally stressed syllable is reduced, while that of the originally unstressed syllable becomes fully articulated.

Wood and colleagues (Holliman, Wood, & Sheehy, 2008; Wood, 2006) found that metric stress awareness could significantly explain word reading for 5 to 7-year English-speaking children. Debree et al (2006) investigated Dutch word stress acquisition in 3-year-old children at risk of dyslexia (defined as children with at least one parent or older sibling with reading difficulties) and non at-risk children who were matched to the at-risk group by age and nonverbal IQ. They found that children at risk were less able to repeat irregularly stressed non-words than were controls. Thus, in languages in which stressed and unstressed syllables are important to distinguish meanings, metric sensitivity appears to be a potentially important indicator of variation in word recognition. In addition, in languages with other obvious suprasegmental features, such features may indicate differences in reading sensitivity as well. For example, the importance of lexical tone as a prosodic feature in Chinese is underscored

by the fact that Chinese children with dyslexia show impaired perception of lexical tones as compared to typically developing readers (Cheung et al, 2008).

Overall, speech perception sensitivity in dyslexics is not only evidenced in behavioral studies but also in studies using various neuroscience techniques. For example, Molfese (2000) demonstrated that those children with and without dyslexia at age 8 years could be distinguished with 81% accuracy from an *Event*-related potentials (ERP) analysis of children's brain responses to speech and non-speech syllables conducted when they were just 36 hours old. Among older children, ERP analyses have also found that dyslexic kindergartners and primary school students show diffused brain activation (or longer latency or smaller amplitude of MMN—mismatched negativity) components compared to typically developing readers in response to both speech and non-speech stimuli (Maurer, Brem, Bucher, & Brandeis, 2003; Schulte-Körne, Deimel, Bartling, & Remschmidt, 1998).

Taken together, these results demonstrate that phonological processing is important for reading acquisition across languages. At the same time, the significance of phonological sensitivity at different levels is constrained by how phonology is represented in specific languages. Different types of speech perception deficits might underlie deficient phonological representation of dyslexics in particular languages based on such constraints.

Apart from phonological awareness, another significant metalinguistic skill for reading is morphological awareness, which we define here very broadly as awareness of and access to the meaning structure of language. Across languages, morphological awareness is measured in different ways, typically including inflectional awareness, derivational awareness, and lexical compounding. Inflectional awareness can be demonstrated by asking children to provide a correct grammatical ending to a newly introduced nonsense word. For example, one could say "This man likes to *hux*; now he is ___," with the hope that children could provide the correct grammatical inflection, *huxing*. Derivational tasks are similar. They typically involve giving a child a root word and asking them for the correct derivation. For example, one might say, "This woman has been entrusted to *investigate* the crime. She needs to form an ____," with the correct answer being *investigation*. Finally, a lexical compounding task is one in which a child is asked to form a new compound word. For example, what would you call a tree that grows donuts? The correct answer here would be *donut tree*. Note that an answer such as *tree donut* would be incorrect because it would incorrectly represent the meaning requested. Another lexical compounding-based task involves the identification of homophones. For example, in one example, two pictures, depicting a bag of flour and a flower, respectively, are shown, and children are required to point to the picture that best represents the meaning of flower in *flowerpot*.

Morphological awareness is important for learning to read in alphabetic languages (Carlisle, 2000; Mahony, Singson, & Mann, 2000), sometimes beyond the role of phonological awareness (e.g., Deacon & Kirby, 2004). However, there is also sometimes substantial overlap between the roles of phonological and morphological awareness for early reading in alphabetic languages (Mann, 2000). Moreover, children's derivational knowledge expands in later years, so the importance of morphological awareness in young alphabetic-reading children may expand with age. Morphological awareness also appears to be important for reading development in young Chinese children (e.g., McBride-Chang, Shu, Zhou, Wat, & Wagner, 2003; Tong, McBride-Chang, Shu, & Wong, in press).

The importance of morphological awareness for early Chinese reading is likely attributable to two aspects. First, Chinese is relatively semantically transparent as compared

to many alphabetic languages. Therefore, if a child understands the meaning of a given morpheme, he or she can grasp the meaning of other novel words that contain the morpheme more easily. Second, there are a large number of homophones in Chinese. In Mandarin, for example, each syllable corresponds to about five homophones (Shu & Anderson, 1997). Typically, therefore, a phonological cue alone is unreliable when accessing the meaning of words or characters in text reading. In this situation, only good morphological awareness can help one to differentiate across meanings.

CONCLUSION

Investigations of environmental and parental factors related to young children's literacy development, as well as cognitive predictors in literacy development and impairment complement our knowledge of children's long-term academic or even overall development. Cross-cultural examinations further extend interesting similarities and differences in literacy development in young children. For example, shared book reading is universally beneficial to general language skill development. However, children learning to read in an alphabetic orthography will benefit from a structured focus on phonological skills and some attention to the features of print in learning to read. In contrast, Chinese children may benefit more from morphological skills or strategies (e.g., Chow et al., 2008; Lin et al., 2009).

Indeed, the interactions among environmental, parental factors and children's literacy development may be particularly salient. Parents help their children within a given environmental context, which includes the home language and orthography of the society, or at least the family. Understanding these issues may be particularly important in facilitating children's literacy development or children with specific reading difficulties. For example, an English-speaking child with difficulties in phonological sensitivity may need a much stronger, wider-ranging, and specific home literacy support system from his parents than would an English-speaking child without such difficulties. Similarly, an English-speaking child may need more of a focus on phonemic awareness games to facilitate early word recognition success than would a Chinese-speaking child, for whom sensitivity to morphemes and homophone differences might be more practically useful for early literacy attainment. Overall, the interactions of children's cognitive skills and home environment within a cultural context are of great interest in optimizing early literacy development across languages and scripts, around the world.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 19-37

Chapter 2

MOTOR PERFORMANCE DIFFERENCES IN PRE-SCHOOL AGED BOYS AND GIRLS

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ABSTRACT

During infancy and preschool age, movement is an integral part of human life. Children use movement to discover both themselves and the world and consequently, the study of a child's motor performance can significantly contribute to the full understanding of his/her entire personality. The research of pre-school aged children's motor performance usually focuses on the motor characteristics that change with growth and differentiate, due to environmental factors or particular features of the children. One of the most widely considered issues is the motor performance differences between boys and girls. The review of the literature revealed conflicting findings. Several researchers suggest that the motor performance of boys and girls is quite similar while others report significant differences even in pre-school aged children. In particular, boys have been found to perform higher than girls in tasks that assess catching, throwing, jumping, kicking and short dashes. On the other hand, girls outperform boys in tasks involving balance, flexibility and fine motor skills. Taking into consideration that at the preschool age, the biological characteristics of boys and girls are similar rather than different, a closer study of the factors that may have caused the aforementioned inconsistency among the research findings was conducted. That study showed that many of the differences are environmentally and culturally induced. It has been established that in some societies, boys and girls have different already been given different anticipated roles in the first years of their lives, while even when they participate in sports they may have qualitatively different opportunities. Motor assessment tools bias is another significant factor for emphasizing motor performance differences between the two genders. Some batteries include tasks associated with traditionally masculine sports and ignore activities

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like dance or gymnastics in which girls perform better. Consequently, the motor assessment with those tools may provide findings favoring boys. According to the foresaid, it is concluded that, as long as the motor performance of pre-school aged boys and girls is quite similar, when significant differences between the two genders are reported, they should be interpreted having considered both the cultural context in which the study was conducted and the motor assessment tool that was used. The identification of motor performance differences between boys and girls is only the first step. The knowledge of the reasons that cause those differences and their proper evaluation will help educators to step beyond the description of the gender differences: leading to an attempt to decrease them.

INTRODUCTION

During infancy and preschool age, movement is an integral part of children's life. In the first six years of life, children discover themselves and the world through movement and captivate their surroundings, through their body and their sensations (Zimmer, 2004). Thus, especially in that period of human life, the study of a child's motor performance can significantly contribute to the full understanding of his/her entire personality (Payne & Isaacs, 1998).

Additionally, the sound assessment of children's motor development level is directly associated with the planning of developmentally adequate movement programs (Zittel, 1994), the implementation of which is considered essential, not only for the better preparation of children in the field of learning, but also for the avoidance of motor disorders and the important subsequent problems during the period of growth and development (Gallahue, 1996). By means of a valid and reliable assessment procedure, the essential information is gathered so that the program elements can be chosen, according to the individual needs of children. Then, the effects of the movement program on the children's motor performance will be evaluated and new aims will be set (Zimmer & Circus, 1993).

Finally, the identification of children that may have developmental delays is the first step towards forestalling later difficulties. Early intervention services are relatively less expensive than treatment at a later stage (McIntosh, Gibney, Quinn, & Kundert, 2000) narrowing and in some cases minimizing problems that are associated with developmental delays (Berk & DeGangri, 1979).

The studies of pre-school aged children's motor development usually focus on the examination of the movement features that change subsequent to growth and differentiate according to environmental factors or unique characteristics of various population groups (gender, race, social surrounding, developmental disorders, etc).

A large volume of papers refer to the improvement of the performance across age. There is a consensus among the researchers that age, as an index of maturation, is a vital factor for children's motor performance (suggestively: Chow, Hsu, Henderson, Barnett & Lo, 2006; Fjørtoft, 2000; Venetsanou, Kambas, Aggeloussis, Fatouros, & Taxildaris, 2009). The second most widely considered issue is the motor performance differences between males and females with considerable attention given to school aged children and adolescents. Are gender differences in motor performance already noticeable during the preschool years (a period that is so critical for human development)?

LITERATURE REVIEW

In an attempt to answer the above question, we will focus on the studies concerning gender differences during the preschool years that were published after 1980. Children's motor performance in these works is mainly studied through two ways: a) total battery or subtests scores and b) individual item scores. When a general index of child's motor performance is sought then the performances on item tasks are summed up or combined in various ways to yield a motor quotient/battery composite/total score. Subtest scores are formed through the combination of the scores of individual items that are associated with an ability (e.g. strength, coordination) or a category of movement skills (e.g. locomotor, object control). On the other hand, the assessment through the item scores focuses on the measurement of specific tasks. Raw or point scores of those tasks give information about children's performance on the examined motor skills.

In order to achieve a better organization of the following literature review, we will present the studies according to the way children's motor performance is assessed.

Studies Providing Total Battery and Subscales Scores

Several researchers suggest that there are no significant differences between the motor quotients of preschool aged boys and girls. Kambas, Aggeloussis, Proviadaki, Taxildaris, & Mavromatis (2002) attempted the standardization of the Motoriktest für vier - bis sechs jährige Kinder (MOT 4 - 6) (Zimmer & Volkamer, 1987) in Greek preschoolers. Three hundred and thirty four children four to six years were administered the 18 tasks of the MOT 4-6. According to the results, boys' and girls' total MOT 4-6 scores were parallel. Similar findings are provided by VanRossum and Vermeer's (1990) study in which 53 3-to 4-years and 91 5- to -7 years old children participated. The children were examined with the MOT '87 (VanRossum & Vermeer, 1990), a modification of the MOT 4-6 and no significant differences between males' and females' performance were found.

Democritos (Kambas, Aggeloussis & Gavriilidou, 2003), a new psychomotor assessment tool for preschool children, is also based on MOT 4-6. Venetsanou (2007) examined the validity and reliability of the aforementioned battery, using the data of 434 4-to-6 year-old children. According to the results of the analysis applied on children's total battery scores, insignificant differences between boys and girls were noticed. In Durmazlar, Ozturk, Ural, Karaagaoglou and Anlar's (1998) study, 1091 children, aged 0-6 years, were tested with the Denver II (Frankerburg, Dodds & Archer, 1990) and the data were analysed for sex and sociocultural differences. As stated by Durmazlar et al. (1998) "the differences in the motor performances of boys and girls were minor and did not show any consistent pattern".

Finally, Aponte, French and Sherrill (1990) administered the Test of Gross Motor Development (TGMD) (Ulrich, 1985) to 300 children, aged 5 to 7 years, in Puerto Rico. The difference between the total battery score of boys and girls were statistically significant, favouring boys. However, the value of effect size was small.

However, in the following studies, in those provide both total- and subtests scores, significant performance differences between preschool aged males and females arise. Nordberg, Rydelius, & Zetterström (1991) conducted a longitudinal survey in order to

examine the psychomotor and mental development from birth to the age of four. The physical health and development of the 497 participants were followed by prospective data achieved from the child welfare centers. At one year of age, 452 of the children and at four-five years of age 412 of the children were evaluated by the Griffith's Developmental Scales (Griffith, 1984). Regarding children's motor development, it was found that at the age of four, girls scored higher than boys in the eye-hand –coordination and gross motor subscales, as well as in the total score.

Similar findings were noted in Silva and Ross' (1980) study in which 1037 children at the age of three were assessed with the Motor Scale of Bayley Scales of Infant Development (Bayley, 1969). Nine hundred and thirty one of these children were also followed up and tested at the age of five. In addition, a randomly selected subsample of 176 from the total sample was also assessed as 4-year-olds and as 6-year-olds. The motor development at ages 5 and 6 years was assessed with the Leg Coordination Subtest of the McCarthy Scales of Children's Abilities (McCarthy, 1972), while an upward extension of the Motor Scale of Bayley Scales of Infant Development (Bayley, 1969) was used for the 4-year-olds' assessment. From the results it was shown that although there were not differences between boys and girls at ages three and four years, there was a significant superiority of girls at ages five and six. Another instrument emphasizing coordination, the Charlop – Atwell Scale of Motor Coordination, (Charlop & Atwell, 1980), was standardized by its designers on 201 children, aged 4-6 years old. Once again, the results showed higher mean scores for girls.

In Sigmundsson and Rostoft's study (2003), 91 four and five year old children were tested using the Movement Assessment Battery for Children (MABC) test (Henderson & Sugden, 1992). On the total scores and in two of three sections (manual dexterity and balance) boys were significantly worse than girls. However, according to Sigmundsson and Rostoft (2003), the significance differences shown between the groups on the MABC total score would appear to be largely contributed to by the scores obtained in the items "threading beads", "bicycle trail" and "one leg balance".

Only two of the reviewed papers focusing on subtest scores resulted in the absence of a gender –related score difference. Chambers and Sugden (2002) assessed 420 three –to five –year-old children using the Early Years Movement Skills Checklist (Chambers & Sugden, 2002) and did not notice statistically significant differences. Also, Ittenbach and Harrison (1990) analysed the records of 979 preschool children on three measures of the Early Screening Profiles (Harrison et al., 1990) and found that boys' and girls' motor performance was quite similar.

In table 1, the findings of all the aforementioned studies are briefly reported. It is obvious that when preschooler's motor performances are assessed through a total battery score, boys' and girls' performance is usually found to be quite similar. The significant differences, favouring girls, found in some studies have to be further investigated, taking into consideration the assessment tool that was used. The Charlop-Atwell Scale (Charlop & Atwell, 1980), for example, focuses on coordination: resulting, perhaps, in one-sided information about children's motor development.

Table 1. Studies reporting total or/and subtests scores

	Assessment tool	Age (years) Gender differences Boys	Girls	N of participants	Studies
Total battery score	Motor Scale of Bayley Scales of Infant Development (Bayley, 1969)	------(3)*----- ------(4)------		1037 176	Silva and Ross' (1980)
	Charlop-Atwell Scale of Motor Coordination (Charlop & Atwell, 1980)		4-6**	201	Charlop & Atwell (1980)
	Democritos – Psychomotor Assessment Tool for Preschoolers (Kambas, Aggeloussis & Gavriilidou, 2003)	------(4-6)-----		434	Venetsanou (2007)***
	Denver II (Frankerburg, Dodds & Archer, 1990)	------(0-6)-----		1091	Durmazlar et al. (1998)
	Griffith's Developmental Scales (Griffith, 1984)		4	412	Nordberg et al. (1991)
	M-ABC (Henderson & Sugden, 1992)		4-5	91	Sigmundsson & Rostoft (2003)
	MOT 4-6 (Zimmer & Volkamer, 1987)	------(4-6)-----		334	Kambas et al. (2002)
	MOT '87 (vanRossum & Vermeer, 1990)	------(5-7)-----		144	vanRossum & Vermeer (1990)
	TGMD (Ulrich, 1985)	------(5-7)-----		300	Aponte et al. (1990)***
Subtest score	Early Screening Profiles (Harrison et al., 1990)	------(5-7)-----		979	Ittenbach & Harrison (1990)
	Leg Coordination Subtest of the McCarthy Scales of Children's Abilities (McCarthy, 1972)	5 6		931 176	Silva & Ross (1980)
	Griffith's Eye –hand coordination subscale (Griffith, 1984)		4	412	Nordberg et al. (1991)
	Griffith's gross motor subscale (Griffith, 1984)		4	412	Nordberg et al. (1991)
	Ball section of the Early years movement skills checklist (Chambers & Sugden, 2002)	------(3-5)-----		45	Chambers & Sugden (2002)
	Manual dexterity section of M-ABC (Henderson & Sugden, 1992)		4-5	91	Sigmundsson & Rostoft's (2003)
	Balance section of M-ABC (Henderson & Sugden, 1992)		4-5	91	Sigmundsson & Rostoft's (2003)

* There were not significant differences between boys and girls. The numbers in brackets present the age of the participants

**Significant gender differences symbolized by column location of age (e.g., 4-6 listed under "grirls" column represents girls significantly better than boys for Charlop-Atwell Scale of Motor Coordination

***In those studies effect sizes of the difference significance are reported.

On the other hand, the findings of the studies in which a subtest score was applied show a superiority of girls in subtests assessing coordination and balance, a finding that can be characterized as expected. The only unexpected one was that of Nordberg et al. (1991), who found girls to have higher scores than boys even in gross motor subscale of Griffith's Developmental Scales (Griffith, 1984).

Studies Providing Item Scores

The assessment of this kind includes both quantitative and qualitative information. Quantitative information stems from product – oriented assessments that are concerned typically with the outcome of the individual's performance. On the other hand, qualitative information derives from process – oriented assessments that examine the patterns of movements' observable as the examinee performs a motor skill.

Product - oriented assessments

Researchers of the majority of the motor performance studies report product scores, such as distance thrown, height jumped, or speed run. Morris, Williams, Atwater and Wilmore (1982) examined the relationship of age and sex to the performance of 3, 4, 5, and 6 year olds on seven motor performance test items (one leg balance, scramble, catching, speed run, standing long jump, tennis ball throw for distance, softball throw for distance), they had created (Morris, Atwater, Williams, & Wilmore, 1981). Although significant age and sex differences were found on most of the motor tests, it appears that age in general was related more to performance than was gender. On the tests of throwing and balancing, gender was as important as age, or more so, in its relationship to performance. Boys were superior to girls at all ages on the throwing tests; girls were superior to boys at age six on the balance test. Gender differences of a lesser magnitude were found on the Speed Run and Standing Long Jump test with the performance of boys generally being superior to the performance of girls. In Toriola and Igbokwe's (1986) study, in which the aforementioned assessment tool was used, in order for 341 Nigerian children aged 3 to 5 years to be assessed, it was revealed that, at each age level, boys consistently performed better than girls in catching, standing long jump, throwing and speed run.

Oja and Jurimäe (1997) attempted to develop a test battery with the purpose of measuring the motor abilities of 4- and 5- year-old children. The subjects were 932 children, who were examined on 3-min run, standing long jump, 4X10 shuttle run, sit-ups for 30 sec, sit- and – reach, and sand bag throw. According to the results, there were significant differences between boys and girls in all tests except the sit- and- reach. Performances of boys were generally better than those of girls of the same age.

In Bala's (2003) study, 367 children were measured with a battery of seven motor tests (obstacle course backwards, arm plate tapping, forward bend and touch on a bench, standing broad jump, crossed-arm sit-ups, bent-arm hand, 20m dash), which were selected on the basis of experiences with adults, and was modified to suit small children (Bala, 1999). The obtained results showed that the boys had significantly better performance in obstacle course, speed run and standing long jump, whereas the girls performed better in the flexibility test (bent and touch).

Du Toit and Pienaar (2002) aimed to evaluate and compare fundamental gross motor skills in a group of preschool children in South Africa. Four hundred sixty four children, aged 3-6 years participated in the study. The results demonstrated significant gender differences in hopping and balancing on the right leg in favour of the females in the 3 year –old group, and in the standing long jump and throwing –for-distance in favour of the males in the 5 and 6 year old groups. Similar differences were found in the tests for standing long jump in the 4 year-old group and throwing in the 3 and 4 year-old groups, although not statistically significant. Du Toit and Pienaar's (2002) suggest that separate norms should be used for the different genders, when assessing standing long jump and throwing –for-distance in 5 and 6 year olds. The superiority of boys in all the examined gross motor skills (throw for distance, kick for distance, jumping, throw for accuracy, and balance) was noted in Al –Haroun's (1988) study, that was conducted in Kuwait with the participation of 240 boys and girls aged 4-10 ½ years.

In Lam, Ip, Lui, and Koong's (2003) study, sex was also a significant factor for performance prediction. One thousand, four hundred and four children aged between three years, three months to six years ten months participated. A set of tests (obstacle course, standing on one foot, walking tip - toe along straight line, throwing) developed for Hong Kong kindergarten children was administered to measure their gross motor proficiency. Boys were superior to girls on obstacle course and throwing, while girls performed better than boys on standing on one foot.

Chow, Henderson και Barnett (2001) examined the suitability of MABC (Henderson & Sugden 1992) in Hong Kong. Two hundred and fifty five children, between the ages of 4 years and 6 years took part in the study. Girls were better than boys on all items except those involving the projection and reception of moving objects. In a more recent study of Chow, et al. (2006) 799 children, aged 4-6 years, from Hong Kong and Taiwan were tested with MABC. From the results it was revealed once more that girls tended to be better than boys on all items except those involving throwing and catching. However, in that study, apart from the statistical significance of the differences, the effect sizes associated with gender are also reported and they were found to be small, a fact that made Chow et al. (2006) conclude that the observed differences were not of great consequence.

In Lejarraga's et al. (2002) study, the psychomotor development of 3.573 boys and girls, aged 0.01-5.99 years in Argentina was observed in order that selected centiles of the attainment ages of 78 selected items belonging to the various areas [personal – social (18 items), fine motor (19), gross motor (23) and language (18)] could be estimated. According to the results, female gender was found to have a positive association with the "heel –to –toe walk", "draw a person" and "copy cross" items.

Even though a large amount of published articles reports motor performance differences between boys and girls even at preschool age, the findings of some studies are quite different. Waelvelde, Peersman, Lenoir, Smits - Engelsman, & Henderson (2008) examined the influence of age and gender on individual test items of M-ABC in 4- and 5-year-old children. Two hundred sixty-seven 4-year-old and 239 5-year-old children took part in the study (260 boys, 246 girls). According to the results of the analysis applied on the raw item scores it was revealed that were no significant gender effects.

In Rose, Burns and North's (2009) study, 60 children, aged 2-4 years, were tested in 10-m run, standing long jump and vertical jump in order to evaluate the foot strength - motor function relationship. It was found that there were no significant differences for any motor

function task between boys and girls. Also Fjørtoft (2000) assessed 75 children, aged 5-7 with the EUROFIT Motor Fitness Test (vanMechelen, vanLier, Hlobil, Crolla, & Kemper, 1993) in order to explore the suitability of the aforementioned assessment tool for that particular age. From the results it was shown, that there was a strong relationship between the children's scores and age but not between scores and sex. The only item, in which significant differences between the two sexes were noted, was the flamingo balance test, with the girls outperforming boys.

Venetsanou (2007) attempted to investigate the validity and reliability of Democritos - psychomotor assessment tool for preschoolers (Kambas et al., 2003), using the records of 434 children aged 4-6 years. Democritos consists of the following 14 items: Tapping, jumping repeatedly sideways, catching a dropped stick, carrying and placing a ball on a box, toe-to-heel walking in backward direction, overhead toss to a specific target, picking up coins and placing them in an area, stepping through vertical hoops, standing jump over a hoop, catching a bean-bag, stride jumping, rebounding with & without external stimulant, standing jump over a stick, body rolling along vertical axis. Boys were found to be better than girls at tapping, carrying and placing a ball on a box, overhead toss to a specific target, catching a bean –bag. However, the values of effect size indexes were small, indicating that the observed differences were not of great importance.

Process – Oriented Assessments

There appears to be a general agreement that superior quantitative scores are at least partially due to qualitative superiority in the performance of motor tasks. In other words, the mover has exhibited a more mechanically efficient pattern or form as measured by scores at a higher level, state, or step in developmental sequence. The subject, regardless of gender, achieves a more successful product outcome because the process is more biomechanically correct (Toole & Kretzschmar, 1993). However, studies focusing on process assessment are not as prevailing in the literature.

In a sequence of studies, Butterfield and his colleagues (Butterfield & Loovis, 1993; 1994; Butterfield, Loovis & Lee, 2003; Loovis & Butterfield, 1993) studied the effect of age, sex, balance and participation in various sports on the development of skills such as throwing, catching and kicking in 719 children, aged 4-14 years. Each child was examined individually with respect to the examined skill item, of the Ohio State University Scale of Intragross Motor Assessment (OSU-SIGMA) (Loovis & Ersing, 1979). According to the results, boys were found to have more matured catching than girls in every age group except the older one, when all the children had a mature catching. The differences between the two sexes were obvious from the age of four. On the other hand, on the throwing, the boys had a better movement quality at every age, whilst regarding to the kicking, although the boys had a better movement pattern, their superiority was not significant.

Nelson, Thomas, Nelson and Abraham (1986) evaluated the influence of biological and environmental variables on the differences between the throwing performance of 5-year-old girls and boys. A total of 100 children were tested on throwing form (trunk rotation, and foot action) and evaluated on eight biological characteristics (height, weight, body mass index, ponderal index, sum of four skinfolds, body diameters arm and leg girths, and somatotypes). Results indicated that boys threw farther than girls and exhibited more mature form. Regarding the biological characteristics, boys had greater joint diameters than girls, a smaller sum of four skinfolds, and more estimated arm muscle. Girls' throwing performance was only

57% that of boys, but when throwing was adjusted for a linear composite of biological variables, girls' throwing performance increased to 69% of boys'.

Ulrich and Ulrich (1985) investigated the relationship between balancing ability, age and gender. For that purpose a battery of 15 items was administered to 72 preschoolers aged 3, 4, and 5 years. Tasks included all eight items from the balance subtest of the Bruninks – Oseretsky Test of Motor Proficiency (Bruininks, 1978). Qualitative performance of six fundamental motor skills (throwing, kicking, striking, jumping, hopping, and skipping) was assessed too. The results suggested that there was not a gender difference on balance scores, while boys performed more proficiently than girls in throwing, kicking, and striking and girls demonstrated a more advanced level of skipping than boys. A significant relationship between gender and hopping or jumping performance was not demonstrated.

Contrasting findings to the aforementioned ones provides a more recent study of Butterfield, Lehnhard and Colabarci (2002), who examined the contributions of age, sex, and body mass index to performance of the locomotor skills assessed by TGMD (Ulrich, 1985) (throwing, kicking, striking, jumping, hopping, and skipping) and 4 fitness tasks (grip strength, step test, sit and reach, and timed sit-ups) by 65 children in Grades K-2. No sex differences were observed in any of the seven skills. In terms of the four fitness tasks, sex was associated with step-test and sit - and reach performance (girls performed better on both).

In Table 2, the tasks in which significant gender differences in motor performance were found, in the aforesaid studies are presented. It is clear that the research findings about the influence of sex on preschooler's motor performance are conflicting. Several researchers suggest that the motor performance of boys and girls is quite similar while others report significant differences.

Boys have been found to be superior to girls at tasks that depend on strength or power, such as throwing, kicking, striking, running and jumping. On the other hand, the tasks that require balance and coordination are executed better by girls.

Apart from the aforementioned studies, a remarkable work is that of Thomas and French (1985; 1987), who conducted a large meta-analysis of gender differences in 20 motor skills. Data were from 64 studies that included 31,444 girls and boys, 3-20 year old. Effect sizes were calculated between girls' and boys' performance at each age level for the 20 motor tasks. When age was regressed on effect sizes, a significant effect was found in 12 of the 20 tasks.

The investigators determined that the dash, long jump, and shuttle run, as well as grip strength and sit-ups, showed small –to-moderate effect sizes favoring boys in early childhood. There were also two tasks in which gender differences were large but not related to age: throwing accuracy and wall volley. In four tasks, the gender differences were small but favored boys: agility, anticipation timing, arm hang, and reaction time. In two tasks, the gender differences were small but favored girls: fine eye-motor coordination and flexibility. No significant gender differences were found in balance or vertical jumping performance during the early years. The catching performance of boys was superior to girls at age three, but the mean performances were similar at age five.

Of the 20 tasks included in this meta-analysis, one was very different from the others: overhand throwing. Note that as early as ages 3-4 years, boys' performance exceeds girls' by 1.5 standard deviation units. The difference at ages 3-4 is three times as large as any of the other motor tasks reported in this meta-analysis.

Table 2. Tasks in which significant gender differences in motor performance were found

Task	Validity	Age (years) Gender differences Boys	Girls	N of participants	Studies
3-min run	✓	4-5**		932	Oja and Jurimäe (1997)
Bent and touch	✓		4-7	367	Bala (2003)
Catching*	✓	4-7+		65	Loovis & Butterfield (1993)
Catching	✓	3-5		269	Morris et al. (1982)
	✓	3-5		341	Toriola & Igbokwe (1986)
	✓	4-6		434	Venetsanou (2007)**
Drawing trail	✓		4 & 6	799	Chow et al. (2006)**
	✓		4-6	255	Chow et al. (2001)
	✓		4-5	91	Sigmundsson & Rostoft, (2003)
Dynamic balance tasks	✓		4 & 6	799	Chow et al. (2006)**
	Not reported		0-6	3.573	Lejarraga et al. (2002)
Static Balance tasks	✓		3	464	du Toit & Pienaar's (2002)
	Not reported		4-6	240	Al –Haroun (1988)
	Not reported		3-7	1404	Lam et al. (2003)
	✓		5-7	75	Fjørtoft (2000)
	✓		4 & 6	799	Chow et al. (2006)***
	✓		4-6	255	Chow et al. (2001)
	✓		6	269	Morris et al. (1982)
	✓		4-5	91	Sigmundsson & Rostoft, (2003)
Hop	✓		3	464	du Toit & Pienaar's (2002)
Kick*	✓	3-5		72	Ulrich & Ulrich (1985)
Kick for distance	Not reported	4-6		240	Al –Haroun (1988)
Obstacle course	✓	4-7		367	Bala (2003)
Posting coins	✓		4 & 6	799	Chow et al. (2006)**
Sit –and -reach	✓		5-7+	65	Butterfield et al. (2002)
Sit-ups	✓	4-5		932	Oja and Jurimäe (1997)
Skip *	✓		3-5	72	Ulrich & Ulrich (1985)
Speed run	✓	3-6		269	Morris et al. (1982)
	✓	4-7		367	Bala (2003)
	✓	3-5		341	Toriola & Igbokwe (1986)
	Not reported	3-7		1404	Lam et al. (2003)
	✓	4-6		434	Venetsanou (2007)**
Standing long jump	✓	3-6		269	Morris et al. (1982)
	✓	4-5		932	Oja and Jurimäe (1997)
	✓	4-7		367	Bala (2003)
	✓	3-5		341	Toriola & Igbokwe (1986)
	✓	5-6		464	du Toit & Pienaar's (2002

Strike*	✓	3-5		72	Ulrich & Ulrich (1985)
Tapping	✓	4-6		434	Venetsanou (2007)**
Threading beads	✓		4 & 6	799	Chow et al. (2006)**
	✓		4-6	255	Chow et al. (2001)
	✓		4-5	91	Sigmundsson & Rostoft, (2003)
Throwing*	✓	4-6+		719	Butterfield & Loovis (1993)
	✓	3-5		72	Ulrich & Ulrich (1985)
	✓	5		100	Nelson et al. (1986)
Throwing for accuracy	Not reported	4-6+		240	Al –Haroun (1988)
	✓	4-6		434	Venetsanou (2007)**
Throwing for distance	✓	5-6		464	du Toit & Pienaar's (2002)
	✓	4-5		932	Oja and Jurimäe (1997)
	Not reported	3-7		1404	Lam et al. (2003)
	Not reported	4-6+		240	Al –Haroun (1988)
	✓	5		100	Nelson et al. (1986)
	✓	3-6		269	Morris et al. (1982)
	✓	3-5		341	Toriola & Igbokwe (1986)

*Qualitatively evaluated tasks

**Significant gender differences symbolized by column location of age (e.g., 4-5 listed under "boys" column represents boys significantly better than girls for 3-min run).

***In those studies effect sizes of the difference significance are reported.

+ Differences extended beyond preschool age.

Possible Reasons for the Performance Differences between the Two Sexes

Having discovered that the sex differences already appear at preschool age, it is important that possible reasons which cause them be investigated. That knowledge will help us to step beyond the sex differences description; to an attempt at their deduction (Thomas, 2000).

Biological Differences

As regards the growth in early childhood, according to Gallahue and Ozmun (1998), gender differences may be seen in terms of height and weight, but they are minimal. The physiques of male and female preschoolers are remarkably similar when viewed form a posterior position, with boys being slightly taller and heavier. The exception in that similarity is that boys have longer forearms (Thomas & French, 1985; 1987), greater joint diameters, smaller sum of skinfolds and more estimated arm muscle than girls (Nelson et al., 1986), a feature that contributes to the better performance of boys in throwing. However, in contrast with Toole and Kretzschmar (1993) who state that those small differences between the physical characteristics of the two sexes are, perhaps, large enough to have a significant effect on particular skills performance, both Thomas and French (1985; 1987) and Nelson et al. (1986) outbid for the importance of environmental factors on the motor performance.

Differences in Physical Activity

There is increasing evidence that motor performance and physical activity are related in childhood and adolescence (Fisher et al., 2004; McKenzie et al., 2004; Wrotniak et al., 2007). This probably happens because children with better motor performance find it easier to be physically active than children with poorer motor performance. However the relationship between these two variables is questioned under investigation (Pate, 2001). Du Toit and Pienaar (2002) attribute gross motor skills performance differences between boys and girls to their physical activity level (boys seem to be more active than girls) and to the type of play they choose. Specifically, boys prefer to play outside in competitive games or sports, while girls more often play inside in quieter games requiring fine rather than gross motor skills (McGuire, 1990). Eaton and Enns (1986) state that already in infancy, boys have a significantly higher physical activity level than girls; that difference becomes greater during preschool age. The above statement is closely correlated to the findings of Louie and Chan's (2003) study, in which physical activity trends among 148 young children aged three, four, and five years old in Hong Kong preschools were investigated, using pedometry. According to the results, boys were more physically active than girls.

Socio-Cultural Context

As long as the motor development occurs in a social context (family, school, etc), the implications of socialization need to be considered in order to avoid an overestimation of true sex motor differences. Each context forms specific requirements on the physical activities of children. Variation in rearing upbringing is frequently indicated as a significant factor influencing motor development during infancy and childhood (Malina, 2004). The impact of social stereotypes on boys' and girls' motor development seems to be of great importance. There is a general consensus among the researchers, that already in the first years of their lives, boys and girls are subject to a different treatment and it is these different experiences that are the most important contributory factors to the motor performance differences observed until puberty (Thomas & French, 1985; 1987; Ulrich & Ulrich, 1985). In infancy the child learns a set of appropriate behaviors and learns to inhibit behaviors that are considered out of character with the sex role. According to Malina (2004), during the first two years of life, motor development sex differences are not systematically recorded, but during the third year of age there are noticeable differences in some motor tasks, that persist into childhood.

In some societies, totally different anticipated roles for the two sexes are formed in the first years of children's lives (Al- Haroun, 1988; Nelson et al., 1986) affecting children's expectations for their abilities (Lee, Nelson & Nelson, 1988). Al –Haroun (1988) attributes the motor performance differences between Kuwaiti boys and girls found in his study to the social value judgments in Kuwait. He states that in Middle Eastern cultures, the female role appears more rigidly defined than in Western cultures, both influencing and limiting sex appropriate motor behaviors and opportunities to develop certain motor skills considered masculine (e.g. soccer is considered a male sport). This sex difference is further supported at school, as at age of 6 Kuwaiti children attend separate schools, as do many children in the Arab world.

Similarly Louie and Chan (2003) report that preschool boys in Hong Kong are more physically active than girls because, due to the Chinese cultural tradition, little girls are encouraged to engage in activities like playing the piano, crayoning and craft work that are mainly sedentary in nature. Boys, on the other hand, are allowed to engage in vigorous activities such as rough and tumble play. According to Du Doit & Pienaar (2002) gender specific are the main school and university sports in Potchefstroom, South Africa, too. Thus, rugby and cricket are practised mainly by males and netball and hockey are practised mainly by females.

In societies with the aforementioned features, both boys and girls may suffer from the stereotypes of their gender role. Girls, for example, may be scared of being rejected by both boys and girls in case they succeed in a sport "labeled" masculine, such as football (Cox, 1998).

Moreover, even in societies where both boys and girls participate in various sports, the qualitative differences in the opportunities the two sexes have during the physical activity, such as trainers' expectations etc., should be investigated (Butterfield & Loovis, 1993; 1994; Butterfield et al., 2003; Loovis & Butterfield, 1993). Encouragement, support, and extended opportunities are all positive consequences of movement experiences still more readily available to boys than to girls. This systematic "reward" system thus provides greater motivation for males than females to participate in the play-game type of skills and activities common to sports (Toole & Kretzschmar, 1993).

In close agreement with the "reward" social system seems to be Garcia's (1994) findings. He studied the behavior of preschool aged children during gross motor activities and found that a significant contributor for the gross motor superiority of boys is the aggressive and competitive style they adopt, contrary to girls who are characterized by a cooperative and helpful behavior.

Motor Assessment Tool Bias

It is well known that preschool children are "difficult" examinees, as they have inhibited or exaggerated performance, easily lose their concentration, are cautious with strangers and do not have a consistent performance when they are in an unfamiliar environment (Gallahue, 1983). Consequently, the assessment of children of this age requires both sensitivity for each child's background and knowledge of the restrictions of that particular age assessment.

Nevertheless, motor assessment tools are not free of bias. Gender bias can be a consequence of item selection. Statements of poor skill performance by one sex may be a consequence of the items included in the instrument and females in particular appear to be disadvantaged. As stated by Okely and Wright (1997), there is a gender bias towards boys in the selection of the tests receiving prominence in Australia. Most batteries are strongly related to skills integral to traditional male sports but are less associated with those which are essential to female activities.

Causgrove - Dunn and Watkinson (1996) investigated whether the Test of Motor Impairment (TOMI) (Stott, Moyes, & Henderson, 1984) contains biased items, using data from school aged children (grades 1 and 6). According to their results, many girls were found to be susceptible to awkwardness, because of their poor score in the catching and throwing tasks of the battery, two tasks that are more commonly practiced by boys.

It is obvious, that the assessment with biased tests incorrectly deduces that girls are poorly skilled, when in reality they may be no less skilled than boys, but rather skilled in different areas.

CONCLUSION

Are there gender differences in motor performance during preschool age? Unfortunately, the answer can not be a definite "yes" or "no". The research findings are conflicting, presenting boys having higher performance in some tasks and girls in others.

The first issue to be concerned about in the interpretation of these differences process, is the significance of the reported motor performance differences, as most of the reviewed studies do not report the effect sizes associated with sex. It is well documented that a statistically significant outcome does not give information about the size of the outcome. The *p* value is not an indicator of the effect size, and consequently, when a measure is not clinically valid a statistically significant outcome only describes a relationship that is unlikely to occur, assuming the null hypothesis is true. It does not reveal the extent of that relationship. On the other hand, the effect size is defined as the strength of the relationship between the independent variable and the depended variable (Gliner, Morgan, Leech & Harmon, 2001).

A sound example of the above is the two studies of Chow et al. (2001; 2006). In their first study, Chow et al. (2001) report statistically significant differences between Chinese boys' and girls' performance on several items of MABC (Henderson & Sugden, 1992). Five years later Chow et al. (2006) using the data of the aforementioned study and adding new ones, conduct a new project. This time, they report effect sizes and they conclude that the observed gender differences are not of any consequence.

In the reviewed studies, where effect sizes associated with gender are reported, their value is negligible. Therefore, concerns arise about how "real" the reported motor performance differences are. Apart from those concerns, a question arises too: "How much do these, perhaps unimportant, reported differences influence educators', teachers' and trainers' expectations which, in turn, affect children's performance?"

Trying to find the possible causes for the observed differences, first of all, it was examined and then concluded that preschool aged boys' and girls' biological characteristics are similar rather than different. Except for throwing, very little justification or accusation can be attributed to biology (Nelson et al. 1986; Thomas & French, 1985).

A significant factor for the formation of children's motor behavior is the socio-cultural context in which they are reared. In populations where cultural and sociological expectations differentiate between genders, larger gender differences in motor performance are often found. Consequently, when significant differences between preschool aged boys and girls are reported, they should be interpreted having considered the cultural context in which the study was conducted.

The assessment tool that is used in a study plays an important role too. In order to have a valid measure of a child's motor development an instrument free from bias should be applied. The items of a motor assessment battery have to be associated with both boys' and girls' activities.

In conclusion, although several researchers refer to sex differences, after comparing boys' and girls' motor performances it has become obvious that many of the differences are induced by factors outside children's sex. Agreeing with Thomas (2000), we believe that as those differences are environmentally and culturally provoked, we have to discuss gender differences. Taking into consideration the aforesaid, it is clear that the identification of motor performance differences between boys and girls should be only the first step. These differences will persist unless teachers, trainers, physical educators do not face them as biologically caused and consequently try to reduce them. If "significant others' " expectations with respect to children's motor behaviour and their encouragement for practice are not gender-associated and social labels, such as "gender-appropriate", do not follow physical activities, both boys and girls will undoubtedly reap significant developmental benefits.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 39-58

Chapter 3

ORAL IMPACTS ON QUALITY OF LIFE IN PRESCHOOL CHILDREN

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ABSTRACT

Oral health problems affect children's quality of life by impairing their physical and psychological and social functioning wellbeing. The main oral health related problem in preschool children is associated with dental pain that may affect sleep, cause difficulty in eating and affect learning. Sleep impairment and difficulty in eating in children contributes to malnutrition. Knowledge of oral and social problems that trigger pain can be used to establish preventive and treatment priorities.

There is new research on oral impacts in quality of life in preschool children. This chapter will explore how the mouth affects quality of life and the epidemiology of dental pain including the determinants of oral diseases. In addition, the chapter reviews strategies to promote oral health in preschool children.

Among oral health problems that may affect preschool children are dental caries, dental trauma, dental erosion, malocclusion and oral soft tissues lesions. There is a universal decline in the prevalence and severity of dental caries in children. On the other hand, dental trauma, malocclusion and enamel erosion are increasing in preschool children. New data are available on the lifecourse approach to the development of caries and malocclusion. As stated earlier, preschool children may be affected by dental pain from dental caries and traumatized teeth.

Recent reports highlight the clear association between dental caries and gingivitis and social economic status.

Traditional dental prevention carried out by dentists and dental personnel using the High Risk Strategy that targets children considered to be more prone to caries, have been relatively ineffective [1]. We will report on systematic reviews of dental health education. The development of oral health promotion policies for preschool children is especially important due to the possibility of positively influencing the acquisition of healthy behaviors and standards that are sustainable along the life course. Health promotion strategies aimed at the child is a responsibility not only of individuals, but of families and communities.

The main strategies to promote oral health for this group of children should be common risk factor approach (CRFA); integrating oral health promotion with general health promotion directed at diet, cleanliness and prevention of trauma. Public health approaches using the Whole Population Strategies, such as health promoting nurseries and schools, should have the highest priority. Chairside prevention directed at individuals should include improving include diet, particularly in relation to non-milk extrinsic sugars, improve oral hygiene, fluoride application, fissure sealants and mouth guards to prevent dental trauma.

INTRODUCTION

This chapter sets out to summarize what is known about the oral impacts on behavior and quality of life in preschool children. In addition we will review the main oral health problems affecting preschool children and in particular, the prevalence of dental pain. Strategies to promote oral health for this group of children will be and reviewed.

1. ORAL IMPACTS IN QUALITY OF LIFE – HOW CHILDREN ARE AFFECTED BY THEIR ORAL CONDITIONS?

Increasing concern about the multidimensional concepts of oral health has lead to the development of numerous theoretical concepts and measures of oral health related quality (OHRQoL), frequently referred to as socio-dental indicators [2]. Socio-dental indicators are defined as “measures of the extent to which oral conditions disrupt normal social role functioning and lead to major changes in behaviors such as inability to work or attend school, or undertake parental or household duties” [3]. They are considered as one of the crucial complements to clinical indicators [4]. In general, their theoretical frameworks represent the multidimensional character of oral health involving both biomedical and socio-medical concepts and convey personal and social outcomes such as physical, psychological, functional and social outcomes. Oral health-related quality of life (OHRQoL) measures are a significant component of measuring oral health and dental needs because the concept of oral health has been expanded beyond the absence of clinical disease [5, 6].

Health is a state of wellbeing in physical, psychological, social and intelligence dimensions. Therefore, a real goal of the dental profession should not be to promote disease-free mouths, but mouths that enable people to live physically, psychologically and socially acceptable lives. In other words, to have a better quality of life in general. Oral health should contribute that well-being and quality of life.

Oral health-related quality of life (OHRQoL) is a significant component of oral health and needs [4]. So, a priority should be to achieve a better oral health-related quality of life. Thus, the traditional normative method of measuring oral health and treatment needs based only on clinical indices is incomplete [7]. A number of socio-dental indicators or, as they have more recently been named, oral health related quality of life (OHRQoL) measures, were developed to assess subjective aspects of oral health [2].

Subjective needs or perceived oral impacts are considered as consequences of oral conditions. Oral health problems can affect an individual's quality of life by impairing physical, psychological and social functioning. Pain is the most frequently cause of oral impacts related problems in preschool children [8]. Poor dental health with associated toothache may contribute to children's low weight gain and on the growth and cognitive development of young children as well as on the quality of their lives [9-12].

A review of the possible effects of dental caries on failure to thrive (FTT) showed that in otherwise healthy children, severe dental decay contributed to FTT [13]. Two reports of improved weight gain following dental rehabilitation in cases of growth failure have suggested that removal of caries can lead to improvement in weight gain [10, 14]. Young children requiring multiple extractions of carious teeth had lower body weights than controls [15]. Dental caries affected the growth of young Turkish children; children with rampant or nursing caries were significantly lighter and shorter than controls without caries [9].

Acs et al. [14] also showed that the weight of children with at least one tooth with pulpal damage was significantly lower than control children; 8.7% of children with caries weighed less than 80% of ideal compared to 1.7% of comparison group. In Turkey the mean weight of children with caries was between the 25th and 50th percentiles compared to controls who were between 50th and 75th percentiles. Seven percent of cases and 0.7% of controls weighed less than the 20th percentile [9]. Following treatment of affected decayed teeth there was more rapid weight gain and growth velocity in the treated children [9-12, 14, 16-18]. Caries in primary teeth may affect nutrition and growth adversely in three ways. Toothache and infection can alter eating and sleeping habits and metabolic pathways. For example, the effect of low levels of dental discomfort on eating and avoidance of certain foods may affect dietary intake and sleep. Disturbed sleep may affect glucosteroid production. A mechanism whereby dental infection can affect growth is through chronic inflammation through a metabolic pathway. In addition, there is suppression of hemoglobin as a result of depressed erythrocyte production in the bone marrow which is well recognized to occur in inflammation.

Severe caries can affect children's quality of life, with significant changes before and after dental rehabilitation. These include pain, eating preferences, quality of food eaten and sleeping habits [19]. Children with early childhood caries (ECC) had significantly lower oral health-related quality of life (OHRQoL) than children without ECC as assessed both by the children and the parents/guardians at baseline [19, 20].

Although not all untreated dental caries affects general health, it significantly impacts on the quality of life of children and dietary intake. Untreated tooth decay results in a reduced quality of life expressed through pain, discomfort, disfigurement, acute and chronic infections [21]. The consequences of high caries levels include a higher risk of hospitalizations and emergency dental visits [22-25], increased treatment cost and time [26, 27], loss of school days and increased days with restricted activity [28-30], and a diminished ability to learn [31].

Research demonstrated the impact of severe dental caries and dental rehabilitation on a child's quality of life [11 19]. Low et al. [19] showed the effect of severe caries on the quality of life in young children as assessed by the child's parent/guardian. Acs et al. [14] and Thomas and Primosch [11] found that dental rehabilitation led to a significant improvement of the children's quality of life, as reported by parents. These improvements were less pain and improved abilities to eat and sleep.

There is a very limited amount of research into the prevalence of dental pain in preschool children. Assessing pain in this group of children is all the more difficult due to variations in cognitive abilities that affect how they perceive, understand, remember and report pain [32-34]. In addition, young children with dental disease do not necessarily complain of pain, in part because they do not fully understand the concept of dental pain and find it difficult to verbalize feelings of pain in a valid, reliable manner [32].

The prevalence, intensity and the impact of dental pain in 5-year-old children is high among Brazilian preschool children and other preschool populations [32]. Pain caused by caries can manifest itself in different ways: children may eat less, sleep less, and/or exhibit negative behavior. There was a significant change in complaints relating to pain, eating preferences, quantity of food eaten, and sleep habits before and after treatment dental caries [19]. A prospective cohort study of 739 children aged 2.8 to 6.2 years attending 50 dental practices in North West England showed that children with caries were very likely to develop pain or having a dental extraction. During the 3-year follow-up, 115 children had one or more episodes of pain, of which 91 had dental pain that was attributable to caries in primary tooth. However, restoring carious molar teeth did not necessarily prevent the occurrence of dental pain or decrease the risk of extraction. This study shows that restoring carious primary molar teeth does not prevent adverse outcomes of pain and extraction from occurring, or stop the disease process [33].

Some studies relate to elements of behavior disruption in children with dental pain, using parental reports. Leake et al. [34] have noted that parents of children with severe early childhood tooth decay reported a significantly greater impact on their children, namely, more pain and a decreased ability to chew than the parents of children with moderate disease or no caries. Dental pain had a significant effect on the well-being of the children, more than half report one or more negative impacts resulting from pain. According to Moura-Leite [32] the most commonly reported impact was "difficulty in eating", which was also reported in others studies.

Milson et al. [35] examined the relationship between dental pain and its sequelae, and the extent of restorative care provided for primary molars, amongst children who regularly attend a general dental practitioner. Almost half the children had at least one episode of pain. Total decay experience in primary molars was the principal predictor of pain, extraction due to pain and the need for antibiotics, whilst the level of restorative care in the primary dentition is less important.

Williamson et al. [36] characterized the behavior of preschool children who were caries-free and compared them with those who had significant dental caries, using the Child Behavior Checklist. The authors concluded that sleep problems, anxiety/depression, aggressive behavior, attention deficit/hyperactivity problems, and total behavior problems were significantly more prevalent in caries-active children than in caries-free children. No significant differences in behavior based on demographics of gender, age, or race were noted, or treatment at a private dental office compared to a low-income dental facility.

Edelstein and coworkers [37] described the experience of children, their families, and their caregivers with children's dental pain. Among children presenting to training programs with oral pain, 28% were under age 6, 38% were regarded by their dentists to have "likely or obvious" functional impairment, with 22% reporting the highest pain level. Pain, experienced for several days by 73% of children, was associated with difficulty: eating; sleeping; attending school; and playing. In addition, the authors found that parent-reported barriers to seeking dental care included: missed work (24%); transportation costs (12%); and arranging child care (10%).

Children are affected by their oral condition during a 12 month period and how this relates to the children's experience of caries, their dental attendance behavior and their social class [38]. The most frequently reported type of impact was pain in all age groups. Impacts on oral function, self-confidence, orally related activity and on the child's emotions were experienced by 4-10% of children of all ages. There was a group of children for whom oral function, self-confidence, orally related activity, emotions, social functioning, their health or their life in general were reported to have been affected by their oral condition. According to Filstrup et al. [20] children's self-reported oral health-related quality of life was significantly correlated with their oral health. Children with Early childhood caries (ECC) had significantly worse oral health-related quality of life than caries-free children. In addition, children with severe caries were ashamed of smiling and stopped playing with other children because of their teeth [39].

Measures of the psychosocial impact of dental conditions have been developed for school children [40-42]. Although, few studies have focused on psychological impact of oral health problems in preschool children. It is known that severe caries affects the quality of life of preschool children. Recommendations for research on functional outcomes and implications for this group of children are discussed later.

2. Oral Health Problems Affecting Preschool Children

The principal oral health problems that affect preschool children are dental caries, dental trauma, malocclusion, dental erosion and oral lesions in soft tissue (Figures 1-8). The following section reviews the concepts and causes of these oral health problems that are relevant to strategies for their control.

Currently, there is a decline in the prevalence and severity of dental caries in children in many countries. However, caries remains a significant dental public health problem in preschool children and is a common cause of tooth loss. Severe dental caries was the most common cause of dental pain in children [43]. The prevalence of untreated dental caries in children, particularly in the primary dentition is extremely high in many developing countries. A review of the dental literature reveals that 95% of the decayed primary teeth and 85-95% of the decayed permanent of children of low-income African and Asian nations remained untreated [44]. The risk of dental sepsis increased in untreated decay tooth [45].

Early childhood caries (ECC) is a particularly severe form of caries in young children. The interaction of some determinants causes caries. The levels of free sugars intake in most countries are too high and cause demineralization of enamel. Sugars are undoubtedly the most important dietary factor in the development of dental caries [46]. Some cross-sectional studies

have also considered tooth brushing habits and exposure to fluoride. They showed that sugar intake was positively associated with dental caries increment in the deciduous dentition [47-49].

Figure 1. Severe Early Childhood Caries in primary anterior teeth.

Figure 2. Frontal view - Dental caries and anterior open bite.

Figure 3. Anterior open bite in primary maxillary incisors.

Figure 4. Traumatic dental injury in a primary incisor.

Figure 5. Erosive tooth wear on incisors (Palatinal surfaces).

Figure 6. Frontal view – Clinical aspect of Gingivitis.

Figure 7. Natal teeth associated with tongue ulceration.

Figure 8. Clinical aspect of the eruption cyst.

Children are most likely to develop dental caries if the cariogenic *Streptococcus mutans* is acquired at an early age. A systematic review concluded that diet and oral hygiene may interact. If there is a balance of good habits by way of maintaining good plaque control and use of fluorides and bad habits by way of having a cariogenic diet, the development of caries may be controlled [50].

Data from a lifecourse epidemiological approach to the development of caries indicates that harmful social and biological risk factors in early life contributed to the development of a high level of dental caries in childhood [51]. This has implications for health policies, namely, that interventions to promote oral health should start in early life [51, 52].

Whereas there is currently a significant decline in the dental caries experience, the prevalence of dental trauma is increasing in preschool children. A recent literature review indicated that between 15.0–36.8% of preschool children had a traumatized tooth [53]. Dental injuries have a large impact on children's quality of life. Inn addition, there are long-term consequences of dental trauma, both in relation to the primary and permanent dentitions. However, treatment of traumatic dental injuries (TDIs) in primary dentition tends to be neglected [54].

Untreated TDIs also affect children's appearance, ability to eat and speak properly, socializing, and psychological well-being [55]. A case control study in southern Brazil showed that adolescents whose teeth had been esthetically treated for enamel/dentin fracture run a greater risk of presenting with oral impacts compared to adolescents that have never had dental injuries [56].

The causes of TDIs include a relationship between oral predisposing factors (e.g. overjet with protrusion and inadequate lip coverage), environmental (e.g. material deprivation, playground design) and human behavior factors (e.g. risk-taking children). Dental trauma has been linked to emotionally stressful conditions [57].

Lalloo and Sheiham [58] assessed the relationship between demographic, socioeconomic, family type and behavioral factors and childhood major and minor head and other injuries. The main conclusion was that boys and children who exhibit certain behavioral problems such as high levels of hyperactivity were significantly more likely to report major and minor injuries affecting the head region. Another report showed the association between attention-deficit hyperactivity disorder and dental trauma in children and adolescents [59, 60].

Traumatic dental injuries are preventable. A health promotion strategy for traumatic dental injuries involves three levels: the prevention of potential harmful events, the

prevention of dental injuries when a harmful event cannot or should not be prevented and thirdly, the prevention of the biological and socio-psychological impacts of dental injuries by optimal care. Dental treatment may restore the child's ability to enjoy food, tooth cleaning, smiling and showing teeth without embarrassment which contributes to emotional state and socializing [61].

Epidemiological studies have demonstrated that the prevalence and severity of malocclusion have increased. However, there is considerable variation in the results of malocclusion in preschool children, depending on the population surveyed and the recording method. It is known that the frequency of harmful exposures, such as finger and pacifier-sucking habits contributes to malocclusion prevalence. Peres et al. [62] assessed the early-life risk factors affecting anterior open bite. When a pacifier was introduced earlier in life, there was a high risk of developing open bite. The second most important proximate risk factor for open bite was presence of dental caries. Open bite in primary dentition was also associated with older mothers and early weaning. Environmental factors, such as the presence of deleterious oral habits as well as social class are associated with malocclusion in children [63]. Some types of malocclusions have an impact on quality of life in adolescents, especially in terms of satisfaction with appearance [64, 65].

Dental erosion is a problem in children. It must not be underestimated. Dental erosion is related to dietary intake, oral hygiene behavior, systemic diseases and salivary concentration of calcium and phosphate. Intrinsic sources of acid from gastrointestinal diseases may cause dental erosion [66]. The vastly increased consumption of acidic beverages in recent decades is often postulated as a cause of dental erosion in industrialized societies. Biological and behavior factors also are risk factors for dental erosion, however, these factors are rarely investigated in epidemiological surveys. Erosion reduces the size of the teeth and in severe cases leads to total tooth destruction and causes dental pain. Extensive erosion requires expensive restorative treatment – it commonly affects the front teeth and they then require expensive crowns for restoration of aesthetics and function.

Two other diseases, periodontal disease and oral mucosal lesions are related to quality of life in preschool children. About two-fifths of children perceived that bleeding and swollen gums caused oral impacts on their life, particularly in relation to difficulty cleaning [6]. Children who had difficulty cleaning their teeth because of gum inflammation are unlikely to achieve good levels of oral hygiene, because brushing may lead to bleeding, and their gum problems would undoubtedly persist or even get worse. Another common cause of dental problems in preschool children are natural process, such as spaces due to a non-erupted tooth or exfoliating primary teeth that may cause pain in preschool children.

There are relatively few systematic studies of the prevalence of oral soft tissue lesions in children. Moreover, not all studies used the same diagnostic criteria. Most of the reports of prevalence of oral mucosal lesions in children have been based on non-representative samples. Llewellyn and Warnakulasuriya [67] assessed the impact of stomatological disease on oral health-related quality of life. They found that patients attending an outpatient oral medicine clinic had significantly lower oral health-related quality of life than the general population on all domains and overall oral health-related quality of life scores.

Oral lesions frequently are the initial presenting signs of HIV infection, early clinical features, predictors of progression of disease and may be useful in staging of HIV and classification [68-70]. Lesions such as: candidiasis, hairy leucoplakia, Kaposi sarcoma, linear gingival erythema, necrotizing ulcerative gingivitis, necrotizing ulcerative periodontitis and

non-Hodgkin lymphoma, are associated with HIV infection seen in both developed and developing countries [71].

The oral manifestations of HIV infection have been an important component of the disease. At some point in the course of the disease nine out of 10 patients present with oral manifestations [72]. Oral soft tissue lesions were common in HIV-infected children [73]. Oral lesions related to HIV/AIDS follow a clinical spectrum, arousing suspicion of acute seroconversion illness (aphthous ulceration and candidiasis), suggesting HIV in the undiagnosed individual (candidiasis, hairy leukoplakia, Kaposi's sarcoma, necrotizing ulcerative gingivitis), indicating clinical disease progression and predicting development of AIDS (candidiasis, hairy leukoplakia), and marking immune suppression in HIV-infected individuals (candidiasis, hairy leukoplakia, necrotizing periodontal disease, Kaposi's sarcoma, long standing herpes infection, major aphthous ulcers) [74]. These lesions may be present in up to 50% of patients with HIV infection and up to 80% of those with AIDS [75]. Oral candidiasis is the most common opportunistic infection seen in all continents [76] and among HIV-infected children [70]. All AIDS patients had oral candidiasis (84.6%), herpetic lesions (53.8%), recurrent aphthous stomatitis (15.4%) and cheilitis glandularis (7%). All AIDS patients had severe xerostomia, and 15.4% had uni or bilateral swelling of the parotid glands. Similar results were reported by Okoje, Obiechina and Aken'Ova [77], Jonsson et al. [78] and Shiboski, et al. [76].The frequency and spectrum of oral manifestations, found that the most frequent lesions were candidiasis (32%), herpetic lesions (15%), cheilitis glandularis (3.9%), recurrent aphthous stomatitis (2%). The ulceronecrotic oral mucosal lesions in 11.5% of the patients manifested with pain, diarthria, dysphagia, and dysgeusia [79], in 2-15 year olds, 75% of the HIV- infected patients had oral-lesions compared with only 35% of the controls [73]. Candidal lesions made up 38% of the HIV-positive lesions; Linear Gingival Erytema was seen in 22% of the HIV-positive participants, whereas it was seen in only 3% of the controls. Median rhomboid glossitis was seen in 12% of the HIV-positive participants and in only on HIV-negative control. Hairy leukoplakia and necrotizing periodontitis were seen infrequently, but only in the HIV-positive participants, herpes simplex virus was seen in a low percentage of both HIV-positive (3%) and HIV-negative (2%). Kaposi's has been reported only from Africa and Latin countries. HIV-associated salivary gland disease has a high prevalence in Africa and Latin America, especially in the paediatric group [68, 80].

SIGNS AND SYMPTOMS

Oral Candidiasis

The manifestations of oral candidiasis are often mild, readily amenable to treatment, or regress spontaneously and are rarely seen beyond infancy in the absence of predisposing factors. Lesions are often characteristic of the pseudo membranous and eythematous types. In general these lesions are widespread and may be located anywhere in the oropharyngeal area.

Pseudomembraneous Candidiasis: Most common oral lesion, creamy white or yellow loosely adherent plaques located anywhere in mouth. Can be wiped off to reveal an erythematous surface with or without bleeding.

Erythematous Candidiasis: Multiple flat red patches on mucosal surfaces. Usually manifest in the palate or top of the tongue, occasionally on the buccal mucosa.

A variant is median rhomboid glossitis – red, smooth, depapillated area on the middle of tongue.

Treatment – candidiasis should be treated promptly and thoroughly with topical antifungal agents. Systemic therapy is used for lesions that do not respond to topical agents and for esophageal candidiasis or difficulty in swallowing.

Angular Cheilitis

Appear as fissures or linear ulcers at the corners of the mouth with varying degrees of inflammatory erythema. Hyperkeratosis and hyperpigmentation may be present peripheral to the fissure. Concurrent intraoral candidal involvement is a common clinical finding. These lesions are usually tender and slow to heal because of repeated opening of the mouth.

Herpes Simplex Virus Infections

The primary lesions of HSV infections in children may manifest as gingivostomatitis, and recurrent lesions are seen as vesicles on the vermilion border, which ruptures to form ulcers on the lips or appear as clusters of small painful ulcers on the palate and gingival. Tend to be chronic and may progress rapidly to cause extensive lesions and marked crust formations on the border of the lips.

Signs & Symptoms – fever, malaise, swollen and tender lymph nodes, and intraoral and perioral lesions of the gingival, hard palate and vermilion border of the lips, but ant mucosal surface may be involved. Initially presenting as vesicles, these lesions rupture and coalesce to become painful, irregular ulcers.

Treatment – early diagnosis and treatment of lesions are important in HIV-infected children with severe, long-standing, painful lesions as they may affect nutrition and hydration. Most herpetic lesions, even in HIV-infected children, are self-limiting. When lesions do persist, they can be treated with systemic antiviral agents.

Oral ulcerations

Ulcers on gums, hard palatal and edges of the lips, but any mucosal surface may be involved. Presents as vesicles, which rupture to become painful, irregular ulcers.

Recurrent Aphthous Ulcers

They occur in several different forms usually described as minor, major and herpetiform. The size of the lesion ranges between a few millimetres and 1-2 cm in diameter and may persist for weeks at a time. Lesions are painful and may interfere with mastication and swallowing. They tend to occur on the soft palate, buccal mucosa, tonsillar area and tongue.

Treatment- severity and location influence the choice of treatment. Topical steroid therapy is usually that first choice. Reinforcement of good oral hygiene is helpful.

Gingival and Periodontal Lesions

Linear gingival erythema (LGE) is the most common form, it presents as an intensely erythematous, linear band involving the labial marginal and attached gingival and may be accompanied by petechiae-like or diffuse red lesions.

Necrotising ulcerative gingivitis (NUG) and *necrotising ulcerative periodontitis (NUP)*. In NUG there is destruction of one or more papillae accompanied by necrosis, ulceration and/or sloughing. Destruction is limited to the marginal tissues. In the acute stage (ANUG), the gingival tissues appear fiery-red and swollen and are accompanied by yellowish-grey necrotic tissue that bleeds easily, pain and halitosis.

Treatment – HIV-related periodontal conditions should be treated with thorough oral hygiene including plaque removal, scaling and root planning. Irrigation with 1% povidone-iodine solution, 0.2% chlorhexidine gluconate mouth rinses as adjunct therapy to good oral hygiene, recommended that patients with pain and severe acute lesions be treated with antibiotics.

Parotid Enlargement

The glands tend to be diffusely swollen and firm without evidence of inflammation or tenderness. The swelling is chronic with unilateral or bilateral involvement, occasionally accompanied by xerostomia. It may be accompanied by pain.

Treatment – no definitive treatment is indicated for HIV related salivary gland disease, but affords should be made to relieve the symptoms of xerostomia.

Molluscum Contagiosum

Is a virally induced lesion of skin, mucous membranes and rarely the oral cavity. It is a benign condition presenting as pearly white, small, discrete and dome-shaped lesions. Children with HIV may develop numerous and unusually large lesions.

Treatment – lesions may be treated by surgical excision, but in most cases are self-limiting.

3. Strategies for Oral Health Care to Improve Oral Health and Quality of Life in Preschool Children

This chapter has reviewed oral impacts on quality of life in preschool children and the main oral health problems that may affect preschool children. Numerous oral health problems influence the quality of life significantly. Direct effects on health can be mediated by

behaviors linked to health. This section of the chapter reviews some strategies for oral health care and health promotion in preschool children.

The first years of life are particularly significant in establishing good oral health related tastes, routines and behaviors. Oral cleaning is related to general health behaviors. Toothbrushing is part of body hygiene, washing, cleaning and grooming habit which is copied from parents and friends and significant persons. Many social, psychological and educational variables influence oral cleaning behavior [81].

Parents should be advised to brush their children's teeth thoroughly twice a day using a small brush. Most children have insufficient manual dexterity to achieve effective plaque removal with a toothbrush until the ages of six to seven years.

Fluoride is an important preventive agent against dental caries and more efforts are needed to fluoridate the mouths of the majority of the population via optimum fluoride concentrations in water and affordable fluoride toothpastes. Exposure to fluoride alone will not control caries but, with reduction in intake of sugar slow levels of caries can be achieved [46]. A systematic review [82] showed that fluoride toothpastes in comparison to mouthrinses or gels appear to have a similar effectiveness for the prevention of dental caries in children. In addition, there is no clear suggestion that fluoride varnish is more effective than mouthrinses and the evidence for the comparative effectiveness of fluoride varnishes and gels, and mouthrinses and gels is inconclusive.

There is an overwhelming evidence of the association between sugars and dental caries. The frequency and time of consumption of sugars-sweetened foods and drinks have both been shown to be important factors in determining caries levels. Bedtime is probably the worst time to consume a sugars-sweetened drink or snack. Children who consumed both a sugary drink and snack in the hour before bed were found to have four times the number of decayed teeth compared to children who had neither. Sugars in pediatric medicines can also cause decay in chronically ill children.

There are specific diet recommendations for children. To reduce sugars consumption it is desirable to remove all non milk extrinsic sugars from infant and baby foods, fruit juices and vitamin preparations. Parents and carers of infants should be specifically warned against the practice of allowing prolonged drinking from a bottle or any type of feeder cup of any sugars-sweetened drink, including carbonated drinks, fruit based juices and natural fruit juice. If sugars-sweetened drinks are given to younger children, they should be very well diluted, taken preferably at meal times only and drinking times should be kept short. An open cup or beaker should be used, never a bottle. Lightly flavored bottled mineral waters are a preferable alternative to sugar-sweetened drinks, but a child's normal fluid intake should ideally be plain water or milk. General medical and dental practitioners should prescribe sugar-free medicines and parents/carers should request them.

In the Scientific Basis for Diet, Nutrition and the Prevention of Dental Diseases, the World Health Organization [46] detailed the following recommendations for prevention of dental diseases:

1) In the presence of adequate exposure to fluoride, the intake of free sugars should be limited to 15 to 20 kg per year. This is equivalent to 40-55g per day. In the absence of fluoride the intake of free sugars should be below 15 kg per year or below 40g per day. These values equate to 6% – 10% of energy intake.

2) The frequency of intake of foods containing free sugars should be limited to a maximum of four times a day.
3) There should be promotion of adequate fluoride exposure via appropriate vehicles such as toothpaste, water, salt, milk and tablets. It should be recognized the most effective means of delivering fluoride is by use of fluoride toothpaste. There is no consensus regarding the exact amount of fluoride that is optimum and that amount will vary with climate and nutritional status. The optimum level of water fluoride in temperate climates is 1ppm and 0.6 ppm has been suggested in tropical countries where intake of water is higher.
4) In order to minimize the occurrence of dental erosion, the amount and frequency of intake of soft drinks and juices should be limited.
5) To minimize the occurrence of fluorosis, there should be de-fluoridation of water supplies in areas with excess environmental fluoride.
6) To prevent enamel hypoplasia and the other potential effects of undernutrition on dental health (e.g. salivary gland atrophy, periodontal disease), there should be continued efforts to prevent undernutrition.

Considering all oral health problems, Evidence Based Dentistry (EBD) using proven methods to treat and prevent diseases should be adopted in daily routines. Nowadays, some recents Cochrane reviews state that contemporary information is insufficient to determine whether fissure sealants or fluoride varnishes are the most effective measures for preventing caries, although there is some evidence that pit and fissure sealants are superior to fluoride varnishes for the prevention of occlusal caries [83, 84].

The philosophy of Minimum Intervention Dentistry has been adopted in clinical practice. This philosophy is based on a wide range of innovations, technologies and treatment methods. However, which the dawn of new philosophies and publications, a systematic and comprehensive appraisal, following evidence-based principles in dentistry is needed [85].

The traditional of dentistry focuses on individual differences in biological characteristics, of disease, lifestyle and choices about health. Chairside prevention directed at individuals need improving including diet, oral hygiene, fluoride application, fissure sealants and mouth guards is not necessarily incorrect but is relatively ineffective. Traditional dental prevention carried out by dentists and dental personnel using the high risk strategy have also been shown to be relatively ineffective Rational strategies for oral health care should incorporate policies to control the determinants of the distribution of oral diseases, establish goals and strategies on evidence-based oral care and include incentives for dental health professionals to treat all people effectively and in a dignified manner [86].

Health promotion is an important component of public policies and represents an essential strategy for the improvement of health of the whole population. The fundamental basis is centred on the wide conception of the process from health to disease and the determinants of health. There is a substantial evidence of the significance of the role played by individuals, families and peers and environmental factors in the determination of oral disease and promotion of oral health in children. The development of oral health promotion policies in the home, the school and day care centres, may encourage socially oriented health related practices that facilitate possibilities for positive actions along the life course [87].

Concern with the education and health promotion of children under 5 year-olds is relatively recent, and is linked to the recognition of the rights of both children and women.

The day care centre, when appropriately organized, represents an educational space that is complementary to the family's that favours the physical, cognitive, and affective development of the child, needing an environment that provides conditions for this to happen. The day care centre environment is especially important for the development of oral health promotion policies in childhood [87]. For example, Rodrigues, Watt and Sheiham [88] and Rodrigues and Sheiham [89] demonstrated that preschool children attending day care centres with good dietary policies and guidelines developed less caries. In addition, the concept of WHO Health Promoting Schools can be applied to day care centres and nurseries to promote oral health in preschool children.

It is important to recognize the determinants directly related to oral diseases before the adoption of strategies for oral health care. Knowledge of factors that influence habits and behaviors is fundamental for dental professional. Once these determinants have been identified they should be incorporated into strategic planning. Oral health is seen as a part of general good health and well-being. Therefore efforts and strategies to improve oral health will be part of a Common Risk Factor Approach which focuses not on specific chronic disease and its prevention but on shared risk factors such as diet and cleaning behaviors [90].

By using the Common Risk Factor Approach dental strategies are integrated and are an integral part of strategies for general health promotion developed to prevent other common chronic diseases such as obesity, diabetes, heart diseases and cancers [90, 91]. For example, risk factors as diet, poor hygiene will affect levels of dental caries, periodontal disease, coronary disease, and many other chronic diseases. A large proportion of pre-school children consume considerable quantifies of soft drinks which have little or no nutritional value and are high in cariogenic non-milk extrinsic sugars. This has implications for children's dental and general health. Recommendations for drinks consumption should be included in food policy guidelines for pre-school children [92, 93].

Considerably more efforts and health promotion policies based on determinants of dental health, attitudes and behaviors are required to encourage implementation of preventive strategies in childhood to reduce oral diseases in preschool children and to avoid its quality of life consequences.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 59-68

Chapter 4

INVENTED SPELLING AND PERSPECTIVES ON SPELLING DEVELOPMENT: THE NECESSITY OF AN INTEGRATED COGNITIVE MODEL

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ABSTRACT

There are several models about the mechanism that make pre-school children evolve regarding the quality of their invented spelling. Ehri´s teorical perspective (1997) describes the development of children's spelling skills in terms of their increasing ability to map sounds of words to phonetically appropriate letters. According to this perspective, written language is conceived as an instrument for translating oral language and phonological awareness determines the precision of invented spelling. This model neglects linguistic variables that might influence children ability to analyse the oral and written language and also does not conceive children's reflection about written code as a factor of evolution. The constructivist perspective from Ferreiro (1988), emphasizes the importance of internal conflict between different criterion about the organization of the alphabetic code. For instance, the repetition of the same vowel in syllabic phonetised writing might cause a conflict in children's thinking with another criterion that they attaint, related with the variation of letters within the written word (e.g. Nunes Carraher and Rego (1984) cited a Portuguese-speaking child who spelled urubu 'vulture' as UUU). This conflict might lead children to analyse syllables in their phonemes and became a source for an alphabetic approach of writing. This and other conflicts are the main factor, from the point of view of this theory, for the evolution of children's conceptions about written language. However those mechanisms are described independently of children ability to analyse oral words or the frequency of words and the articulatory properties of phonemes that integrate those words. On the other hand, Polo, Kessler and Treiman (2005), think that that statistical learning skills exists from an early age. These skills are applied in learning to spell, as in other tasks. This perspective emphasizes that children's writing reflects the characteristics of the input to which they have been exposed as they try to find meaningful patterns in regularities of written language. These regularities give children information about graphical as well as phonological patterns of the language in

which they reflected their very early spellings. However, this perspective never analyses the nature of children thinking and how that reflects their approach to written language. It is quite important to create a model that integrates these several contribution.

ARTICLE

A large number of studies (Ferreiro, 1988; Pontecorvo & Orsollini, 1996, Robins & Treiman, 2008; Sulsby, 1989) have shown that the understanding of the abstract rules that underlie the organisation of alphabetic systems is a process that begins early on, via the informal contacts that children, little by little, make with written language. In their efforts to understand the meanings of graphic marks and via interaction with others (both peers and adults), children gradually ask themselves questions about the correspondences between objects and writing, about the graphic features of writing, and about the relationships between the oral and the written forms of language. In this way they build up unconventional ideas about the properties of writing and what it represents. Charles Read (1971) was the first author to use the concept of invented spelling while observing young children attempts to write down words. He was also the first to notice that exists some logic in children's early spelling and that logic changed over time according to children's literacy experiences. In general, he believed that invented spelling reflects a developmental progression of increasing sophistication as children become more adept at representing in print the sounds identified on spoken words. By his own words: "some non-standart spellings represent a more advanced conception of the task or the language than others" (Reid, 1986, p.47).

Almost fourty years after, the cientific interest on invented spelling increased since the children's early spelling can be seen as a window of their concepts and skills about literacy and about the written code. From the 1990's onwards various authors (Adams, 1998; Treiman, 1998) began to point out the interest of children's invented spellings as a mean of coming to understand the alphabetic principle, but the knowledge about the written code that children reveal in their attempts at writing has often been seen as just one more indicator of phonological awareness (Mann, 1993; McBride-Chang & Ho, 2005; Vale & Cary, 1998). This last point of view is being gradually abandoned. Nowadays it became more or less consensual that engaging in invented writing leads to the appropriation of the alphabetic principle because spelling is an activity that provides an interaction between a child's capacity to segment words into phonemes and his/her use of the graphic support offered by letters with which to represent them (Ferreiro, 2002; Ouzoulias, 2001) . Several investigations have shown that invented spelling fosters phonemic awareness, since children mobilize and apply activities involving metalinguistic reflection about speech as a function of their attempts to write down words. (Alves Martins & Silva, 2006; Silva & Alves Martins, 2002; Treiman 1998) At the same time invented spelling can promote the storage of orthographic information within lexical representations, beyond learning letter names and sounds (Quellete & Sénéchal, 2008a). In a recent research, Quellete and Sénéchal (2008a) provide evidence that invented spelling was a found to be related to orthographic awareness, namely they proved that the awareness of legal characters and awareness of permissible sequences in print predicted invented spelling beyond the sizable contribution of phoneme awareness.

The relevance of invented spelling is confirmed by an intervention study where the same authors (2008b) tested whether invented spelling plays a causal role in learning to read. Three

groups of kindergarten children participated in a 4-week intervention. Children in the invented-spelling group spelled words as best they could and received developmentally appropriate feedback. Children in the two comparison groups were trained in phonological awareness or drew pictures. Invented-spelling training benefited phonological and orthographic awareness and reading of words used in the intervention. Importantly, the invented-spelling group learned to read more words in a learn-to-read task than the other groups. These findings are in accord with the view that invented spelling coupled with feedback encourages an analytical approach and facilitates the integration of phonological and orthographic knowledge, hence facilitating the acquisition of reading (Alves Martins & Silva, 2006; Quellete & Sénéchal, 2008a).

It is possible to identify in literature several theoretical approaches and qualitative research that offered a comprehensive description of children's spelling evolution and that take into account the gradual sophistication in children's early spelling attempts. Polo, Treimam and Kessler (2007) refer three current approaches to the study of early spelling development in alphabetic writing systems: the *phonological*, *constructivist*, and *statistical-learning* perspectives. These theories differ not only on the perspectives about the phases of early spelling but most of all diverge on the mechanisms behind the evolution. The two first approaches present the progression on invented spelling through a stage models while the third approach does not, because, according to their point of view "an important implication of the statistical-learning perspective is that the same basic mechanism underlies spelling acquisition throughout development. This contrasts with the idea that children move through stages whose operative principles are divorced from those of previous stages" (Polo, Treimam e Kessler, 2007 p.14).

From the point of view of evolution, and in common to the *phonological* and to the *constructivist* approaches, children evolve from an initial level where spelling is not yet determined by linguistic criterion to an alphabetic phonetic spelling. However the names and characteristics of the phases these models describe differ significantly.

Authors like Ehri (1998), Firth (1985), and Gentry (1982) represent the so called *phonological* perspective (Polo, Treimam e Kessler, 2007). From the perspective of these authors evolution on spelling reflects a progression from initial non alphabetic markings to increased proficiency in capturing a word's phonology in print, to the emergence of conventional word-specific forms.

These theorists consider that children's first spelling attempts reveal no knowledge of letter-sound correspondence. Spelling attempts appear to be a random stringing together of letters of the alphabet. This initial stage is called by Ehri as *prealphabetic* phase and by Gentry as the *precommunicative* stage. In *partial alphabetic phase* (Ehri, 1998) or *semi phonetic* phase (Gentry; 1982) children begin to conceptualize that letters have sounds that are used to represent sounds in words. A letter name strategy is very much in evidence at this stage. In *full alphabeti*c phase (Ehri, 1998) or *phonetic* phase (Gentry; 1982) children are able to provide a total mapping of letter-sound correspondence and provide phonologically plausible spellings but only in *consolidated alphabetic* phase (Ehri, 1998) or *transitional* stage (Gentry, 1982) children adhere to basic conventions of orthography and produce conventional spellings.

Ferreiro (1988) is one of the most representative authors from the *constructivist* approach and she analysed the invented spelling of children who had not yet received any formal teaching in reading and writing. The results of her research led to the conclusion that

children's knowledge about written language evolves along a path with three essential levels of conceptualisation. The first of these levels can be characterised by the search for criterion that make it possible to differentiate between drawings and writing. Alongside this differentiation the child also works out criterion that makes a series of letters capable of transmitting a message. These criterions are the minimum quantity of letters needed to write and to read a word and the fact that one does not employ the same sequence of letters in different words. The second level involves a refining of the ways in which both qualitative (the diversification of the orders of known letters in children's attempts to write) and quantitative (the minimum number of letters required to make it possible to interpret writing) differentiation between chains of letters are achieved. This is necessary in order to ensure differences between the ways in which different words are represented. At these levels in their attempts at writing, children do not search for any correspondence between oral and written language and often spell words according to the size of the reference items — for example, by using more letters for words that refer to large items. On the third level children begin to relate oral to written language. This level begins with the search for equivalencies between letter elements and syllabic segments in words (the syllabic hypothesis). Via this type of relationship children begin to solve the problem of the correspondence between the whole of the word and its constituent parts. This conceptual level culminates in an understanding of the alphabetic nature of written language, preceded by an intermediate phase involving syllabic–alphabetic spellings, in which some of the phonemes in each word are not yet represented.

With a few differences derived from the particular characteristics of each language and with variations in the names by which the authors in question designate the various phases of evolution, this evolutionary path has been identified for a wide range of languages, including French (Besse, 1996; Chauveau & Rogovas-Chauveau, 1994; Fijalkow, 1993), Portuguese (Alves Martins, 1993), Italian (Pontecorvo & Orsolini, 1996), Hebrew (Tolchinsky, 1995) and English (Sulzby, 1989).

From a descriptive point of view, the *phonological* and the *constructivist* approaches differ in their conceptions about the nature of children's knowledge associated to their earliest attempts of writing (when spelling is not yet determined by linguistic criterion) and on their hypotheses about the way children began to connect oral units and print.

From the *constructivist* approach perspective (Ferreiro, 1988) on the earliest stages, and through exposure to print, children become aware of a number of salient graphic features, namely they understand that writing works differently from drawing, they reject that strings of identical symbols (e.g., AAA) are appropriate for writing and they decide that a minimum quantity of letters is needed to write and to read a word. These criterions reveal children's knowledge about the graphic nature of the writing system, but are quite neglected by the phonological approach on the correspondent *prealphabetic* phase or *precommunicative* stage.

On the other hand, the syllabic hypothesis (Ferreiro, 1988) is extremely important in *constructivist* approach for developmental progression on spelling. In addition to being the first manifestation of the understanding that print represents speech; the syllabic hypothesis calls the child's attention to the phonological similarities and differences between words. However for the phonological approach the process that leads children conceptual understanding that print is connected with oral segments is related with learning letter names. As children learn about letter names and sounds, they begin to understand the sound-symbolizing function of letters in spellings. At the dawn of this understanding, children are

able to represent only a few sounds in a word, generally a sound at the beginning or a sound at the beginning and a sound in the end of the word. For example, children may produce the letters *JL* for the word *jail* (Ehri & Wilce, 1985).

Evidence that knowledge of letter names helps children grasp how alphabetic writing represents speech comes from a study in which children were asked what letters would be used at the beginnings or ends of various words (Treiman, 1998). When questioned about initial letters, preschoolers were more likely to respond with the correct *b* for letter-name words such as *beach* than control words such as *bone*.

These differences are clearly associated with a different explicative mechanism that these theoretical approaches defend as the main source for the progression on invented spelling. Phonological perspective (Ehri, 1997) describes the development of children's spelling skills in terms of their increasing ability to map sounds of words to phonetically appropriate letters. According to this perspective, written language is conceived as an instrument for translating oral language and phonological awareness determines the precision of invented spelling. The fact that the coordination of these two types of knowledge is a necessary condition if children are to understand the systematic relationships between letters and sounds (Byrne, 1998; Byrne & Fielding-Barnsley, 1991, 1993), corroborates until a certain point this model. Children in literate societies acquire many skills in both domains well before formal reading instruction begins and that might influence the nature of their invented spelling. The development of phonological awareness is intimately involved in the evolution of invented spelling and some linguistic factors referred by research in this area must be considered. For instance the articulatory properties of the phonemes in the words that they have to write can also influence the quality of children's writing, inasmuch as some phonemes are likely to be easier to isolate within the flow of speech than others. For example, according to Liberman, Shankweiler, Fischer and Carter (1974), children become aware of vowels more easily than consonants and find it easier to identify fricative consonants than occlusive ones. Treiman (1998), Byrne and Fielding-Barnsley's (1991, 1993) work shows that it is easier to train children in relation to the phonetic identity of fricatives than to that of occlusives, because it is easier to produce these sounds in isolation. At the same time, in the written form it is easier to confuse phonemes which only differ from one another in their voicing than those which are only different in their articulation (Treiman, Broderick, Tincoff & Rodriguez, 1998). These linguistic factors undoubtedly have consequences in terms of the ease or difficulty with which pre-school children mobilize conventional letters in their attempts to spell.

Nevertheless, the way in which phonological awareness and the knowledge of letters interact with one another to enhance the development of alphabetic conceptions about the written code is not yet completely clear. Quite apart from anything else, this is because in a lot of the research in this area, children are dichotomously classified as readers or non-readers without conducting additional analyses of the extent of their knowledge about written language (Ferreiro, 2002).

Phonological perspective also neglects variables related with differences in writing systems and orthographies that might influence children's ability to analyze the oral and written language and also does not conceive children's reflection about written code as factor of evolution.

The research under constructivist perspective has been influenced by the methods and theory of Piaget. According to Ferreiro (1988, 2002), cognitive development is a constructive process since it implies the reconstruction of already acquired knowledge at new levels.

Piagetian's influence in this model is reflected, on one hand, on the fact that the understanding of the written code by children requires the resolution of logic problems and, on the other hand, by the role of cognitive conflict for evolution of invented spelling. For instance, the emergency of the syllabic hypothesis is a consequence of a logic problem that children have to solve related with the relationship between all of the words they intent to write down and its constituent parts. In order to solve that problem, children began to relate the print with oral syllables, since the syllable is the natural unit of articulatition.

As referred above, the cognitive conflict is considered the main mechanism of evolution and presents two modalities: conflicts between the input from the literacy experiences and the assimilation schemata built up by the subjects and conflicts between contractions on the results obtained by the mobilization of different assimilation schemata available on children. An example of this last conflict on spelling is the repetition of the same vowel in syllabic phonetised writing (for example, Nunes Carraher and Rego (1984) cited a Portuguese-speaking child who spelled *urubu* 'vulture' as *UUU),* might cause a conflict in children's thinking with another criterion that they attaint, related with the variation of letters within the written word. This conflict might lead children to analyze syllables in their phonemes and became a source for an alphabetic approach of writing.

One of the critics that may be done to constructivist approach is that the mechanism of conflict is described independently of the children's ability to analyze oral words or the frequency of syllables and letters that integrate written words or the articulatory properties of phonemes that are part of the words children intent to write down. One important aspect that is also worthy to be criticized is that when it comes to children who spell in accordance with the syllabic hypothesis, Ferreiro (1988) does not differentiate between those who establish the letter/syllable equivalence on a purely random basis and those who choose conventional letters with which to represent one of the sounds in a syllable. In this context, the facilitating effect of letter names and their relation to children's increasing ability to map sounds in the pronunciation of words with phonetically appropriate letters is not object of discussion, namely in what concerns to the assimilation of this kind of information to the previous children's schemata. This factor is clearly important for the beginning of phonologically plausible spelling. Besides the studies in English (Mann, 1993; Treiman & Cassar, 1997) referred before, the facilitating effect of letter names has also been found in studies conducted in other languages, such as Spanish (Quintero, 1994), Hebrew (Levin, Patel, Kushnir, & Barad, 2002), and Portuguese (Alves Martins & Silva, 2001, Cardoso-Martins & Batista, 2005). For instance in the case of Portuguese the effect is more accentuated for vowels than for consonants – the opposite to the case in English (Pollo, Kessler, & Treiman, 2005), and that might influence the frequency and the nature of conflicts children have to deal with in their attempts to write down words in syllabic phonetised writing.

In spite of the fact that they do not present a stage model, *statistical-learning* perspectives defend that statistical learning skills exist from an early age (Polo, Kessler and Treiman, 2005). These skills are applied in learning to spell, as in other tasks. This perspective emphasizes that children's writing reflects the characteristics of the input to which they have been exposed as they try to find meaningful patterns in regularities of written language. These regularities give children information about graphical as well as phonological patterns of the language in which they reflect it even in their very early spellings. This approach agrees with the constructivist idea that young children build up

hypotheses about the nature of writing before they understand that letters represent oral segments, namely related with graphic features of written words.

The idea that statistical properties of printed words and spoken languages influence children's spellings early in development, gives help to understand differences on invented spellings from different orthographies. In the case of Portuguese, young Portuguese-speaking children have been reported to produce more vowel- and syllable-oriented spellings than have English speakers. Pollo, Kessler and Treiman (2005) found that Portuguese words have more vowel letter names and a higher vowel-consonant ratio than do English words. The differences that we observed are attributable to quantitative differences in the languages and their writing and letter name systems.

However, this perspective never analysed the nature of children's thinking about the written code or how that reflects on their attempts to write. The learning process that is behind the *statistical-learning* approach is the same that is present in connectionist models, which have been tested mainly on fluent reading and writing. According to this view, children seem to have a passive role since learning involves modifying the connections between the units in response to exposure to a substantial number of examples (Seidenberg, 1997). The idea that children apprehend graphic regularities from exposition to literacy experiences is quite imprecise to characterize children's cognitive attitude towards the written code.

A comprehensive theory of literacy development should incorporate the study of invented spelling and the research about invented spelling must be open to the contributions of these several theoretical approaches. One example of attempt of theoretical and empirical integration is the work conducted by Alves Martins and Silva (2006, 2009). On their line of research, the authors tried to combine the constructivist point of view towards children reasoning with empirical research related with articulatory properties of phonemes and with statistical properties of printed words and spoken languages (in the context of Portuguese language). These authors (2006) organized various experimental studies in which they undertook intervention programmes designed to make the quality of preschool children's invented spellings evolve. More precisely, they carried out three studies (op. cit.) in which they worked with children who possessed different levels of knowledge about writing – children whose spelling still showed no sign of a relationship with the oral (grapho-perceptive spelling), children whose spelling possessed an underlying term-to-term correspondence between the number of letters and syllables, but whose choice of letters was still random (syllabic spelling without phonetisation), and children whose spelling also matched the syllabic hypothesis, but who chose the right letters (syllabic spelling with phonetisation). The intervention was similar in all three experiments and was based on the following methodology: after writing a few words, the children were confronted with the spellings of a child on the level immediately above their own (e.g. syllabic / syllabic with phonetisation), and they were asked to analyse the word orally and think what letters to use, to think about the two ways of spelling the word, to choose one, and to justify their choice. In this way metalinguistic thinking was induced at the level of speech, writing, and the relationships between them. The main cognitive activities involved were: predicting the number and the type of letters to be written, comparing the child's own spelling with spellings one level higher, evaluating which one was better, and justifying the spelling. This procedure led to a clear evolution in the quality of the children's invented spellings, and by the post-test moment many of them (particularly the ones whose initial spellings already displayed some form of correspondence with the oral) had started respecting alphabetic criterion in their writing.

This investigation was clearly conducted according to some constructivist principles since the authors stuck to the model of stages within that perspective and, at the same time, the experimental intervention with children was sustained by conflict. Using the same experimental paradigm, in recent studies, these authors (Alves Martins & Silva, 2009) tried to manipulate linguistic variables, taking into account the research conducted by *phonological* and *statistical-learning* perspectives. They, for instance, (op.cit., 2009) analyzed the impact of the characteristics of occlusive versus fricative phonemes used in writing programmes on the evolution of pre-school children's invented spelling. This study confirmed that conducting intervention programmes that work on pre-school children's writing leads to an evolution in the children's thinking about the characteristics of the written code. On the other hand, the results indicated that the number of words in which the initial phonemes were correctly phonetised in the post-test situation was higher in the case of the children in experimental group 1 – whose writing program had used the occlusive initial phonemes *[b]* and *[p]* – than it was for those in experimental group 2 – whose writing program had used the fricative initial phonemes *[f]* and *[v]*. So we might conclude that children's conflicts and reasoning about the nature of written code are influenced by the linguistic nature of words children try to write down.

In conclusion: research on invented spelling is a very promising area since invented spelling leads children to integrate knowledge from different areas, specifically phonology, orthography, and morphological processing (Quellete & Sénéchal, 2008b) . However, it is vital to incorporate the contribution of different theoretical models in order to build up a clear picture of children's evolution on invented spelling. It must also be highlighted that by definition invented spelling is a natural process that should be encouraged in educational sets.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 69-78

Chapter 5

SQUELCHING THE GIFT: UNWRAPPING THE DEVELOPMENTAL MILESTONES OF THE GIFTED PRESCHOOLERS THROUGH ACTIVITY AND BEHAVIOR ANALYSIS

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ABSTRACT

A child plays with a toy for 30 minutes before losing interest. While parents of an 8 year old might not be surprised, many parents of an 8 month are not either. Why? Parents and caretakers are often oblivious to the emergent indicators of giftedness.

What are the signs that a child might be gifted? How can developmental milestones be measured in preschool children who are gifted? Why is it even important to answer these questions? Early identification of gifted children in their preschool years will have a profound impact on their development, since many who work with preschool children "are not aware that if appropriate input does not occur during this sensitive period, potential talent may be delayed, reduced, or eliminated" (Biber, 1977). Thirty years after Biber penned those words, gifted preschool children are still misidentified and misunderstood. Too often, gifted children are misidentified as being hyperactive, a behavior problem, or having an attention deficit (Chae, Kim, & Noh, 2003). Unfortunately, identification of gifted preschool children is not as simple as giving a single test. In fact, because no reliable test for giftedness in youngsters yet exists, it is imperative that the behaviors of preschoolers be carefully examined for incipient giftedness. Research into the physical activities and behaviors of preschool children provides markers against which growth and development may be measured.

This chapter will outline the current research into the identification of gifted children based on observable behaviors. Using the authors' research into early indicators of giftedness in children, coupled with current neurological investigations, the chapter provides an analysis of the attributes of the gifted preschool child.

INTRODUCTION

One problem with the concept of giftedness is that there is no real agreement among scholars and researchers as to what it really is. Annemarie Roper defines giftedness as "a greater awareness, a greater sensitivity, and a greater ability to understand and transform perceptions into intellectual and emotional experiences" (1982, p. 21). The Columbus Group defines giftedness in greater detail as:

asynchronous development in which advanced cognitive abilities and heightened intensity combine to create inner experiences and awareness that are qualitatively different from the norm. This asynchrony increases with higher intellectual capacity. The uniqueness of the gifted renders them particularly vulnerable and requires modifications in parenting, teaching and counseling in order for them to develop optimally. (Columbus Group, 1991, p. 1)

Renzulli Defines Giftedness as Follows

Giftedness consists of an interaction among three basic clusters of human traits—these clusters being: above average abilities, high levels of task commitment, and high levels of creativity. Gifted and talented children are those possessing or capable of developing this composite set of traits and applying them to any potentially valuable area of human performance. (Renzulli, 1978, p. 180-181)

Yet another definition is given by the US Federal Government. This Federal Definition of Giftedness emerged from the Jacob K. Javits Gifted and Talented Students Education Act of 1988 (U.S. Congress, 1988) and is as follows: “Children and youth who give evidence of high performance capability in areas such as intellectual, creative, artistic, leadership capacity, or specific academic field, and who require services or activities not ordinarily provided by the school in order to fully develop such capabilities (PL 100-297, Title IV, Sec. 4103).”

By pulling the adjectives from the above definitions, a picture may be constructed of a gifted learner may as one who is aware, sensitive, intellectually able, focused, creative, and asynchronous in growth in all these areas. It is this latter characteristic that sometimes causes confusion for parents and teachers alike. A four year old child, who is able to read fluently, work simple mathematical equations and create games and plays, may have an emotional breakdown if people don't follow rules. In older children we may see a boy doing advanced trigonometry at the age of 11, playing piano at a high level, yet crying if asked to draw a picture while listening to some music; crying not because the music is sad or moving, but because he simply doesn't want to do the task. One of the authors had a teacher say to her, in response to a recommendation that an 11 year old girl be placed in a gifted environment "She’s not gifted. You should have seen her on the trip [to a foreign country for two weeks], she cried all the time because she couldn’t take being away from home." It is often the very fact that gifted children are so advanced in some areas that highlights a "deficit" in other behaviors, behaviors that may in fact be completely age appropriate.

IMPORTANCE

Why is it important to know if a young child is gifted? Won't a child who has advanced abilities simply meet his or her own needs? Isn't it over-reacting or being somewhat overbearing to want to know if a two year old is gifted? We would say no. If a gardener wishes to grow a plant, he or she will find out what kind of soil that plant will grow best in, what kinds of fertilizer it needs, how often and how much it needs to be watered, and what kinds of temperature it prefers. Some plants are very hardy and will grow anywhere, others have very specific needs. No matter what, each plant grows best in an environment tailored to its needs. How much more important it should be for us to determine the needs of our children in order for them to experience optimum growth.

The issue of IQ is often mentioned when discussing gifted children. Most experts in gifted education would agree that an IQ score of 130 and above would indicate giftedness. Such a score is at least two standard deviations above the mean, meaning that about 98% of the population score lower. Children who score 70 on an IQ test are determined to have special needs; 2% of the population would have an IQ at this level or lower. We feel strongly that just as a child 2 standard deviations below the mean needs special accommodations because of their learning differences, so too does a child with an IQ two standard deviations above it. Unfortunately, older children with such high IQs often want to fit in and appear "normal." They have the ability to hide or shade their giftedness and can sometimes coast along undetected. Younger children, on the other hand, tend to simply be themselves, without the desire to blend in quite so thoroughly. Therefore, determining whether or not children are gifted may in fact be easier when they are still preschoolers; they are not bored, haven't given up, and aren't trying to hide because of peer or gender pressure. Thus, if adults know the signs to look for, detecting giftedness in a youngster can help them on the path to better accommodations at school, and therefore a better learning experience.

It has always been intriguing that we have talent searches for athletes, and that when talented athletes are discovered, we put them into specialized programs where they can fully develop their potential. In terms of music, if a child is discovered who has an amazing ear for music, parents will often allow them to learn an instrument and teachers and schools will give that child special dispensation to go and perform. Hollywood sets up special education facilities for talented child actors so that they can develop their acting talent while at the same time pursuing their schooling in a "career-friendly" way. Does it not make sense to look for our intellectually gifted children and create programs for them also? Teachers and parents of gifted children would tend to agree with the idea of special programs or curriculum adaptations and accommodations for gifted learners. Morelock and Morrison (1999, p. 2) state that "if such children are not allowed access to the quality and level of stimulation they require, they can suffer emotionally and become anxious and demoralized."

It is also important to identify gifted children early in order to prevent a misdiagnosis of ADHD (Schetky, 1981; Whitmore, 1980). Gifted children typically have high energy levels, coupled with the need to find something complex enough to hold their interest. When they cannot find something that interests them, they may change foci several times - which may be mistaken for flightiness, or a short attention span. Compare the following:

BEHAVIORS ASSOCIATED WITH ADHD (BARKLEY, 1990)	BEHAVIORS ASSOCIATED WITH GIFTEDNESS (WEBB, 1993)
Poorly sustained attention in almost all situations	Poor attention, boredom, daydreaming in specific situations
Diminished persistence on tasks not having immediate consequences	Low tolerance for persistence on tasks that seem irrelevant
Impulsivity, poor delay of gratification	Judgment lags behind development of intellect
Impaired adherence to commands to regulate or inhibit behavior in social contexts	Intensity may lead to power struggles with authorities
More active, restless than normal children	High activity level; may need less sleep
Difficulty adhering to rules and regulations	Questions rules, customs and traditions

It is easy to see how a person untrained in the signs of giftedness might mistake it for ADHD. The indicators are very close. However, children with ADHD often have trouble staying focused on one thing. Gifted children may move rapidly from one topic to another, but they are capable of sustaining focus for a long time if the topic is of interest and has enough complexity to keep their mind engaged. How tragic though, for a child to be medicated due to misdiagnosis rather than being provided with encouragement and enrichment.

MEASURING MILESTONES

The first people to notice that there is something "different" about a child are usually the parents. Parents have first-hand knowledge of their children's development, personality, and characteristics. They know when their child spoke a first word, and what that word was. They know when their child made some profound or unusual comment, and what that comment was. They know when their child was first able to put a puzzle together, build a tower out of blocks, or paint a picture of a greyhound. Parents, however, may *not* know if those actions, milestones, or achievements are atypical, particularly if they have no other children or are bright or gifted themselves. While parental observations and insights are extremely important, parents may need input from other sources to help analyze their child's development. What children do in the home is usually accepted as normal and not unusual. Silverman (2002) noted that IQ scores of siblings are often within 10 points of each other. One mother related an incident about her son:

Joey was 8 months when we left him with a babysitter for the evening. He was in his walker and playing with a toy when the sitter answered the telephone and started talking. She told me that she kept an eye on him while she talked, but that the call lasted for over thirty minutes. Joey continued to play with his toy during the entire time. The sitter was amazed at Joey's attention span. She kept going on about how unusual this was. Joey was my first child and to be honest, I had always heard about the short attention span of babies and until this incident, I had no idea how unusual this was, I was actually looking forward to the day when he would play for longer periods of time.

Characteristic	Elaboration	Example
Attention span	Will soak up or look or learn a great deal; focus	As a baby, Julie always had to be facing out. She couldn't stand to be in a snuggly. She always wanted to be looking at something. She'd stare at something for the longest time, just looking.
High energy drive	Highly active and on the go, may not spend much time sleeping	Once Brennan started walking, it seemed he never stopped. He didn't need much sleep, and every day, he ran from one activity to another. Whatever he did, he put his whole body into it. Everyone told me to put him down for naps, but he never slept. If I put him down, he just spent the time talking and making up stories with his stuffed animals.
Independent	Insists on doing things own way	Michael would ask me how something worked. If he had his own theory, he would interrupt and explain why his ideas were right. He never wanted me to show him how to do anything. He would argue that he knew how to do it. Only after he had failed a couple of times would he be willing for me to show him how to do something.
Emotionally intense	Too bossy, knows the "Way things" ought to be done, has elaborate rules and frustrated with those who do not play by those rules	Sometimes he would get mad in preschool and storm away from his friends, yelling that they were cheaters because they didn't play right. I couldn't seem to get him to understand that everybody didn't always want to play the way he did.
Thinking and talking fast	Often provide too many details; try to explain what they are thinking, and can't get the words out fast enough when they begin to write	He went through a time when he developed a slight stammer. A speech therapist told us it was because he had so many thoughts to share, he couldn't get them out fast enough.
Outrage at injustice	Key words are: "That's not fair". This can be directed towards their own situation or they may be the advocate of others	Everything is an issue with him. He wants us to explain every decision. Even if we tell him that we understand why he did something (like becoming annoyed with his brother), he can't drop the subject. He will become very frustrated if we don't listen to his explanation. I keep trying to tell him that not everything is a big deal, but he will start crying because we aren't listening to his side. The truth is that after four children, I really don't need to listen to his reasons in order to sum up the problem.
Sense of Humor	Humor is more advanced. Children understand jokes at a different level and often seem out of step with their peers	I first noticed his sense of humor when he was about a year and a half. He was watching something on television and he just started laughing at all the right places. He went through the joke stage when he was about four. His first grade teacher told me that he "got" her jokes. Most of the other kids had no idea she was even joking, but he always understood the point.
Day Dreaming	Appears to tune out the rest of the world and may spend time thinking. When questioned, their thoughts reflect their strong imagination	I've noticed that sometimes when Callie is doing something, she will just stop moving and stare off into space. She used to do this as a toddler when she has supposed to be taking a nap. When I ask her what she is doing, she always says, "Just thinking". Later, she will share with us her stories or theories about how things work. I am always amazed that such a little girl can think about these things.
Learn quickly Learning is fun	Highly focused on a topic, wants to know everything	As a baby, some toys did not last very long. She would look at something for a long time and might play with it for a little while, but once she was done with it, she would never go back to it. It's as if she had figured it out and then was bored with it.

Characteristic	Elaboration	Example
Carry out multi-step directions at an early age	Remembers procedures or steps when learning new process	Until I started teaching fourth grade, I didn't know how unusual it was that Scott was only four and could be told to pick something up, put on his shirt, and bring his shoes downstairs. He would do it and never had to be reminded. I taught fourth graders who couldn't follow more than one step at a time without getting confused.
Curious about advanced concepts; Complex ideas	May not learn in an organized, orderly fashion; Asks many questions	I thought we were prepared for the "Why" stage, but Matt's questions never seemed to stop. He just kept pressing for more information. Sometimes, after we talked about something, it might be it would be a couple of months later when he would bring up the subject again, and just amaze us with the connections he had made.
Memory is very good	Remembers details and facts	Katie was four when we were talking about a trip we were going to make. She reminded me that she had already been there. She started giving me details of her last visit there. She was only 2 when we had been there.
Large vocabulary, early vocabulary (Hearing/speech problems can mask this)	Large early vocabulary, more words that average, advanced words; Some children wait and begin speaking in full sentences	We were watching one of the Star War movies in the theater and when one of the space ships came on the screen, I asked my husband if it belonged to the good guys or the bad guys. The three year old next to me said, "It's the devastating imperial starship cruiser."
Learns to read early or shows interest in reading.	Likes to be read to by others. Some children begin teaching themselves to read Some are not ready to read and then blossom, while other read at an early age.	Ethan was three and a half when he read aloud his first book. We were amazed that he taught himself to read. When he was four, the first and second grade teacher let him be a guest reader during "I love to Read Week".
Develops/discovers patterns	Makes connections and may discover patterns:	Danny was around 5 when he told his father that there were many colors in the night. First the sky went to green dark, blue dark, purple dark, and then black dark.
Imagination	Makes up stories, may be very complicated, may use stuffed animals or dolls, cars, or create own "actors" out of objects; may have several imaginary friends and create elaborate stories about them	She has over fifty stuffed animals and they all have names, special powers, and she uses them in her stories. She expects me to know all about them and sometimes I feel as if I need a book to keep all of them straight. I am amazed that she can.
Intense Physical Sensitivity	May react strongly to textures, tastes, environmental noise; May not like the feel of clothing or the blankets	When she was a baby, she would often cry when I wrapped her in a crocheted blanket. As she got older, I had to cut the tags out of all her clothes because she complained about them.
Empathy	Goes beyond understanding the feelings of others, child may seem to absorb and internalizes the feelings	When he was in preschool, if one child started crying, he would too. He told us that it was because he knew how they felt. As he grew older, if his friends became depressed, he became depressed. High school was especially tough because on top of his own emotional roller coaster, we lived with his friends' problems, too.

Those who work with young children on a regular basis; teachers, daycare supervisors, babysitters, may have important insights to share with parents. They see children in the context of groups and may therefore see differences more clearly. However, the majority of teachers have not had training in identification of the gifted, so they may not realize what it is that they see. Teachers need to be cognizant of the characteristics of gifted children.

Justin's preschool teacher told me that there was something different about him. That he seemed to be very different than the other kids. I asked if he was ready for kindergarten. She said, "Yes, he's ready. He knows the material, but there is just something that doesn't seem right." I really worried about this for the next two years, imagining all sorts of things that might be wrong with him. Sometime around the middle of first grade, his teacher told me she thought he was gifted. Later, when he was tested, we discovered that his IQ was very high. When I think of the anguish I went through, wondering what was wrong with my son . . .

Intelligence tests can be used to obtain a measure of ability, although some research has shown that the results of these tests may not always be reliable as a result of various factors such as retesting, practice (familiarization), test administrator, time, and place. However, as a piece of the whole (including parent and teacher observation, achievement tests, and rating scales), these can be useful. Some of the more common IQ tests used with preschoolers include the Wechsler Preschool and Primary Scale of Intelligence (WPPSI). This test is designed for children ages 2 years 6 months to 7 years 3 months and gives both subtest scores and a composite IQ score. Other commonly used IQ tests include the Slosson Intelligence Test, Stanford Binet Intelligence Scale, and Raven's Progressive Matrices. The Gesell Developmental Schedules can be used to measure intellectual ability in infants as young as 4 weeks, and as old as five years. However, they were originally developed to measure developmental progress and to identify youngsters with retardation or impairments.

Developmental checklists can be very useful in identifying gifted children. While early development is not necessarily a definitive sign of giftedness, many parents of gifted children do report early development in different areas. One of the authors of this chapter reports a story told by her mother of how, as a baby she was walking at 9 months, and talking very early. However, her mother babysat a boy a week younger than her and at 15 months was not walking, yet speaking in complex sentences with advanced vocabulary. He, at 28 years of age, became the equivalent of an assistant professor at a prestigious British university while the author was much older when she finally reached the same goal.

CHARACTERISTICS

Gifted children are often misidentified and misunderstood. If a toddler is reading by 11 months, the identification of high IQ is pretty obvious. However, not all gifted children fall into the profound range. Many parents may think that their child is unusual, but often explain it away, believing that unless their child has produced something significant, the term designation of gifted does not apply (Silverman, 2002). Mothers or other early caregivers are usually in the best position to identify a child as gifted because of the amount of time they spend with a toddler. The preschool/toddler years are critical to understanding not only how a child learns, but the capabilities for learning.

The first step for caregivers is to spend time observing the child. This is the easiest source of data. Only by observing what and how children are interacting with their environment can their activities be analyzed. In the early years, it is critical for caregivers to understand how children. Most parents of gifted children are slow to recognize a child as gifted. One reason is because parents, especially first time parents, may not be aware how unusual their child's abilities are compared to other children. When parents do suspect their child might be gifted,

they tend to downplay their child's skills, finding excuses for the precociousness their child exhibits. Not wanting to seem to be bragging, many parents find themselves making excuses for their child's abilities (Silverman, 2002). Pre-school teachers or other early caregivers can play a crucial role in the identification of gifted children because their observations often validate parent's suspicions. Most of the literature on identification of gifted children provides examples of characteristics which are sometimes difficult to apply to preschool children (Lovecky, 2000; Palmer, 2006; Parke & Ness, 1988; Porter, 2002; Rogers, 2002; and Silverman, 2002).

ACTIVITIES

When gifted children are at play, their imaginations are fully engaged. If they are lucky, the other children in their playgroup will be willing to follow their lead. These children invent games and stories and pull their friends into their stories. Many young children put on plays, using toys and stuffed animals as actors if they need extra players.

Our sons, who were both gifted, would create costumes out of anything. We were always surprised at their creativity. They wanted us to video tape their plays. One would narrate the story while the other would adlib dialog. I made extra capes for neighborhood kids so that when kids came over, everyone could participate. Although the other kids were willing to act, I can't remember a time when one of boys wasn't the director.

Playing games with gifted children can be difficult. As young children, their fine and gross motor skills will not match their intellectual capabilities. For some, their internal picture of perfection may not match their capabilities. Not living up to the high standards they have set for themselves can be very frustrating. It is not only the problems of their own high standards that may plague the playground. Gifted children are usually out of step with their peers. Most preschool children are very flexible about rules and how games should be played. However, most gifted children become aware of rules and expect everyone to follow them to the letter. They become frustrated when other children do not follow the rules.

Christopher was in kindergarten when he invented a game called “the dogcatcher.” Everyone played it, and it was really popular. One day his teacher told me that he had spent the whole recess crying because the other kids weren’t playing by his rules. The game had become a chase game and the rules he had carefully worked out were ignored. He couldn’t get past the fact that the other kids weren’t following “the rules” and were cheating. His teacher tried to talk to him, but she told me that no matter what she said, he just kept crying and saying they weren’t following the rules.

Video games often become the focus for many gifted children. The more complex the game, the better they enjoy the challenge. Children will learn and remember all of the characters, their special attributes, and their conversations will be peppered with references to the game.

One day my boys came to me with a stack of drawings. They had created a video game based on the Animaniacs cartoon series. They had drawn all of the levels, worked out character details, and had the game all planned out. It was very elaborate. They wanted me to send it all to Steven Spielberg. I think they were 7 and 8 years old at the time.

CONCLUSION

Raising a gifted child can be difficult. The special needs of gifted students are rarely recognized by the educational system and many gifted children are not identified (Silverman, 2000). The preschool years are critical for intervention. Acceleration is best when it occurs in the early years (Barbour & Shaklee, 1998; Rogers, 2002). As early as preschool, gifted children, especially girls, will often cover up their abilities in order to blend in with their peers (Martinson, 1973; Parke & Ness, 1988; Silverman, 2000). Early identification of gifted children by either teachers, parents, or other caregivers is crucial to making sure these children's educational, social, and emotional needs are met. Many of the characteristics are misunderstood, overlooked, or explained away. More research is needed in order to understand how to identify gifted children before they begin formal education.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 79-90

Chapter 6

ASSESSMENT OF COGNITIVE AND MOTOR DEVELOPMENT AMONG RURAL HEAD START PRESCHOOLERS

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ABSTRACT

This chapter presents data from a study that examined cognitive and motor functioning in rural Head Start preschoolers. The participants were 122 preschool children enrolled in a county Head Start program. The following tests were administered to the children: Bender Visual Motor Gestalt Test, a short form of the Wechsler Preschool and Primary Scales of Intelligence-Revised, Test of Gross Motor Development-2nd Edition, and the Boehm Test of Basic Concepts-3rd Edition Preschool. Results indicate that these Head Start preschoolers function at a lower cognitive level than average preschoolers, based on comparisons to test norms. However, these preschoolers' gross motor skills were well above average, contradicting prior research that Head Start children also suffer from motor deficits. Correlations between tests and the potential implications of these findings are discussed. While the purpose of Head Start is to help prepare these children for school in order to reduce the likelihood of failure, the present research indicates some specific areas that educators should target within this population. In addition, the advanced motor skills demonstrated by the children in the present study may be utilized in the development of activities and games that promote cognitive development.

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Keywords: Head Start, disadvantaged preschoolers, cognitive development, motor development

INTRODUCTION

The Head Start program in the United States was developed in 1965 to provide developmental services to low-income preschool children (Fact Sheet, 1999). The services provided include parent and child education, health awareness and maintenance, and social services. The premise of Head Start is that these low-income children are disadvantaged and at risk for academic failure (Kirchhoff, 1998). Indeed, studies have found that Head Start children have lower IQ's than their higher-income peers (Greeson, 1981; Lee, Brooks-Gunn, & Schnur, 1988; McCarver & Ellis, 1972; Oakland, King, White, & Eckman, 1971).

Little research has examined the motor development of Head Start preschoolers as compared to their more advantaged peers, but the little available research suggests that Head Start children are also deficient in perceptual and motor skills (Rice, 1971). Thus, it appears as though Head Start preschoolers face potential delays in areas of both cognitive and motor development (Lee, et al., 1988).

In addition, much of the research has been done with somewhat urban populations of Head Start children (i.e., Adams & Lieb, 1973; Ainsa, 1989; Lamp & Traxler, 1973; Oakland, et al., 1971; Rhodes, Whitten, & Copeland, 1997). Very little work has been done to examine the functioning of rural Head Start preschoolers, who may suffer from additional hardships due to limited resources, physical distance from such resources, fewer social interactions, etc. The present sample consists of Head Start children from a rural county in northern West Virginia and may provide a point of comparison against prior research done in this area.

There are surprisingly few studies that examine the performance of Head Start children on standardized tests, especially more recent and updated versions of these tests. This paper presents baseline data from a study examining the effect of computer use on Head Start preschoolers' abilities, as measured by standardized assessments. The current study examined Head Start children's performance in the domains of cognitive and motor development as compared to standardized norms, while also examining familial factors that relate to differences in the children's performance.

METHOD

Participants

The participants for the present study were 122 preschool children enrolled in the Head Start Program in Monongalia County located in northern West Virginia. The Monongalia County Head Start Program is operating in eight sites serving 181 families. The majority of the families (90%) enrolled into the program met with federal income eligibility. There were 134 students enrolled in the Monongalia County Head Start Program for school year 2001-2002. Of the enrolled students, eleven did not participate in the current study for various legitimate reasons (i.e., five children with significant developmental or behavioral problems;

four were consistently absent and not available for testing; one was enrolled after testing had completed; one child refused to participate; and one was not tested due to teacher's concerns).

The participants consist of 57 boys and 65 girls, with a mean age 4 years, 4 months (range 3 years, 2 months to 5 years, 1 month). As shown in Table 1, approximately 82% of the mothers had completed at least high school, while approximately 74% of the fathers had achieved this same level of education. The majority of these families were low-income homes, with a median annual income of $11, 662 (range $0 to $62,000). One-quarter (n=30) of the participants also attended Early Head Start or Head Start in previous school year. All children were participating in a randomized controlled experiment designed to examine the effect of computer use on preschoolers' cognitive and motor development; the present findings are based on the baseline assessments conducted for this study. The study protocol was approved by the Institutional Review Board at the West Virginia University.

Table 1 Sample Characteristics

	Overall	Boys	Girls
N (%)	122 (100%)	57 (47%)	65 (53%)
Age in months (SD)	52.09 (6.05)	52.09 (6.56)	52.09 (6.49)
Number of over-income families (%)	13 (11%)	8(14%)	5 (8%)
Median family income (in dollars)	11,662	12,000	11,588
Median family income[1] (in dollars)	10,340	10,296	11,220
Years in Head Start (SD)	1.25 (.43)	1.18 (.38)	1.31 (.47)
Number of younger siblings (SD)	.61 (.70)	.61 (.70)	.60 (.74)
Number of older siblings (SD)	1.04 (.99)	1.18 (1.06)	.92 (.91)
Mother completed high school	97(82%)	45(82%)	52(81%)
Father completed high school	81(74%)	39(75%)	42(74%)

Note: 1. Over-income families were removed from this calculation.

Measures

Family Demographic Characteristics and SES. Parents of participating children were asked to complete a brief family survey during Head Start pre-enrollment home visits. The survey contained family demographic information (e.g., number of young and older siblings living in the same household) and children's years in Head Start. Each family also provided information regarding family income, education attainments and occupations of both the father (male guardian) and the mother (female guardian).

Bender Visual Motor Gestalt Test (Bender). The Bender Visual Motor Gestalt Test (Clawson, 1999) was used to assess children's visual motor development. To administer this test, children are shown 8 cards one at a time, each with a figure on it. The children are asked to draw each figure as best they can. When the child has completed one figure, the tester moves to the next card. Children's drawings are then scored by assigning one point for each significant mistake that is made (e.g., perseveration) such that higher scores indicate lower levels of visual motor development.

Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R). A short form of the WPPSI-R (Wechsler, 1989) with four subtests (i.e., information, block design, picture

completion, and similarities) was administered to the children in the present study due to time constraints of assessment. Sattler (1992) found significant correlations between estimates of IQ based on this short form and IQ scores based on the full WPPSI-R. The information subtest involves asking children to identify pictures of everyday objects and to answer questions about everyday information; children receive a score of 1 for each correct answer and 0 for each incorrect answer. For the block design subtest, children are asked to copy designs either from a design made by the tester or from a design in a book. Children can receive a score from 0 to 4 depending on how quickly they complete the design. The picture completion subtest involves showing children an incomplete picture and asking them to identify the missing part; children receive a score of 1 for correct responses and 0 for incorrect responses. Finally, the similarities subtest involves having children identify similar pictures and then also explain similarities between items; children receive a score of 0 for incorrect responses and 1 for correct responses on most items. Children's scores range from 0 to 2 on the last part of this subtest based on the sophistication of the child's response. Raw scores are computed for each test and then converted into standard scores. The child's estimated IQ is based on the sum of the child's standard scores (Sattler, 1992).

Test of Gross Motor Development—2nd Edition (TGMD-2). The TGMD-2 (Ulrich, 2000) measures children's gross motor abilities in the following two areas: locomotor (running, jumping, etc.) and object control (catching, hitting, kicking, etc.). To administer this test, the tester demonstrates each action and asks the child to repeat it twice. The child receives credit for various aspects of the action. A child's scores for each action are summed and all actions within a subtest are then summed; this raw score is converted to a standard score and percentile. The two subtest standard scores are summed and then converted into a total gross motor quotient and percentile.

Boehm Test of Basic Concepts-3rd Edition Preschool (Boehm-3 Preschool). This test (Boehm, 2001) is designed to assess children's understanding of basic concepts relating to size, direction, position, time, quantity, and classification. To administer this test, the tester shows the child a picture and reads a corresponding statement. The child is asked to point to the part of the picture that best matches what the tester says. The child receives a score of 0 for an incorrect response and 1 for a correct response. The raw score is converted into a percentile and into a performance range score (1 = good; 2 = average; 3 = poor).

Procedure

Written informed consent and family demographic information was obtained from the parents prior to the start of the 2001-2002 school year. The parents were informed about the purpose of the study and scope of the assessments. Trained psychology graduate students tested the children during school hours; each child was tested on only one test at a time, although some children were administered the Bender and Boehm-3 Preschool (both are relatively short in length) at the same time. A licensed clinical psychologist at West Virginia University provided assistance with retraining the graduate students and supervised the assessments.

Statistical Analysis

Mean scores were calculated for derived scores on each of tests. Inter-test correlation was assessed using the Pearson Product Moment Correlation Coefficient. Student T-tests were employed to explore the association of test scores with individual and family characteristics.

RESULTS

Test Performance

As depicted in Table 2, children's scores on the Bender ranged from 5 to 21. The mean score was 13.84 (SD = 2.86). There are no percentiles scores for this test.

Table 2. Mean Test Scores by Gender

Test	Overall	Boys	Girls
Bender	13.84 (2.86)	14.35 (2.59)	13.42 (3.01)
Boehm-3 Preschool			
Raw score	34.26 (9.65)	33.27 (9.68)	35.16 (9.61)
Percent correct	65.44 (18.54)	63.50 (18.56)	67.19 (18.49)
Performance range	1.92 (.84)	1.98 (.86)	1.87 (.82)
Percentile	29.75 (26.46)	26.66 (23.21)	32.52 (29)
TGMD-2 Locomotor			
Raw score	35.56 (8.58)	36.02 (9.14)	37.03 (8.10)
Standard score	13.72 (3.44)	13.65 (3.75)	13.77 (3.17)
Percentile	81.03 (21.43)	78.19 (23.63)	83.52 (19.16)
Age-equivalent	6.90 (2.17)	6.86 (2.43)	6.93 (1.93)
TGMD-2 Object control			
Raw score	33.62 (6.20)	34.81 (6.59)	32.58 (5.69)
Standard score	13.79 (2.30)	13.22 (2.30)	14.29 (2.21)*
Percentile	84.69 (15.94)	81.13 (18.51)	87.76 (12.67)*
Age-equivalent	6.58 (1.57)	6.37 (1.65)	6.77 (1.49)
TDMD-2			
Quotient	122.53 (14.29)	120.61 (15.61)	124.19 (12.94)
Percentile	87.20 (18.28)	84.04 (19.47)	89.95 (16.84)
WPPSI-R Block design			
Raw score	13.72 (5.57)	13.16 (5.80)	14.22 (5.36)
Standard score	8.24 (2.71)	8.00 (2.82)	8.45 (2.60)
WPPSI-R Picture completion			
Raw score	13.72 (5.57)	13.16 (5.80)	14.22 (5.36)
Standard score	10.33 (3.23)	10.97 (2.86)	10.67 (3.04)
WPPSI-R Information			
Raw score	12.10 (5.37)	11.51 (5.13)	12.62 (5.55)
Standard score	7.84 (2.37)	7.47 (2.06)	8.17 (2.59)
WPPSI-R Similarities			
Raw score	8.56 (5.33)	7.14 (4.57)	9.80 (5.67)**
Standard score	8.46 (2.32)	7.75 (2.01)	9.08 (2.41)***
WPPSI-R Performance			
Standard score	18.91 (4.88)	18.33 (5.40)	19.41 (4.36)
WPPSI-R Verbal			
Standard score	16.30 (4.14)	15.23 (3.59)	17.25 (4.38)**
Estimated IQ	91.35 (12.31)	89.07 (12.39)	93.35 (11.98)

* $p < .05$, ** $p < .01$, *** $p < .001$

The percent of Boehm items correctly answered by children ranged from 15 to 96, with a mean of 65.44 (SD = 18.54); the mean raw score was 34.26 (SD = 9.65). Children's percentile score on the Boehm ranged from 1 to 99, with a mean of 29.75 (SD = 26.46). Approximately 31% of the children received a performance range score of poor, while approximately 30% received a score of average; the remaining 39% of the children received a good score on the performance range. The mean performance range score was 1.92 (SD = .84).

Because a short form of the WPPSI was used, only estimated IQ scores can be obtained. The estimated IQ of the children in this study ranged from 63 to 119, with a mean estimated IQ of 91.35 (SD = 12.31).

Percentile scores on the locomotor subtest of the TGMD-2 ranged from 0 to 99, with a mean of 81.03 (SD = 21.43), while percentile scores on the object control subtest ranged from 5 to 99, with a mean of 84.67 (SD = 15.94). The mean gross motor quotient score was 122.53 (SD = 14.29; range 64 to 148) and the mean gross motor percentile score was 87.20 (SD = 18.28; range 4 to 99).

INTER-TEST CORRELATIONS

As shown in the upper part of Table 3, Bender scores were significantly correlated to the percentage correct on the Boehm-3 ($r = -.23$, $p = .01$), such that children with fewer errors on the Bender had higher percentage scores on the Boehm-3. In addition, Bender scores correlated significantly with children's TGMD-2 object control percentile scores ($r = .26$, $p < .01$) and the TGMD-2 gross motor quotient ($r = .20$, $p = .04$); here, children with fewer errors on the Bender had lower percentile scores on the object control subtest and had lower gross motor quotient scores.

Children's percentile scores on the locomotor subtest of the TGMD-2 significantly correlated to children's percent correct on the Boehm ($r = .34$, $p < .01$), children's performance range score on the Boehm ($r = -.26$, $p = .01$), and to children's percentile score on the Boehm-3 ($r = .20$, $p = .04$) such that children who performed better on the locomotor subtest also performed better on the Boehm. This locomotor percentile score also significantly correlated with children's performance on the performance tasks of the WPPSI-R ($r = .30$, $p < .01$), the verbal tasks of the WPPSI ($r = .30$, $p < .01$), and children's estimated IQ's ($r = .37$, $p < .01$). Children's total gross motor percentile scores also correlated with these measures, as well (performance, $r = .28$, $p < .01$; verbal, $r = .24$, $p = .01$; estimated IQ, $r = .32$, $p < .01$).

Children's percent correct on the Boehm significantly correlated with children's scores on the performance tasks of the WPPSI ($r = .41$, $p < .01$), verbal tasks of the WPPSI ($r = .58$, $p < .01$), and estimated IQ's ($r = .57$, $p < .01$). Such correlations were also found for children's performance range score on the Boehm (performance, $r = -.38$, $p < .01$; verbal, $r = -.57$, $p < .01$; estimated IQ, $r = -.53$, $p < .01$) and for Boehm percentile scores (performance, $r = .41$, $p < .01$; verbal, $r = .56$, $p < .01$; estimated IQ, $r = .55$, $p < .01$).

Table 3 Correlations among selected test scores

	1	2	3	4	5	6	7	8
1. Bender		-.144	.059	.262**	.177	-.128	-.075	-.094
2. Boehm			.198*	-.072	.106	.411****	.560****	.553****
3. Locomotor				.473****.884****.298***	.303***	.367****		
4. Object					.755****.174	.094	.170	
5. Motor						.279**	.235*	.320****
6. WPPSI-P							.377****	.836****
7. WPPSI-V								.773****
8. IQ								
Gender	1	2	3	4	5	6	7	8
1. Bender		.093	.276*	.322*	.361**	-.02	.159	.061
2. Boehm	-.265*		.221	-.017	.100	.379**	.592****	.574****
3. Locomotor	-.087	.169		.506****.876****.243	.153	.255		
4. Object	.300*	-.178	.394**		.815****.119	.099	.139	
5. Motor	.086	.089	.891****.660****	.194	.105	.196		
6. WPPSI-P	-.203	.445****	.351**	.220	.358**		.274*	.882****
7. WPPSI-V	-.146	.531****	.407***	-.003	.290*	.456****		.695****
8. IQ	-1.67	.533****	.465****	.15	.411***	.788****	.825****	

Note: Locomotor = TGMD Locomotor scale, Object = TGMD Object Control scale, Motor = TGMD Gross Motor score, WPPSI-P = WPPSI Performance, WPPSI-V = WPPSI Verbal, IQ = Estimated IQ; For the lower matrix, the upper diagonal represents correlation coefficients for boys and the lower diagonal for girls.

*p < .05, **, p < .01, *** p < .001, **** p < .0001

GENDER DIFFERENCE

As shown in Table 2, independent samples t-tests reveal that there were significant gender differences in the percentile scores for the object control subtest of the TGMD-2, t(114) = -2.27, p = .03, such that girls had significantly higher percentile scores. In addition, girls' scores on the verbal tasks of the WPPSI-R were significantly higher than boys' scores, t(120) = -2.76, p = .01, and girls also had marginally higher estimated IQ's, t(120) = -1.94, p = .055.

The lower matrix in Table 3 revealed some gender-related patterns of the inter-test correlation. Whereas measure of visual motor development (i.e., Bender) was significantly associated with gross motor measures (e.g., p<.05 for TGMD-2 locomotor and p<.01 for TGMD-2 overall gross motor) only among boys, it was significantly associated with school readiness (i.e., Boehm) only among girls (p<.05). In general, gross motor development was associated with cognitive development among girls, but boys. Particularly, TGMD-2 locomotor was significantly associated with WPPSI-R performance task score (p<.01), WPPSI-R verbal task scores (p<.001), and estimated IQ (p<.0001) only among girls. Likewise, TGMD-2 overall gross motor measure was significantly correlated with WPPSI-R performance (p<.01) and verbal tasks (p<.05) as well as estimated IQ (p<.001).

Table 4. Correlations between demographic factors and selected test scores[1]

Test	Age	Income	YHS	#YS	#OS	ME	PE			
Bender	.353****	-.172	-.147	-.029	.255*	-.122-.141				
Boehm	.424****	.155	.409****	-.140	.198*	047	.004			
Locomotor	.144	.020	.067	-.014	-.164	.048	.008			
Object control	-.214*	-.118	-.024	-.202*	-.088	.091	.118			
Gross motor	-.014		-.057		.039	-.119		-.188*	.081	.091
Performance	.033	.101	.089	-.162	.078	.238**	.129			
Verbal	.162	.037	.217*	-.120	.048	.070	.001			
Estimated IQ	.130	.096	.157	-.170	.096	.163	.068			

Note: 1. Percentile scores for gross motor measures (locomotor, object control, gross motor) and standard scores for WPPSI-R subtests (performance, verbal) were reported in this table.

YHS = years in Head Start; #YS = number of younger siblings; #OS = number of older siblings; ME = maternal education; PE = paternal education

* p < .05, ** p < .01, *** p < .001, **** p < .0001

INDIVIDUAL AND FAMILY CHARACTERISTICS

As shown in Table 4, advancing age of children was associated with better performance in the Bender (r=.35, p<.0001) and the Boehm-3 Preschool (r=.42, p<.0001). However, compared to younger children, older ones in this group performed worse than their average peers on the TGMD-2 object control (r=-.21, p<.05). While family income did not have any significant relationship with nay of the test scores in the table, it did correlate with children's percent correct on the Boehm (r = .21, p = .02) and Boehm performance range scores (r = -.22, p = .02) such that children from higher income families performed better on this test (data

are not shown in the table). Children attended Early Head Start or Head Start in previous year performed better on the Boehm-3 Preschool ($r=.41$, $p<.0001$) and WPPSI-R verbal tasks ($r=.22$, $p<.05$). Children with more younger siblings performed significantly worse on the object control subtest of the TGMD-2 ($r = -.20$, $p = .03$), while children with more older siblings performed significantly better on the Bender ($r=.26$, $p<.05$), Boehm-3 ($r = .20$, $p < .05$), but significantly worse on the TGMD-2 as determined by the gross motor percentile score ($r = -.19$, $p < .05$). There was no correlation between parental education attainment and cognitive and motor measures, except that children with a higher level of maternal education performed better than their peers in WPPSI-R performance tasks ($r=.24$, $p<.01$).

DISCUSSION

The present data support the assumption that Head Start preschoolers are functioning at lower cognitive levels than average preschool age children, but suggests that they have higher levels of gross motor functioning.

The present sample's mean raw score on the Boehm-3 Preschool was 34.26, which is below the 4-year-old mean of 37.73 obtained by the norming sample. In addition, the mean percentile was just under 30%, indicating that these children are, on average, well below most other children in their understanding of preschool concepts. The fact that the average estimated IQ was approximately 90, which is below the normal average of 100, supports the finding that these children are exhibiting lower levels of cognitive functioning.

These children scored, on average, above the 80th percentile on both subtests of the gross motor test and on the gross motor quotient as well. This suggests that the children in the present study have advanced gross motor skills and that they are functioning at higher levels than the typical preschool age child.

Children's Bender scores correlated significantly with Boehm-3 scores to suggest that visual motor development relates to the acquisition and/or understanding of preschool concepts. A surprising finding is that Bender scores correlated with gross motor scores such that children who had better visual motor skills had lower object control and overall gross motor skills. One would expect that children with better visual motor skills would be especially good at object control activities, which also involve some visual coordination with movement.

Children's locomotor and gross motor scores correlated significantly with performance on the Boehm-3 and on the WPPSI-R. This is in accord with Piaget's theory (1952), which states that children learn by exploring their environments; thus, those children with more advanced motor skills are likely to have more advanced cognitive skills due to the increased exploration that their motor abilities allow them.

Children's scores on the Boehm-3 also correlated significantly with children's WPPSI-R scores. This provides validity for the results for each test, suggesting that the scores obtained represent the children's abilities.

Gender differences were noted on the gross motor test such that girls had significantly higher scores than boys on the object control subtest. It is assumed that boys have higher object control skills (Clark & Phillips, 1987; Ulrich, 2000) so these results are in contrast to

prior research. In addition, girls also had significantly higher scores on the verbal tasks of the WPPSI-R and had higher estimated IQ's.

Family variables were also correlated with children's performance on these tests. Family income correlated with children's performance on the Boehm-3 such that children from higher income families performed better on this test. Thus, even in this community of low-income families, having a higher income has a positive effect on children's cognitive development, possibly because of increased resources in the home. In addition to income, the number of siblings in the family influenced performance on some measures. Children with more older siblings performed better on the Boehm-3, suggesting that children may learn some of these preschool concepts by interacting with their siblings. On the other hand, children with more younger siblings performed significantly worse on the object control subtest, while children with more older siblings performed significantly worse on the total gross motor test.

The present study was able to demonstrate that Head Start children are cognitively deficient, as measured by standardized tests. However, the present results suggest that these children do not have motor delays and that they function in the upper range of gross motor skills.

A major limitation of the present study is that the assessment conditions were not ideal. Because of limited physical space in the Head Start classroom, assessment was conducted in any available space at each site, which included testing in hallways, in the classroom with other children, or in separate rooms where several children were being tested at the same time. Thus, a more ideal testing situation might change the test results slightly such to produce different results. However, since these results support prior research suggesting that Head Start children do function at a lower level than average children, the results of the present study are likely valid. For example, the estimated IQ of the current sample (i.e., 91) was consistent with previous findings among the Head Start population or disadvantaged children (e.g., Lamp & Traxler, 1973; Oakland, et al., 1971).

In addition, the Bender Gestalt Test did not appear to be an appropriate measure of visual-motor development for children of this age group. Whereas the test has been widely used in assessing maturation of visuoperceptual and visuomotor functioning in children (Psychological Corporation, 2001), it appeared to be difficult for these children to perform the tasks. It is also difficult to keep the children's attention focused on the task. In addition, no test norm was available for children of this age group. Other more age-appropriate standardized measures that are easier to administer may provide more meaningful results of visual motor assessment.

Future research might seek to examine more specific areas of Head Start children's cognitive development, such as language, math skills, science, etc. It would be interesting to note in which of these areas Head Start children are below average.

In summary, the present study supports prior research to suggest that rural Head Start preschoolers function at a lower cognitive level than do average preschoolers; the scores of the present sample do not appear significantly different to suggest differences between urban and rural populations, but further research would be necessary to support such an assumption. However, the present study refutes findings that Head Start children suffer from motor deficits as well, as the data in the present study indicate high levels of gross motor performance.

ACKNOWLEDGEMENTS

This study is in part supported by the American Academy of Pediatrics and the Center for Ecoliteracy (Grant #01-1-044). The authors wish to thank Ms. Barbara Myers of the Monongalia County Head Start Program of West Virginia for her assistance in data collection and thank Dr. Christina Adams who was at West Virginia University Department of Psychology at the time of the this study for her efforts in providing training and supervision for the assessment. The authors also thank the Head Start teachers of Monongalia County for their cooperation in data collection and the graduate students of West Virginia University Department of Psychology who conducted the testing of the children.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 91-102

Chapter 7

OPHTHALMOLOGICAL ASSESSMENT OF PRESCHOOL CHILDREN: EYE BLINK AND PUPILLARY DIAMETER

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ABSTRACT

Introduction: Nevertheless the eyes have a fast development mainly in the early childhood, there are many difficulties in eyes examination, leading to late diagnosis to various conditions. Conventional ophthalmic tests are difficult to implement in preschool children. Digital image processing system might provide important informations about the eyeblink and pupil evaluation. **Purpose:** To investigate, using a digital image processing system, the eyelid dynamics and the pupillary areas and diameters of normal preschool children. **Methods:** 50 newborns and 200 preschool children were examined. Images were recorded using a digital camera during three minutes. Complete and incomplete blink rates, opening, closing and complete blink times were calculated. Moreover, pupil diameter and pupil area of the preschool children were evaluated during attentive and spontaneous gaze. Data were expressed in pixels and arithmetic means of each parameter were calculated. **Results:** The complete eye blink was more common and the blink rate increased with age. The incomplete blink rate was the same for all ages. The eyelid opening and closing times and the complete blink time were similar for both sexes. The closing eyelid time was slower. The mean pupil diameter and area were similar for both eyes, presenting values of 18.5 and 311.7 pixels during attentive and 15.4 and 237.6 pixels during spontaneous gaze, respectively. There were no differences between sexes. However, six-year-old children showed lower pupil diameter and area. **Conclusion:** The digital image processing system is a very good method to evaluate children and permitted to observe the complete blink rate increases with age. Pupil diameter and area were larger during attention and similar for both eyes.

INTRODUCTION

Working with children is a pleasurable task, however complex, especially with preschool children, who are in the early years of childhood that precedes the beginning of elementary school.

The result of ophthalmic evaluation depends on cooperative behavior and it is not possible in many children. So, one should use subterfuges to allow an effective and ludic examination, without stress. Unsatisfactory and even unreliable results would be possible if the exam is not well done.

For these reasons, there are not so many publications in Ophthalmology assessing preschool children, especially their normal ocular development, such as blink rate, pupillary diameter and area.

There are two types of blinking: involuntary or reflex (corresponding with spontaneous) and voluntary (which depends on the individual's intent). Blink rate influences lacrimal drainage (Sahlin and Chen 1997) and ocular surface integrity (Tsubota and Nakamori 1995), and depends on various conditions, including time of day (rates increase at night) (Barbato, Ficca et al. 2000), gender (men have higher rates than women) (Bentivoglio, Bressman et al. 1997), cognitive processes and attention level (Bentivoglio, Bressman et al. 1997) and ocular alterations (Dumery 1997).

Blink rates in adults vary across different age groups (Schellini, Sampaio et al. 2005). In normal adults, blink rates range from two to 50 blinks / min (Monster, Chan et al. 1978; Tsubota 1998).

The blink reflex is present at birth, but spontaneous blink rates are low in very young children (Zametkin, Stevens et al. 1979; Lawrenson, Murphy et al. 2003). Blink rates increase rapidly during the first year of life, but remain lower than those in adults (Tsubota 1998).

Stimulation of parasympathetic nerves excites sphincter muscles of the pupil causing miosis. On the other hand, stimulation of sympathetic nerves excites pupil's dilation muscles causing mydriasis (Guyton and Hall 2002).

Pupillary diameter varies according to illumination, accommodation, emotional status, and systemic and topical medications (Miller 1985; Thompson 2002). The fact that pupils are highly dynamic and asymmetrical makes the assessment of pupillary measurements a difficult task (Winn, Whitaker et al. 1994; Rosen, Gore et al. 2002). Importance of pupillary measurements has increased due to advances in corneal refractive surgery (Wickremasinghe, Smith et al. 2005). In addition, these measurements have been used in the development of new intraocular lenses, to monitor individuals with sleep disorders, and for psychophysiologic tests (Borish 1988; Atchison 1989; Applegate and Gansel 1990; Pande and Hillman 1993; O'Brart, Corbett et al. 1995; Applegate and Howland 1997; Fountoulakis, Fotiou et al. 1999; Holladay 2002; McLaren, Hauri et al. 2002; Rosen, Gore et al. 2002; Stark, Englehart et al. 2003; Iskander, Collins et al. 2004).

Constant variations in pupillary measurements associated with methodological difficulties have resulted in little knowledge regarding quantitative values of pupillary diameter, particularly in children.

PURPOSE

The purpose of this study was to demonstrate the digital image processing system in investigating eyelid dynamics in normal newborn infants and preschool-age children and in the evaluation of pupillary areas and diameters of normal preschool children.

METHODS

Two hundred and fifty healthy children were evaluated at Faculdade de Medicina de Botucatu, São Paulo, Brazil. Fifty newborns (up to 30 days old) and 200 preschool children aged 4 (66 children), 5 (54 children), and 6 (80 children) years participated in this study. Children with eyelid abnormalities (e.g. congenital ptosis) or diseases that may affect blink rate (e.g. ocular allergies) were not enrolled in this study.

Evaluation of children was performed by recording digital images (frontal and lateral shots) of newborns and children fully awake, in primary eye position, with the observation target placed at pupil height at a distance of one meter. All images were taken by the same observer, under the same environment, using a Sony Lithium® digital video camera (Sony DCR-TRV110, Sony, Manaus, Brazil) and 8 mm video tapes; images were transferred to an Apple MacIntosh G4® computer and processed with the iMovie® software (Apple Computer Inc., Cupertino, CA, USA). This software detects intervals of 1/30 of a second (1 frame) allowing us to capture the high speed of human blink (Dumery 1997).

Spontaneous blinking was evaluated over a three-minute period and included eyelid opening and closing times (in milliseconds), complete blink time (sum of eyelid opening and closing times in milliseconds), and rate of eyelid movements per minute. In order to evaluate these parameters, (i.e. closing, opening, and complete blink times), one complete eyelid movement from each minute of observation was randomly chosen. Eyelid movement was considered complete when the superior eyelid touched the inferior eyelid; otherwise, it was defined as incomplete.

Because blink rates can be affected by many internal (e.g. concentration level, humour) and external (e.g. dust, wind, smoke) factors (Monster, Chan et al. 1978; Bentivoglio, Bressman et al. 1997), we decided to record eyelid movements during a three-minute period to allow the children to be more comfortable with the environment. In addition, images were also recorded at lateral position and, at the same time, children were distracted from the fact that they were being filmed in order to capture spontaneous blinking.

Results were analyzed and presented according to descriptive statistics (mean, standard deviation, and median), and non-parametric tests were used to compare groups.

Two hundred normal children aged 4 (66 children), 5 (54 children), and 6 (80 children) years participated in the study of pupillary diameters and areas. Their pupillary diameters and areas were evaluated by analyzing digital images at two different moments: during attentive (AG) and spontaneous gaze (SG). Children with any systemic disease or previous eye or eyelid surgeries were excluded from the study.

Images were obtained using a Sony® Lithium camcorder (Sony DCR-TRV110, Sony, Manaus, Brazil) during the subject's attentional state and primary gaze position. The objects of observation were located at pupil height, recorded on 8-mm tapes, transferred to an Apple

MacIntosh G4® computer and then processed by the iMovie® software (Apple Computer Inc., Cupertino, CA, USA) after being submitted to the Invert filter of the Adobe Photoshop® software package, version 5.0 (Figure 1).

Figure 1. Images during pupillary measurements.
A: Original picture at attentive gaze. B: Picture with "negative aspect" at attentive gaze (using the Invert filter of the Adobe Photoshop® software, version 5.0). C: Circumference (right eye) represents how pupil area was measured. Broken line (left eye) represents how pupil diameter was measured.

Three consecutive measurements of the right (RE) and left (LE) eyes' pupillary diameter and area were made at two evaluation moments (AG and SG), and the arithmetic mean of each parameter was calculated by using the NIH 1.55 software. Pupil measurements were expressed in pixels.

Statistical analysis included the comparison of means using Student's t-test for dependent samples and analysis of variance for repeated measurements in independent groups.

RESULTS

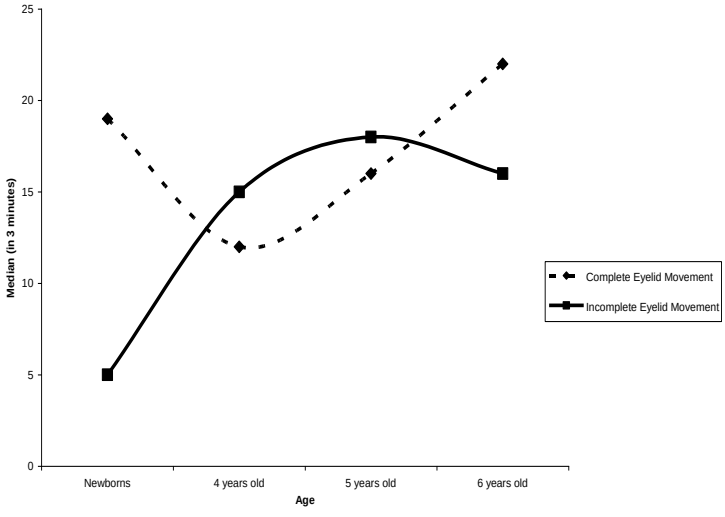


Figure 2. Median values of blink rate for complete and incomplete eyelid movements according to age.

Figure 2 shows median values of blink rate according to age. Newborns had 19 complete eyelid movements during the three-minute period, which was similar to complete eyelid movements presented by 4-, 5- and 6-year-old children (median values of 12, 16 and 22, respectively). Newborns presented a lower number of incomplete movements that than preschool age children. Newborns had 5 incomplete eyelid movements during the three-

minute period, while 4-, 5- and 6-year-old children presented 15, 18 and 16 incomplete eyelid movements, respectively (median values, p<0.001). The complete blink rate was lower in newborns (6.2 blinks/minute) than in preschool age children (8.0 blinks/minute). The complete blink rate was higher than incomplete blink rate in both newborns (6.2 and 2.5 blinks/minute, respectively) and preschool children (8.0 and 6.3 blinks/ minute, respectively).

Eyelid closing time as well as eyelid opening time were longer in newborns than preschool children at all observation times (p<0.0001). Similar results were seen for complete blink time: newborns have longer complete blink time than preschool children (p<0.0001) (Table 1).

Table 1. Mean (± standard deviation) eyelid closing, opening and complete blink times (in milliseconds) over a three-minute period, according to age.

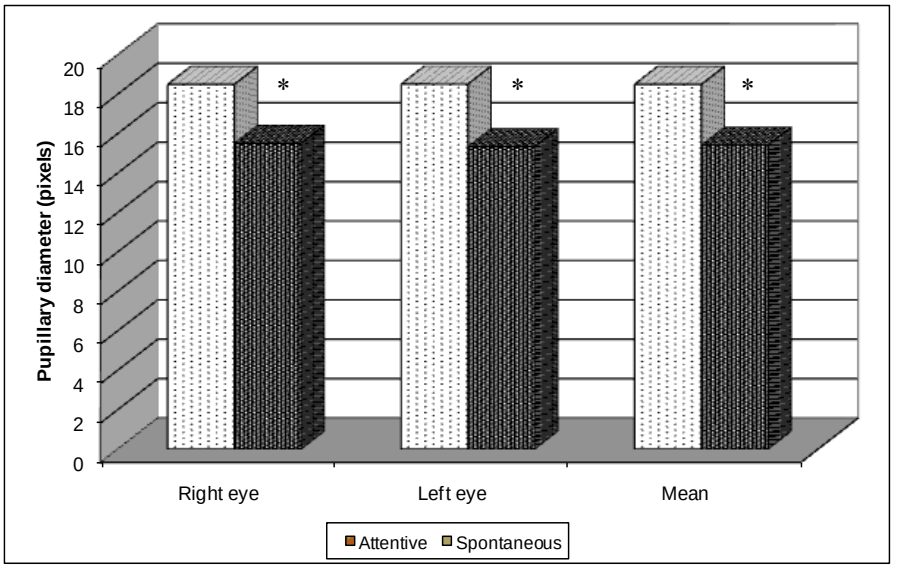
	Eyelid Closing Time				
	Newborns	**4-year-old**	**5-year-old**	**6-year-old**	**p-value***
1st minute	433.3 ± 92.7	225.0 ± 68.3	226.7 ± 84.3	228.0 ± 55.0	p<0.0001
2nd minute	435.3 ± 76.0	231.3 ± 59.3	240.3 ± 88.3	230.7 ± 57.0	p<0.0001
3rd minute	424.3 ± 88.0	234.3 ± 63.0	230.7 ± 72.7	232.0 ± 75.0	p<0.0001
	Eyelid Opening Time				
	Newborns	**4-year-old**	**5-year-old**	**6-year-old**	**p-value***
1st minute	330.7 ± 64.3	192.3 ± 51.7	187.7 ± 54.7	200.7 ± 40.7	p<0.0001
2nd minute	333.3 ± 61.0	201.0 ± 49.0	194.0 ± 52.0	201.7 ± 40.7	p<0.0001
3rd minute	319.3 ± 60.0	200.3 ± 55.3	189.0 ± 47.0	206.0 ± 49.0	p<0.0001
	Complete Blink Time				
	Newborns	**4-year-old**	**5-year-old**	**6-year-old**	**p-value***
1st minute	764.0 ± 139.0	417.3 ± 113.0	414.3 ± 127.0	428.7 ± 88.7	p<0.0001
2nd minute	768.7 ± 124.3	432.3 ± 99.3	434.7 ± 126.3	432.3 ± 89.7	p<0.0001
3rd minute	743.7 ± 123.3	435.0 ± 111.0	420.0 ± 106.7	438.0 ± 117.3	p<0.0001

* p-value: comparison between newborns and 4-, 5-, and 6-year-old age groups.

Pupillary diameters were similar in both eyes with mean values of 18.5 ± 3.9 pixels for right eye (RE) and 18.5 ± 3.9 for left eye (LE) when the child was examined at AG. During SG, diameters were also similar with mean values of 15.5 ± 3.8 and 15.3 ± 3.8 pixels for RE and LE, respectively. Since no differences between eyes were found, 18.5 pixels and 15.4 pixels were considered the mean values for pupil diameters at AG and SG, respectively. However, differences of diameters at different gaze states were statistically significantly (p<0.001) (Figure 3).

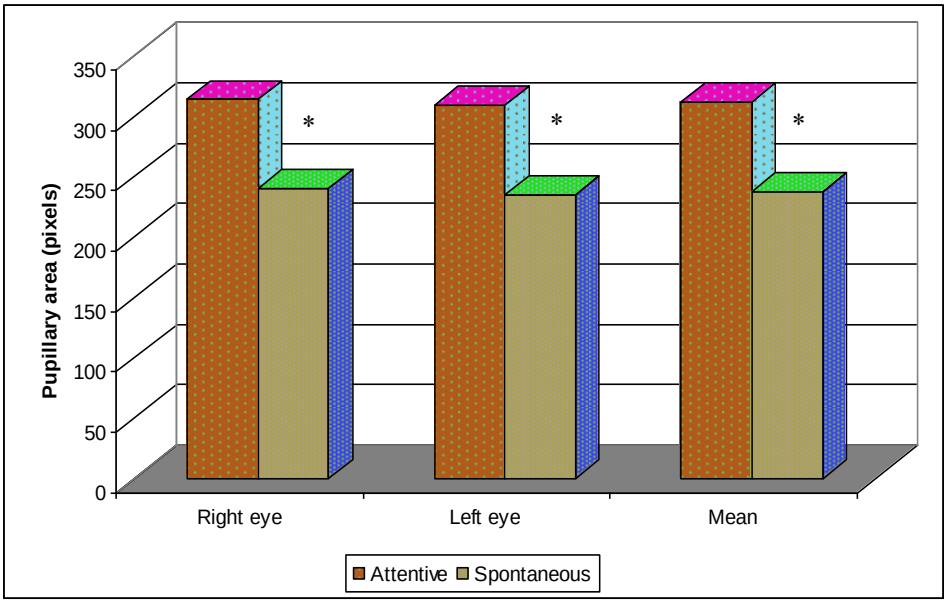
The mean pupillary area was 311.7 pixels and 237.6 pixels at AG and SG, respectively. Pupillary areas showed similar values for RE and LE and higher values (p<0.001) when the child was examined during AG (Figure 4).

During AG, 6-year-old children presented a smaller mean pupillary diameter (16.4 ± 3.8), when compared to 4- and 5-year-old groups (19.6 ± 3.4 and 20.2 ± 3.1, respectively) (p<0.0001). Analyzing SG, similar observation was found (13.7 ± 3.7, 16.2 ± 3.4 and 16.9 ± 3.3 for 6-, 4- and 5-year-old children, respectively) (p<0.0001).



* p<0.001

Figure 3. Right and left eyes and mean values of pupillary diameters in preschool children at attentive and spontaneous gaze.

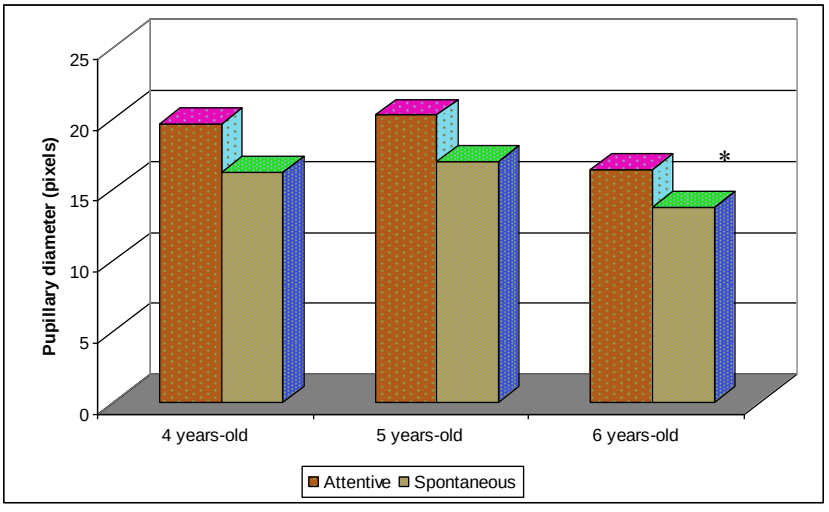


*p<0.001

Figure 4. Right and left eyes and mean values of pupillary areas in preschool children at attentive and spontaneous gaze.

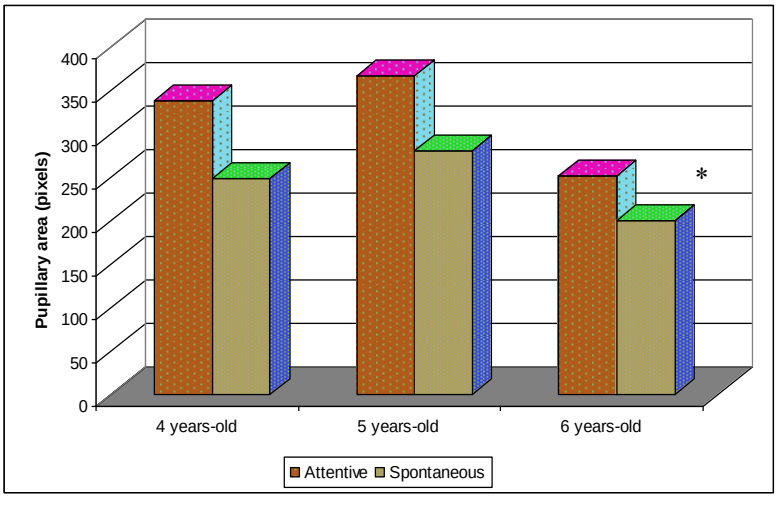
Mean pupillary area of 6-year-old children was smaller (252.0 ± 96.4) when compared to 4- and 5-year-old groups (338.2 ± 95.5 and 367.6 ± 96.6, respectively) (p<0.0001), during

AG. The same observation was found during SG (200.1 ± 82.3, 248.5 ± 87.7 and 279.9 ± 96.0 for 6-, 4- and 5-year-old children, respectively) (p<0.0001) (Figures 5 and 6).



*p<0.0001 when compared to 4- and 5 year old children.

Figure 5. Mean pupillary diameters of preschool children at attentive and spontaneous gaze by age group.



*p<0.0001 when compared to 4- and 5 year old children.

Figure 6. Mean pupillary areas of preschool children at attentive and spontaneous gaze by age group.

There were no differences in pupillary diameters/areas when both sexes were compared (data not shown).

DISCUSSION

Our study evaluated the dynamics of eyelid movements in a group of healthy newborns and preschool children. The ocular surface, together with the eyelids and lacrimal system, represents a functional unit that ensures the quality of the refractive surface of the eye and also protects ocular structures from noxious stimuli arising from the environment (Rolando and Zierhut 2001). The preocular tear film is the most dynamic structure within this unit, and an adequate rate of tear production and a rapid turnover is essential for ocular health. Tears cleanse, lubricate, and defend the ocular surface against infection. Furthermore, by smoothing out irregularities of the corneal epithelium the pre-corneal tear film creates an even surface of excellent optical quality that is reformed with each blink. In newborns, the optical characteristics of the tear film are important for the generation of a clear retinal image, which is an essential prerequisite for normal visual development (Lawrenson, Murphy et al. 2003). As the tear film is inherently unstable, frequent blinking is normally required to prevent surface drying. The reported low rate of spontaneous blinking in neonates and infants (Zametkin, Stevens et al. 1979) thus raises important questions regarding tear stability and the ability of ocular surface receptors to detect tear break-up.

In addition, reduced rate of reflex tear secretion may limit the dilution of topical ocular medication, leading to longer contact of the drug with the ocular surface, increasing the risk of adverse reactions (Isenberg, Apt et al. 1998).

One important finding from our study was the fact that newborns clearly had a different eyelid movement pattern compared to preschool children. Newborns, for example, had lower blink rates and higher opening and closing times compared to 4 to 6 years-old children.

Other authors have also reported that newborns present decreased blink rate compared to older children (Zametkin, Stevens et al. 1979; Lawrenson, Murphy et al. 2003) and this rate increases during life until adolescence. After adolescence, it appears to remain constant throughout life (Barbato, Ficca et al. 2000).

The lipid layer of tear film in newborns is thicker than in adults, slowing evaporation and increasing tear film stability, preventing ocular surface drying (Isenberg, Apt et al. 1998; Lawrenson, Birhah et al. 2005). In addition, less ocular surface area is exposed in newborn infants (Fox 1966). The combination of these factors (i.e. more stable tear film and smaller ocular surface area), may in part explain why children in this age group have lower blink rates. This idea is supported by Tsubota who observed that increase in blink rate represents an important mechanism with which to compensate for the greater tear film evaporation resulting from the increase in ocular surface exposure caused by the ocular globe growth (Tsubota 1998).

Another hypothesis to explain the lower blink rate in newborns relates to the development of the visual and central nervous systems. Newborns do not achieve the same level of image formation in the retina and brain as older children, and external stimuli are probably less important to the blinking process because of the immaturity of the neural circuit and the eye. Moreover, the immaturity of other systems may also contribute to the lower blink rates observed in newborns. For example, afferent pathways that detect a reduction in tear film on the ocular surface, caused by evaporation, could also not be fully formed. In addition, although the relationship between dopaminergic plasticity and spontaneous blink frequency in newborns is unclear (Meng, Ozawa et al. 1999; Herlenius and Lagercrantz 2001), it is

believed that the reduced blink rate in newborns, as seen in this study, may reflect a relatively underdeveloped dopaminergic system.

The main limitation in our study concerned the difficulty of recording eyelid movements in newborns because they were awake for only short periods of time and, as a consequence, a lower number of children in this age group were examined. Although the number of newborns (50) differed from the total number of children from 4 to 6 years-old (200), non-parametric statistical tests allowed us to make comparisons between these two groups.

This study used digital imaging in order to evaluate pupillary dimensions using a digital camcorder to record images of children in two different situations: during attentive and spontaneous gaze.

Some difficulties were found during pupil evaluation, particularly in eyes with dark irises due to the necessity of pupillary contrast in relation to the iris using the image color inversion resource provided by Adobe Photoshop® software.

Other methods of pupil measurement exist such as pupillometer (Wickremasinghe, Smith et al. 2005), infrared systems (Obstfeld and Chou 1998; Schnitzler, Baumeister et al. 2000; Pop, Payette et al. 2002; Kohnen, Terzi et al. 2003), videokeratoscope (Boxer Wachler and Krueger 2000), Asclepion Aberrometer®, WaveScan Wavefront Analyzer®, among others. However, these equipments are usually costly and not always available in all clinics.

When fixation on a distant object is switched to a nearby one, pupil contraction occurs as part of the accommodation and convergence process. When switching the fixation back to a distant object, pupils slowly dilate (Ishikawa, Asakawa et al. 2004). Therefore, it is necessary to take these factors into account when analyzing pupillary measurements. Anisocoria is not an uncommon condition and could be present in our sample. However, statistical analysis showed that measurements were similar in both eyes.

Two parameters were used in this study: pupillary diameter and pupillary area. Greater variability was observed when measuring pupillary areas compared to diameters. One possible explanation is that for the measurement of the area, the examiner had to assume that pupillary shape was circular. Although most of the studies using commercial pupillometers assumed such condition, it is known that the pupil is not circular and shows irregularities (Wyatt 1995). Therefore, it is suggested that measurements of pupil diameters are more accurately measured and should be used for future studies.

Differences found when comparing children in different ages suggest that age-related differences might exist. It is known that during the second decade of life, pupil size increases almost 1.5 mm (Zoethout 1935; MacLachlan and Howland 2002).

Sympathetic autonomic nervous system (ANS) is intensively activated in many emotional states, such as situations of anger, stress or alarm, thus triggering the so-called fight or escape response (Guyton and Hall 2002). The stimulation of sympathetic nerves excites the radial fibers of the iris and causes mydriasis. In addition, it has been observed that whenever an individual is awake and alert, pupils are larger, in contrast to being smaller during sleep (Yoss, Moyer et al. 1970).

Regarding the two observation moments, while at AG, children paid attention to the camcorder, a distinct object being handled by an examiner who was also unknown. In addition, such condition could be characterized as a situation with relative stress. Later, children gradually became used to the researcher's presence, which provided a moment of spontaneity (SG).

As presented above, a greater activation of the sympathetic ANS was expected to occur in the stressful situation. The observed results confirmed such hypothesis, since a significant difference was found in pupil diameters and areas comparing children at AG and SG.

CONCLUSION

The digital image processing system is a method relatively easy, cheap and safe to be applied in the examination of preschool children. It also allows the evaluation of a wide range of subjects such as: blink rate and eyelids dynamics, pupillary assessments, among others. It should be emphasized that this method, despite its advantages, is relatively new and, lately, it still has not been much applied for the purposes above.

Using digital images was possible to know that blink rates were lower and blinking times longer in newborns compared to preschool children. Specific characteristics found only in this group of children, such as immaturity of neural system and more resistant tear film, may explain these findings in part.

Besides that, we concluded that the use of the *Invert* resource of the Adobe Photoshop® software was highly useful to improve contrast between pupil and iris, thus facilitating image analysis. Less variability in results suggested pupillary diameter as more accurate measurement than pupillary area. Pupillary diameters and areas were similar in both eyes and were larger at attentive gaze. Older children (6-year-old) differed from younger ones (4- and 5-year-old) regarding pupillary parameters suggesting an influence of age.

ACKNOWLEDGEMENT

The authors would like to thank the following people, without whom this work could not be concluded successfully: Carlos Roberto Padovani and Flávio Eduardo Hirai.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 103-114

Chapter 8

ASSESSMENT OF LUNG FUNCTION IN PRESCHOOL CHILDREN

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Respiratory system disorders may appear at any age, however in children are relatively frequent. Symptoms such as cough or wheezing may arise from viral or bacterial infections but also may be caused by chronic illnesses. Therefore, assessment of objective measures of lung function is of a great importance.

Preschool children constitute a real challenge in this regard. Most of lung function testing procedures require cooperation during specific respiratory maneuvers necessary to complete the examination. This chapter is designed to show methods and techniques used for evaluation of lung function status in preschool child. The most popular among them – spirometry is presented, the advantages and disadvantages are discussed. A special attention is paid to a relatively new technique of studying respiratory system properties – the forced oscillation technique and its modification called impulse oscillometry (IOS). Also using interrupter technique to asses resistance of respiratory system is presented. Those techniques are commonly used in preschool age and make possible not only to help in diagnosis, but also in controlling and monitoring the disease progress or efficacy of the treatment.

INTRODUCTION

Lung function testing is a primordial issue in respiratory medicine. It makes possible to evaluate objectively the state of respiratory system, to confirm symptoms reported by the patients, finally, it is an important factor in differential diagnosis.

Respiratory system related diseases are the major health problem during the childhood. According to Martinez et al (1), about 29 % of the children had wheezing at the age of 6 years. The study of Kuehni et al. (2) analyzing prevalence of respiratory symptoms in

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children aged 1-5 years during the period 1990-1998 has shown a significant increase in the prevalence of wheezing (from 16% in 1990 to 29% in 1998), diagnosis of asthma (from 11% to 19%) and admissions for wheeze or other chest troubles (from 6% to 10%). In United States, the prevalence of self-reported asthma in the age group 0-4 has increased from 369 000 in 1980 to 805 000 in 1996, while in the age group 5-14 years the increase was from 1 530 000 to 2 771 000 in the same period. In 1996 about 4 millions of asthma attack were noted in children aged 0-15 years (3). International consensus on asthma diagnosis and treatment (GINA) recommends using spirometric measurements or PEFR to establish the diagnosis and severity of asthma and the degree of the control of the disease. Lung function evaluation is also essential in other, less frequent pulmonary diseases in the pediatric group – for instance in cystic fibrosis or more and more frequent immune disorders.

For the assessment of respiratory system properties many techniques are used worldwide. The classic approach is to use spirometry for measuring lung volumes and capacities, body plethysmography or gas dilution methods for the assessment of total lung capacity, plethysmography for the assessment of respiratory mechanics and carbon monoxide diffusion techniques to measure diffusion of gases within the lungs. All those techniques require more or less subject cooperation, moreover – special respiratory maneuvers need to be performed to obtain results. The methodology is described by international consensus statements published in 2005 (4-8).

Preschool children form a special group in this regard. Young children have problems with understanding the language describing measurements and maneuvers, are afraid of the devices used, moreover – independently of the willingness to cooperate – they might have problems with - for instance - prolonged forced expiration.

An ideal functional test to asses respiratory system properties in preschool children (9) should:

- make possible to examine the patient at any age, thus making possible longitudinal assessment and comparisons of lung function;
- be easy to perform (by the patient as well as by the operator)
- be safe to patient
- lead to repeatable results
- be enough sensitive to distinguish between healthy and diseased patients and to detect changes due to growth;
- be acceptable to the child and its parents.

There are three main techniques used in preschool children: spirometry, interrupter resistance measurements and forced oscillometry. This chapter describes those techniques and presents advantages and disadvantages of them – when applied to a preschool child.

There is no technique available which meets all the above criteria. Every attempt to evaluate respiratory system properties requires understanding the goal of the procedure and willingness to cooperate actively or at least passively.

Two problems have to be discussed clearly: the first is the usefulness of a single measurement. In children – a single measurement may give some information on the degree of development of the respiratory system as compared to normal values using the percentiles. However, if there is a pathological process, that development might be disturbed by the

disease. Then serial, repeated measurements rather may give better insight to what is going on. There are also specific procedures (reversibility of bronchial obstruction, bronchial provocation) that need repeated measurements over a short time. In this regard using spirometry – as much more demanding may be questionable and one should think about alternative techniques.

The second problem is the interpretation of the results. It is not advised to use any fixed percent value to classify result as abnormal. Instead – a representation in z-scores is recommended:

$$Z=(X_{observed}-X_{predicted})/RSD$$

In this terms z is a number of residual standard deviation (RSD) that measured value differ from the mean predicted in population. When the distribution of the value is normal, values of z less than -1.645 (below the 5th percentile) are regarded as being abnormal (observed value is lower than lower limit of normal). Values of RSD should accompany equations for normal values for every parameter and every technique used.

Spirometry

Spirometry is the most popular method of studying respiratory system properties. The technique is known for many years, has been a subject of repeated standardization statements, of which the most recent version which has been published in 2005 is the common position of the American Thoracic Society and European Respiratory Society.

During spirometry one measures flows and volumes within the lungs during specific, maximal respiratory maneuvers. In adults the performance of spirometry mainly depend on the qualifications of the personnel involved and on the understanding and willingness to cooperate. Quality criteria help to distinguish between good and poor maneuvers. If we consider flow – volume measurements – a good effort should fulfill start of test criteria, end of test criteria and the repeated measurements should be reproducible. Quality criteria for spirometry for adults and older children (6) are listed below:

Acceptability: Start of test criteria:

- PEF should occur close to the point of maximal inflation (short time to PEF)
- Backextrapolated volume less than 5% FVC or 150 ml whichever is greater

End of test criteria:

- forced expiratory time grater than 6s (for children aged 10 yrs or less – 3s) and plateau on the volume time curve (change in volume less than 25 ml during last second of forced expiration)

reproducibility: the difference between the best and the second best value of FVC and FEV1 less than 150 ml

Numerous studies have shown, that preschool children have many difficulties when trying to perform spirometry. In a study from our laboratory (10) on untrained preschool children we have shown, that the rate of cooperation during performance of the flow volume loop is quite low, and increases with age. Among 4-years old children only about 5% were able to cooperate during spirometry, this percentage increases to ~20% in 5-years old children, and ~50% in 6 years old. Later problems with cooperation occur sporadically. The study (11) of Loeb et al. revealed similar result – they stated that "the percentage of acceptable and repeatable spirometry increased with age rising above 50% by age 6 and reached a plateau with approximately 85% success at age 10".

Generally, when dealing with preschool children, special attention should be paid to creation of friendly atmosphere, non-threatening environment to make the child safe and comfortable. According to recommendations, testing of preschool children is not advised in 'adult' laboratories, moreover the personnel should be familiar and experienced in the work with with children.

To improve the rate of cooperation some authors suggest initial training before the spirometry is to be done. This comprises familiarization with the lab, its atmosphere and with the equipment, also, as shown by Vilozni et al (12) computer games may be used to teach proper technique required during spirometry. In the work of Eigen et al. (13) who studied children aged 3-6, a procedure of performing FV examination in a child is described. Briefly, they started with talking and blowing into party favors or whistles. Then they explained the procedure using different phrases like 'blowing out birthday candles', 'blowing like the big bad wolf' to 'make a mountain on the computer screen'. Once the procedure has been understood, the technician demonstrated detailed actions and verified them. Finally – the children were examined standing, with noseclip on. The rate of cooperation in the group of 259 healthy children who entered the study was 82.6%. Such actions might improve cooperation rate up to 90% as reported by Piccioni (14).

Apart from the problems with cooperation, the quality of maneuvers is also a problem. Evidences from many works, among them from the work of Aurora et al. (15) show that performance of the maneuver is different from that in older children and adults. Those evidences lead to recommendations published in (9), which may be summarized in the following points:

1. If it is the child's first attempt – training is necessary. The child should be familiarized with the equipment, technician, procedure and commands.
2. Computerized interactive games are allowed but not mandatory.
3. The operator should note posture and use of a noseclip. During the maneuver he/she should observe the child carefully to ensure that the maneuver is performed properly and there is no leak through the mouthpiece
4. Both flow-volume and volume tracks should be inspected. If there is no rapid rise to PEF or smooth descending limb or cough and/or glottis closure is observed – the maneuver should be discarded.
5. Maximal number of maneuvers is not stipulated, however a minimum of three maneuvers should be registered.
6. Starting point for forced expiratory flows should be determined by back-extrapolation

7. If volume of back-extrapolated (Vbe) is greater than 80 ml or 12.5% FVC the registered curve should be carefully analysed, but not necessarily rejected
8. If there is premature termination of maneuver (flow drop greater than 10% of PEF) FEVt from such a curve may be reported, but not FVC
9. In ideal case the child should produce at least two curves that are acceptable, and the FVC and FEVt should be repeatable within 100 ml or 10% of the highest value. The number of maneuvers should always be reported.

Acceptability and reproducibility criteria for younger children are different from those applicable to older ones and adults as listed above. Moreover, it should be noted, that some of the children, especially the youngest ones may have problems with prolonged forced expiration and may finish the maneuver without reaching 1 s, which makes impossible to measure FEV1. This is why FEVt is used, for the evaluation of respiratory system state FEV0.5 or FEV0.75 can be measured.

For the preschool children several sets of reference values are available (13,14,16). Some of them are of limited use because they report FEV1 only (not FEV0.5 or FEV0.75) – see table 1. Recently a joint initiative has been finished (17) aimed at the construction of reference values for children in preschool age basing upon the data collected during earlier studies. This task included 3777 children form 15 centers and 11 countries and brings the most up to date normal values calculated on the biggest group ever, with the newest methodological considerations. Thus – it makes possible to interpret spirometry measured in a preschool child.

Table 1. Selected reference values for spirometric indices in preschool children.

	Number of children	Group composition	remarks
Eigen et al (13)	214	Age: 3-7 Height: 85-130 cm	FVC, FEV1
Piccioni et al. (14)	766	Age: 3-6 Mean height 111.3±6.2 cm	FVC, FEV1, FEV0.5 FEV0.75
Vilozni et. al. (16)	109	Age: 3-6 Height: 83-126	FVC, FEV1, FEV0.5 FEV0.75; flows
Stanojevic et al. (17)	3777	White caucasian	FVC, FEV1, FEV0.75

Impulse Oscillometry in Preschool Children

Contrary to spirometry which measures only flows and volumes, the forced oscillations technique (FOT) allows to explore respiratory mechanics. The principle of the technique is to analyze the response of the system to known, external pressure fluctuations. Initially the technique used sinusoidal pressure excitations, then, when computers became available – more complex signals containing several harmonics. During the years several commercial versions appeared on the market, however – they have not gained much popularity. Its

modification called impulse oscillometry, present on the market since 1994 (18) uses triangular pressure pulses superimposed on breathing. Contrary to the classic approach – this modification of FOT is quite popular in many countries, including US and Europe.

The relationship between pressure and flow called respiratory impedance contains information on frictional losses of energy within the system and inertial and elastic loads, i.e. information on resistive as well as elastic and inertial properties of the system. In mathematical notation (where j denotes imaginary unit):

$$Z = \frac{P_{rs}}{V'_{rs}} = R_{rs} + jX_{rs}$$

respiratory impedance Z is a complex sum of resistance Rrs (an in-phase component of the relationship between P and V' – respiratory system resistance) and the so called reactance X (out-of phase component determined by apparent elasticity and inertive properties of the system – respiratory system reactance). Impulse oscillometry yields to values of R and X at 5, 10, 15, 20, 25 and 35 Hz and also brings the value of resonant frequency – i.e. the frequency at which X=0 (at this point elastic reactance is balanced by inertive properties).

The loudspeaker producing pressure pulses is closed in the box. The pressure signal leaves the box and through a pneumotachograph reaches respiratory system of the examined person. Pressure and flow are measured simultaneously and after filtering out the components of natural breathing values of resistance and reactance at a number of predefined frequencies are calculated using Fast Fourier Transform.

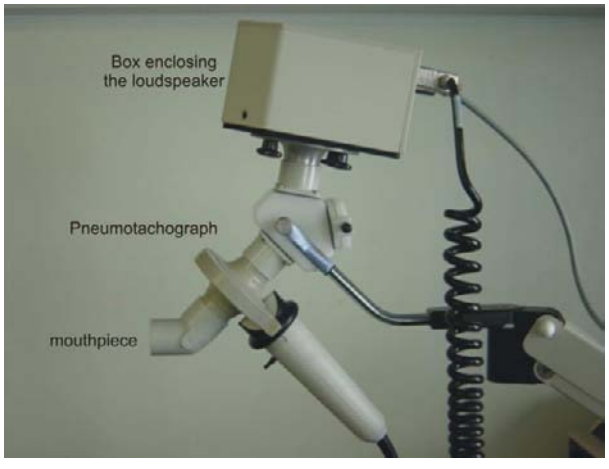

Figure 1. presents the measuring head of the IOS device.

The measurement is quite simple. The child is sitting and wears the noseclip. When breathing naturally (tidally) through the mouthpiece, the technician firmly supports his/her cheeks (this minimizes artifacts coming from the motion of elastic parts of extrathoracic airways). The measurement lasts for 30-60 seconds to register several respiratory cycles.

The assessment of respiratory system properties by means of IOS has some advantages comparing to spirometry. Firstly, the examination is made during quiet breathing and does not require any specific respiratory maneuvers. Secondly – it has been applied with success in the

young children starting at the age of 3 years. Finally – it brings information on respiratory mechanics – mainly resistance. Comparing to spirometry – much more young children are able to perform the test procedure, especially in younger group. Ducharme and Davis (19) have shown, that IOS can be performed in 3 years old children with a success rate of 50%. In the study of Malmberg et al. (20) made in the children aged 2.1-7.0 years out of 131 children 109 of them were able to make measurements. Frey et al. (21) had 95.3% of cooperating children in their study involving children aged 3-10 yrs; in a study from our laboratory (22) we had 96% of cooperation in a group of 626 children aged 3.1-18 years.

Assessment of resistive properties by means of the analysis of resistance at various frequencies is much better documented than analysis of reactance and elasto-inertive properties, so the discussion will be limited to analysis of resistance measured with IOS.

It is assumed, that R at 5 Hz (R5) reflects the total sum of resistances within respiratory system (i.e. extrathoracic, central and peripheral resistances) while R20 (at 20 Hz) more central resistance. Thus, IOS potentially gives some information on peripheral resistance.

The IOS results have been compared to other techniques in many studies. Generally there is a good agreement between IOS and spirometry. In the study of Buhr (23) and coworkers made in 60 healthy and 66 asthmatic children aged 4-8 yrs, at the fixed specificity of 0,95, the sensitivity of spirometry was 0,76 while of forced oscillation 0,66. However, 27% of the examined children could not perform spirometry. In another study from our laboratory (24), correlation coefficient between FEV1 and R5 was -0.65 in 337 children aged 5-18 years.

The technique is very useful in the assessment of bronchodilatatory effect or in provocation tests – where spirometry fails. This is particularly important – as assessment of bronchodilatation in very young children is important in differential diagnosis. According to Nielsen (25) drop in R5 by 29% means significant response; Hellinckx et al. (26) have found that a relative change of resistance of less than 40% should be regarded as within normal range. The usefulness of IOS in determining bronchodilator response in preschool children has been validated recently by Olaguibel et al. (27).

A variety of published reference values (20-22) makes possible to assess respiratory system state after a measurement. The most recent, coming from or laboratory were calculated using the results obtained in 626 healthy children aged 3.1-18.9 years. This offers unique possibility to trace lung function during all the growth period from early childhood to adultery.

Table 2. Selected reference values for impulse oscillometry in preschool children.

	Number of children	Group composition	remarks
Frei et al. (20)	222	Age: 3-10 Height 100-150 cm	White Caucasian
Malmberg et al. (21)	109	Age: 2.1-7.0 Height 109±10 cm	Finnish preschool children
Nowowiejska et al. (22)	626	Age – 3.1 – 18.9 Height: 95-193 cm	Polish children

Of all three techniques of studying respiratory system properties described here, IOS seems to be the easiest to perform.

The Interrupter Technique

The technique is based upon Pascal's principle, which says that in closed systems pressure is the same in every point of the system. When the airflow at the mouth is rapidly interrupted by a fast valve, alveolar pressure and mouth pressure will rapidly equilibrate. So, interrupter resistance Rint is defined as mouth pressure divided by the airflow measured just before interruption.

The technique has been introduced in 1927. After revision in 70 and 80's it gained some popularity. Detailed description can be find in (28). With the appearance of commercial setups it started to be used in many laboratories in the world to study preschool children. As measurements are made during quiet breathing – only passive cooperation is required. Standardisation recommendations (9) define the procedure as follows:

- Measurements should be done in sitting position, with noseclip on, using bacterial filters.
- The cheeks should be supported during measurement
- The occlusion should last 100 ms, evoked by a fast valve closing in less than 10 ms.
- Occlusion should be triggered by flow during expiration
- A minimum of five acceptable occlusion should be recorded
- The median of all acceptable occlusion resistances should be reported

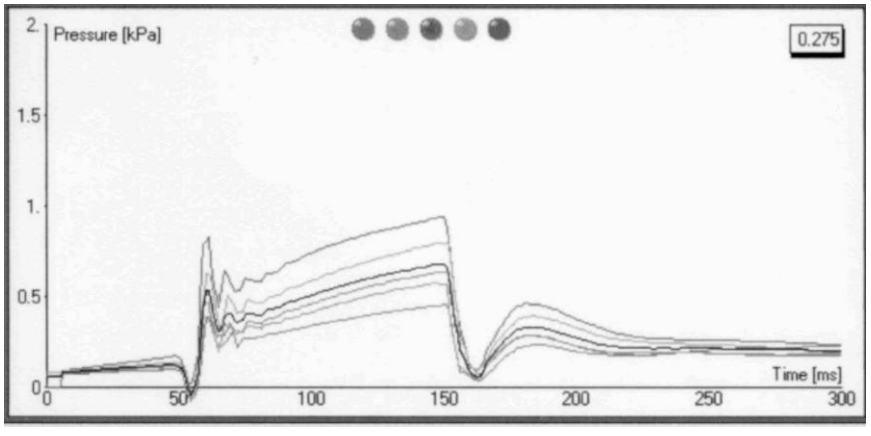

Figure 2. A screen presenting six registrations of occlusion. Note initial oscillations just after occlusion and then slow increase of pressure.

After a fast occlusion of the airways, there is a rapid increase of mouth pressure, followed by a series of oscillations which are damped depending on the properties of the whole system (chest wall, lungs, upper airways, equipment), and then slow increase of Pmo which is reaching final plateau at the end of occlusion (see Figure 2). Due to those oscillations it is difficult to determine the proper value of occlusion pressure, so several methods have been proposed to calculate occlusion pressure. This difficulty in analysis limits somehow the use of the technique.

According to (28), repeatable measurements of Rint can be obtained in ~95% of children aged 4 years and from a smaller percentage of children aged 2-3 years, and the percentage of success improves with practice. Baseline values of Rint are lowest in healthy children, and a bit greater in children with wheezing. However, relatively high coefficient of variation of Rint causes a considerable overlap between the groups. Reported values of coefficient of variation in young children are 8-15% and are higher than those for FEV1 (~5%) and similar to the variation of impulse oscillometry indices (10-11%). The study of Chan (29) showed rather poor between-ocassion repeatability of Rint over 3 week period in wheezy children (limits of agreement – 53%), which may limit the usefulness of the technique in measuring the effects of intervention over longer periods of time, but for short time assessment (e.g. bronchodilator effect) the technique seems to be suitable.

For interrupter resistance several sets of reference values have been published – see table 3 for examples.

Table 3. Selected reference values for interrupter resistance in preschool children.

	Number of children	Group composition	remarks
Lombardi et al. (30)	284	Age: 3.0-6.4	White children
Merkus et al. (31)	208	Age: 3-13	White children
Beydon et al. (32)	91	Age: 3 – 7	White children

Contrary to the impulse oscillometry – Rint still needs verification by comparing to other techniques (IOS, spirometry).

CONCLUSIONS

When considering evaluation of the respiratory system properties in preschool children, one has to take into account pro's and contras as there is no ideal technique suited for young children. Table 4 compares the three techniques available.

Table 4. Comparison of spirometry, IOS and interrupter technique.

	Spirometry	IOS	Interrupter technique
Popularity	+++	+	+/-
availability	+++	+	+/-
Standardization documents	+++	++	+
Reference values	++	+	+
Requirements: Cooperation	+++	+/-	+/-
Respiratory Manouvers	+++	-	-
Easiness of performance	-	+++	++
Analysis of data	easy	difficult	difficult
Cost	very low	low	low

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 115-124

Chapter 9

RELATIONSHIP OF OBJECTIVE MEASUREMENT OF PHYSICAL ACTIVITY AND BMI IN PRESCHOOL CHILDREN

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ABSTRACT

Purpose

The purpose of this study was two fold (1) to describe objective levels physical activity (PA), including sedentary activities (SB) total PA (TPA) and moderate-to-vigorous PA (MVPA) patterns during school hours and (2) to determine the association of body mass index status (BMI) with school hours PA patterns in preschool children.

Methods

The sample comprised 59 preschool children (31 girls) aged from 2 to 5 years old. Weight and height were measured according to standard protocols. Cole's cut off points were used to define obesity status. The children used the accelerometer (MTI/CSA) for 4 consecutive days during school hours.

Results

We found an overweight/obese prevalence of 30%. We only found statistically significant differences between genders at the age of 5 years-old. No statistically significant association was found between BMI and PA patterns.

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Conclusion

No statistical significantly differences between gender and BMI were found for these age-groups. Gender differences in MVPA at school are presented in early aged.

INTRODUCTION

The prevalence of paediatric obesity has increased dramatically in the last decades, in most countries (1, 2), as well as in Portugal. This continued broaden is particularly alarming not only for the increasing risk of multiple medical comorbidities (3), but also due to the tracks into adulthood (4). The increased obesity prevalence in children (5, 6) has increased awareness of physical inactivity as a public health problem (7). Indeed, it is commonly assumed that reduced PA and the increase sedentary behaviour (SB) are implicated in the aetiology of childhood obesity (8, 9). Early infancy is a period of rapid weight gain (10) and some behaviours such as increased television viewing, increased energy intake and decrease in physical activity (PA) may all contribute to the development of overweight among children (11, 12). Some studies indicate that levels of total energy expenditure (TEE) in young children are very low (13) and levels of SB exceptionally high (14, 15). However, few studies of physical activity in kindergarten children have been undertaken so far. Additionally, there is a need to understand the factors that influence PA in preschoolers and to learn how to help them to being more active as well as to follow over time the potential risks associated to obesity development. For instance, the intrauterine life, infancy, and the preschool period, around the time of the adiposity or body mass index rebound, have all been considered as possible critical periods during which the long term regulation of energy balance may be programmed (16). Prevention strategies for childhood obesity to date have usually been unsuccessful and typically focus on change in lifestyle during childhood or adolescence. Thus, future interventions might be based on data from early age's population; focus on environmental changes targeted at relatively short periods in early life, attempting to modify factors early childhood, which are independently related to later risk of obesity (16). For instance, increasing birth weight was independently and linearly associated with increasing prevalence of obesity in late childhood and adolescence (17).

Variation in physical activity may be particularly important in preschool children because it might influence timing of the "adiposity rebound," when body mass index (BMI) increases after reaching its nadir in childhood. The adiposity rebound is a critical period for the risk of later obesity; children who experience early adiposity rebound are at greatly increased risk of adult obesity (18). Furthermore, evidence that dietary energy or macronutrient intake does not influence timing of adiposity rebound implies that declining levels of habitual physical activity/increased physical inactivity might be responsible (18). However, there is a paucity of data on physical activity in representative samples of children around the time of the adiposity rebound. Previous studies of PA in young children have been limited by the lack of acceptable measures of PA. It is well known that at this age, children are unable to self-report their PA accurately (19, 20), and surrogate reports by parents and other adults have limited validity (21). Hence, the measurement of the PA since early ages is a key factor in lifestyle evaluation and a tool for its control. Recent reviews have concluded that accelerometry provides an objective, practical, accurate and reliable means of quantifying the amount and

intensity of habitual PA and amount of SB in children (22, 23), particularly in preschool children (18, 24, 25). Despite that, there are few studies that addressed the relationship of objectively measured SB, PA and BMI in young children. Thus, the aim of this study was two fold (1) to describe objective levels physical activity (PA), including sedentary activities (SB) total PA (TPA) and moderate-to-vigorous PA (MVPA) patterns and, (2) to determine the association of body mass index status (BMI), PA patterns in preschool children.

METHODS

Participants and Setting

The participants were 59 healthy Portuguese preschool children (28 boys, 31 girls) aged from 2 to 5 years old (mean 4.3±1.15). Mean height was 101.03 ±9.79 cm and body mass was 17.50±3.26 kg. These values were within the normal ranges for children of this age (15, 26, 27). Informed written consent was obtained from children's parents or guardians and the school principal before the subjects entered into this study. The Portuguese Ministry for Science and Technology provided permission to conduct this study.

Anthropometric Measurements

Body height and body weight were determined by standard anthropometric methods. Height was measured to the nearest millimetre in bare or stocking feet with girls standing upright against a Holtain portable stadiometer. Body weight was measured to the nearest 0.10Kg, with participants lightly dressed (underwear and tee-shirt) using a portable digital beam scale (Tanita Inner Scan BC 532). The average of two measurements was used for both height and weight. Body mass index (BMI) was used to define overweight and obesity from the references establishing by (28) as recommended by the International Obesity Task Force (IOTF).

Physical Activity Assessment

PA was measured using the MTI/CSA WAM-7164 accelerometers (MTI, Fort Walton Beach, Florida, USA). This is a small, lightweight, uniaxial device (measures movement in the vertical plane). This accelerometer produces 'raw' output in activity counts per minute (CPM), which can be considered as a valid index of total 'volume' of PA. Alternatively, accelerometry output can be interpreted using age specific cut-points, which describe different intensities of PA.

The study was conducted on five consecutive schooldays (Monday to Friday) in February of 2008, during school hours, for a minimum of 6 hours per day. In one of the days the students were engaged in a swimming lesson, consequently this day had less than 6 recording hours and therefore was excluded from the analysis. Thus, for the purpose of this study only 4 days were considered. Teachers were instructed to place the accelerometer on the respective

child at the arrival at school and remove it before they went home. The accelerometer was firmly placed at the child's waist by an elastic belt over the non-preferred hip under clothing (own cloth and school coat).

For the current study, the epoch duration or sampling period was set at 5 seconds to detect the as much as possible children's spontaneous activities (29). Accelerometer data were treated with specific software MahUffe (version 1.9.0.3). Data was analysed using specific paediatric cut-points which have been validated for young children (30). The age-specific counts-per-minute (CPM) cut-offs for classes 2, 3, 4 and 5 years old for the different activity intensities (in CPM) were respectively: Sedentary - ≤1028, ≤1204, ≤1452, ≤1592; Light PA - > 1029, >1205, >1453, >1593; MVPA - ≥1984, ≥2457, ≥3245, ≥3561, as recommended by (30).

A diary was given to the children's teachers, who were instructed to record the time when the monitor was attached in the morning and detached in the evening. They were also instructed to note every time the children performed any activities like swimming, gymnastics, walks, gardening and simply going to the recess. No activities were prescribed or directed for the teachers; children participated in normal activities with their classmates. After analysing the data with the MAHUFFE software, we re-analysed each children's data manually, considering the teacher's diaries, in order to delete counts that appeared outside the recording hours, avoiding therefore data errors.

Statistical Analysis

All data was checked for normality prior to statistical analysis using descriptive statistics, histograms with normal distribution curves and using Kolmogorov-Smirmov normality test. All anthropometric, sedentary activities (SB); total PA (TPA) and MVPA data were parametrically distributed. Therefore a T test and ANOVA test, followed by a post hoc Scheffe test when necessary, were used to determine differences between gender and age-groups, respectively. A chi-squared test was used to compare differences between categorical values, i.e. between BMI and gender or age-groups. Statistical analysis was performed using SPSS 15 software (SPSS Inc., Chicago, IL, USA) and Microsoft Excel 2000. The level of significance was set at $p \leq 0.05$.

Results

The descriptive data (mean and standard deviation) of anthropometric measurements, by gender and age-group, are shown in Table 1. It was found that boys are, in average, slightly heavier and taller and have an higher BMI than girls, although these differences are not statistically significant (p>0,05). BMI decreases with age. Older children (5 years old) showed significantly lower BMI compared to their younger counterparts (2 years old) (p=0,02). All together the prevalence of OV/OB was 30.5%. However, no statistic significant differences were found either for gender or age-groups (p>0,05).

Table 1. Frequency of Overweight by gender and age-groups.

	Age (years)	Weight (kg)	Height (m)	BMI (kg/m2)	BMI (%)	
					Normal	Overweight/Obese
Group (n=59)	4.26±1,15	17.50±3,26	101.03±9,79	17.06±1,27	69,5	30,5
Gender						
Girls (n=31)	4.35±1,08	17.39±3,04	100.92±9,20	17.03±1,42	71,0	29,0
Boys (n=28)	4.16±1,23	17.62±3,55	101.16±10,59	17.08±1,11	67,9	32,1
Age-Groups						
2 y old (n=13)	2.69±0,17	13.68±1,61	87.31±4,08	17.89±1,27(*)	69.2	30.8
3 y old (n=13)	3.57±0,28	16.10±1,43	97.19±3,47	17.03±0,91	76.9	23.1
4 y old (n=16)	4.64±0,26	18.78±2,72	104.78±5,25	17.04±1,37	56.3	43.8
5 y old (n=17)	5.64±0,26	20.29±2,18	110.94±4,12	16.46±1,16(*)	76.5	23.5

* significant at the 0.05 level

Table 2. Physical Activity patterns of boys and girls in different classes

	Sedentary Time		Total Physical Activity		MVPA	
	%	Minutes	%	Minutes	%	Minutes
Group (n=59)	82.31	332.96	17.69	66.07	7.53	26.46
Gender						
Girls (n=31)	83.05	347.18	16.95	65.08	6.97	25.41
Boys (n=28)	81.49	317.22	18.51	67.16	8.16	27.63
Age-Groups + Gender						
2 y old (n=13)	86.89	274.86	13.11	41.71	6.00	19.06
Girls (n=6)	87.30	292.19	12.70	43.39	5.57	19.09
Boys (n=7)	86.54	260.00	13.47	40.28	6.37	19.04
3 y old (n=13)	71.98	175.90	28.02	67.73	14.65	35.36
Girls (n=6)	72.20	168.00	27.80	65.33	14.00	33.01
Boys (n=7)	71.79	182.67	28.21	69.79	15.20	37.39
4 y old (n=16)	83.70	392.13	16.31	75.57	5.99	27.87
Girls (n=10)	83.14	382.44	16.86	76.42	6.40	29.21
Boys (n=6)	84.62	408.27	15.38	74.16	5.31	25.65
5 y old (n=17)	85.41	441.82	14.59	74.47	4.72	23.99
Girls (n=9)	87.35 (*)	464.11	12.65 (*)	66.77	3.84 (*)	20.32
Boys (n=8)	83.23 (*)	416.74	16.77 (*)	83.14	5.71 (*)	28.10

* significant at the 0.01 level

Table 2, shows the percentage of time spent in SB, TPA and MVPA by gender and age-group (mean and SD). On average, 82,31% of time spent in school day was allocated to sedentary tasks. About 7,53% of time (26,46 minutes per day) was spent in MVPA. Two years old children showed higher level of SB (86,89%), while the 3 years-old showed the lowest (71,98%) level ($p \leq 0,000$). The most active group was the 3 years old. This group allocated 28,02% of the time to TPA and 14,65% to MVPA. These values were statistically higher ($p \leq 0,000$) when compared with other age-groups. At the age of 5 years-old boys were significantly more engaged in TPA ($p=0,006$) and MVPA ($p=0,041$) and less in SB

(p=0,006), than their female peers. No statistically significant differences were found for other age-groups. Further, no statistically significant associations were found between OV/OB and PA patterns.

Discussion

The increased obesity prevalence in children (8) has increased awareness of physical inactivity as a public health problem (7). However, few studies of physical activity in very young children have been undertaken so far.

In this study we found a frequency of Ov/Ob of 30,5%. Although in Portugal the childhood Ov/Ob has been increasing (31), there aren't, at best of our knowledge data reporting Ov/Ob prevalence in this age-groups. Data with children aged 7-9 years-old showed and estimated prevalence of Ov/Ob around 30%, which is close to our findings. Our results, however, are less than to those reported in Italian and Greece (32%) as well US (38%) children (32-34). Although participants were not country representative the outcomes raised some concerns. Indeed, despite greater risk for the persistence of obesity in adolescence (RR=6.2) than in childhood (RR=4.2) (34), the values found in our study are alarming and call for appropriate interventions. For instance, some researches estimate that over 46% of childhood in the US will have overweight by 2010 (35). Given that paediatric obesity can lead to adult obesity (36) our data may rise further in the coming years.

We used accelerometers to measure PA patterns. Accelerometer as a means of assessing engagement in activity, relative to direct observation of physical activity, is already used for preschool children (37), providing an objective measure of PA in these ages (25). Our data showed that our preschooler children spent in average 82.3 % of the school time in SB. These values were below (90%) of those reported by Alhassan et al. (15) and slightly higher (78%) of the reported by Kelly et al. (38) Thus our data seems to suggest that most of the time spent in school is related to SB, which in turn is believed to be central to childhood obesity risk (7). Further, our findings support the idea that even in early childhood the average daily time in SB are high, which doesn't allow to accomplish PA-health related guidelines. Indeed, general guidelines suggested that preschool aged children should accumulate at least 120 minutes of PA per day (60 minutes daily of structured and 60 minutes daily of unstructured of PA) (39). On the other hand, an expert panel reviewed the literature on PA in school-aged children and recommended that children should participate in at least 60 minutes of MVPA per day every day (40). Moreover, recently, the American Heart Association released a statement pointed-out that schools should ensure that children participate in a minimum of 30 minutes of MVPA during the school day, including active time during physical education classes (2). Despite those values are assigned to school children, our data showed that with exception for the 3 years-old group (35.36 min of MVPA) no other age group accomplished that goal. The age group of 3 accumulated significantly more TPA and MVPA compared with the other age-groups, which is likely due to their school schedule. A diary observation showed that they have more recess time and less seat activities in their class room. Moreover, both values, SB and MVPA, suggest that early PA interventions are needed. Despite that, we didn't find a statistical significant association between the children's SB, PA and BMI, which agrees with other study showing no significant association between low activity level and BMI (41). Nevertheless, Reilly et al (7) observed a weak positive correlation between BMI-SD score

and activity. One possible explanation for our data might lie on the fact of the high level of OV/Ob found. Moreover, specific MVPA guidelines designed for preschool children, taking into consideration their motor development and physiology is needed.

Additionally, our outcomes showed statistically significant differences between genders only for the 5 years-old age group. In fact, Girls aged of 5 spent more time in SB activities than boys (87,3% vs 83,2%) and they were significantly less engaged in MVPA (3.8% vs. 5.7%). Thus, our data corroborates other studies pointed out that gender differences are present early in life (7, 42). This is particularly worthy to stress because girls are usually described as less active than boys (43). Further, different determinants were identified as significant risk factors of childhood obesity between genders, being low activity associated to obesity in girls (44).

Strengths of this study lie on the fact that this study objectively measured PA patterns in a preschool sample which enhanced our confidence in the findings.

Some limitations of the study should also be recognized. First this study is a cross-sectional design with a relative small sample. The intent was to explore associations between PA and obesity according defined age-and-sex-specific cut-off points, but it is not possible to inferred causal relationships with such a design and, therefore results should be looked with caution. This study would benefit from additional longitudinal data combining behaviour variables and social background characteristics, which can enhance the outcomes.

ACKNOWLEDGEMENTS

We thank the preschool students and parents for contributing in the study. Paula Coutinho, preschool director, and the teachers who welcomed us into their classrooms: Maria, Isabel, Clara, and Margarida.

Research was supported by Foundation of Science and Technology: SFRH/BD/30059/2006.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 125-181

Chapter 10

EVALUATION OF A WHOLE-CLASS TOKEN ECONOMY TO MANAGE DISRUPTIVE BEHAVIOR IN PRESCHOOL CLASSROOMS

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ABSTRACT

The behavior of children in a preschool classroom was assessed to evaluate the effectiveness of two classroom management approaches: (a) strategies already employed by the teachers, and (b) the Level System. Strategies already employed by the teachers were those that they currently used in their preschool classroom. This phase was considered the baseline or "A" treatment phase. The Level System is a new program that utilizes strategies including a token economy, stimulating rewards, strategic attention, and labeled praise to manage a range of behaviors exhibited by children in the classroom. This was considered the "B" treatment condition. These two approaches were evaluated using an ABAB sequence where each was employed for a minimum of 17 observations with 4 male 4-year-old participants. Behaviors were assessed using unobtrusive classroom coding of activities and teacher report. Four main findings were obtained: (a) the Level System was more effective in managing disruptive behavior than previously-used classroom management strategies, (b) fewer time outs were given while the Level System was used in the class compared to while the typical classroom management strategies were used, (c) teacher report of satisfaction with the Level System varied, but parents reported high levels of satisfaction with the Level System, and (d) negative effects on "intrinsic motivation" with use of the Level System were not evident.

INTRODUCTION

Research suggests that the amount of behavior problems exhibited by preschool children (ages 2-5 years) has been increasing, and current estimates range from 2% to 17% (Campbell,

1990; Lavigne et al., 1996, 1998). The prevalence of behavior problems has increased from 1.7% in 1979 (Clark and Cheyne, 1979) to at least 8.3% in 1998 (Lavigne et al., 1996, 1998). For example, oppositional defiant disorder (ODD) has been reported to be present in 16.8% of preschool children (Lavigne et al., 1996, 1998). The reason for these increases is unknown. However, social factors such as increased parental stress, unemployment, single parent status, and decreased social support partially may account for this trend (Bacharach and Baumeister, 2003; Dunifon, Kalil, and Danziger, 2003). Thus, it appears that the number of children with behavior problems in preschool classrooms will increase (i.e., approximately 2-3 per class), and teachers will be required to manage these disruptive behaviors. However, 75% of teachers reported that their education insufficiently prepared them to manage children with special needs (including children with disruptive behavior disorders), and 72% of teachers reported that they were insufficiently prepared to manage behavior problems in the classroom (Merrett and Wheldall, 1993). Despite these facts, 69% of teachers reported that discipline is the most important issue to consider when attempting to improve the education of children (Merrett and Wheldall). Thus, providing preschool teachers with strategies to manage disruptive behavior in the classroom effectively is essential to meet the teachers' needs as well as the needs of the children. Furthermore, early intervention with children exhibiting behavior problems have yielded clinically significant improvements in functioning (e.g., Hoffman and DuPaul, 2000; McConaughy, Kay, and Fitzgerald, 1999; McNeil, Capage, Bahl, and Blanc, 1999).

The current study examined the effectiveness of the Level System (McNeil and Filcheck, in press), a new and innovative whole-classroom approach for behavior management in preschools. The program is similar to a token economy with a response cost, and it was designed to provide preschool teachers with skills and strategies to manage behavior problems in their classrooms. The Level System consists of seven levels: three sunny levels, three cloudy levels, and one neutral level. Each child is assigned a shape that is placed on the chart. The teacher provides social reinforcement (i.e., labeled praise) and moves the children's shapes up a level for appropriate behavior. For inappropriate behavior, the teacher provides a warning and moves the children's shapes down a level for continued inappropriate behavior. At specified times throughout the day, all of the children with shapes in the sunny area receive a reward (e.g., activity, sticker). In the current study, potential positive and negative effects of the Level System were evaluated, as well as teacher and parent satisfaction with the program.

This paper is organized in the following manner. First, general issues surrounding the use of token economies in preschool classrooms are discussed. Second, considerations in using token economies in preschool classrooms are presented. Third, the effectiveness of token economies is discussed. Fourth, a review of the literature regarding the use of token economies to manage disruptive behavior in preschool classrooms is conducted. Fifth, a description of the Level System is presented. Finally, the results of the current study are presented and discussed with respect to the hypotheses.

Token Economies

Behavior management strategies (e.g., positive reinforcement, time out, response cost) have proven effective in decreasing inappropriate behavior and increasing appropriate

behavior exhibited by children (e.g., Donahoe and Palmer, 1994; Martin and Pear, 1996; Miltenberger, 2000). However, few such techniques have been evaluated in the context of managing disruptive behavior in preschool classrooms (Baker, Stanish, and Fraser, 1972; McGoey and DuPaul, 2000; Wolfe, Boyd, and Wolfe, 1983). In elementary classrooms, though, token economies have been used to manage disruptive behavior (e.g., Anhalt, McNeil, and Bahl, 1998; Bahl, McNeil, Cleavenger, Blanc, and Bennett, 2000; Drege and Beare, 1991). A token economy (e.g., star chart) has been defined as a program in which individuals earn tokens (e.g., poker chips, stickers) for exhibiting certain targeted behaviors (e.g., compliance). These tokens can be exchanged for rewards (e.g., activity, snack) (Cooper, Heron, and Heward, 1987; Martin and Pear; Miltenberger). Often, token economies include a response cost procedure as well. A response cost is characterized by the removal of a pre-determined number of tokens following the emission of an undesirable behavior (Cooper et al.; Martin and Pear). For the purpose of this paper, token economies will be discussed with the addition of the response cost procedure, unless otherwise specified.

A token economy is comprised of several components. First, the target behaviors must be operationally defined (Cooper et al., 1987; Miltenberger, 2000; O'Leary and O'Leary, 1977). These are the behaviors that the implementer wants to increase (e.g., compliance, sharing) or decrease (e.g., noncompliance, throwing toys). The operational definitions should be objective and explicit to the implementers as well as the children to ensure that each person understands which behaviors are required to receive tokens.

The second component involves determining the type of token, or secondary reinforcer, to be used (Cooper et al., 1987; Miltenberger, 2000; O'Leary and O'Leary, 1977). Miltenberger suggests using poker chips, smiley faces, coins, stamps, stickers, and geometric shapes as tokens, but warns against using tokens that can be duplicated or acquired elsewhere.

Another component of a token economy is establishing the backup or conditioned reinforcer (i.e., rewards) (Cooper et al., 1987; Miltenberger, 2000; O'Leary and O'Leary, 1977). The reward must be reinforcing to the child to increase the child's appropriate behavior. In addition, in a classroom setting, the rewards also must be acceptable to the teacher. For example, some rewards may be logistically unacceptable to the teacher (e.g., long walks to fast food restaurants, expensive toys). Novel and variable rewards have been suggested to be effective with children, particularly those with behavior problems such as hyperactivity (Anhalt et al., 1998; Bahl et al., 2000). Additionally, variable reinforcers repeatedly have been shown to result in an increase in target behavior (e.g., Martin and Pear, 1996, Miltenberger).

Establishing a token exchange rate is the fourth component of developing a token economy (Cooper et al., 1987; Miltengerger, 2000). In other words, the implementer must decide how many tokens are required to receive each backup reinforcer. Typically, smaller rewards require fewer tokens than larger rewards. When using a token economy with preschool children, the exchange rates should be simplified to enhance understanding. Specifically, the amount of tokens needed to receive a reward should be kept small so that advanced counting skills are not required (e.g., 1 red sticker for a reward).

Deciding when and how often the tokens will be exchanged is the last component of a token economy (Cooper et al., 1987; Miltenberger, 2000). For example, a teacher may decide that tokens may be exchanged only at the end of the day, or after breakfast and after lunch. Depending on the reward, misbehavior may occur with the backup reinforcer. Specifically,

children may want to play with the reward, or share it with other children. Rules concerning this behavior should be clear when the token economy is implemented.

The addition of a response cost to a token economy is suggested when there are undesirable behaviors that potentially will compete with increasing the desired behaviors (Miltenberger, 2000). Adding a response cost procedure entails operationally defining the inappropriate behaviors that will result in the loss of tokens and the amount of tokens that will be lost for exhibiting the defined behaviors (Miltenberger; Walker, 1983). The number of tokens lost should reduce the likelihood that the child will have the opportunity to receive the backup reinforcer. However, the child must have some tokens in reserve or there will be no tokens to lose. Therefore, it is important to use baseline data to determine the amount of token loss per behavior (Cooper et al., 1987).

When determining whether or not to use a response cost in addition to a token economy, some disadvantages of response costs must be considered. For example, sometimes, the loss of tokens may be unethical such as removing food (Miltenberger, 2000). Also, using a response cost may result in increased verbal or physical aggression by the participant (Cooper et al., 1987). Other disadvantages of using response costs are that the implementer (e.g., teacher) may become a conditioned aversive stimulus leading to avoidance behavior from the student, and that the behavior being punished may actually be reinforced by the attention provided by removing the token (Cooper et al.).

Considerations in Using Token Economies in Preschool Classrooms

Practical Considerations

Token economies have been shown to be easy to implement, acceptable to teachers and parents, and developmentally sensitive for preschool children (e.g., Jones, Downing, Latkowski, Ferree, and McMahon, 1992; McGoey and DuPaul, 2000; Storey, Danko, Ashworth, and Strain, 1994). However, token economies also may be expensive, overwhelming for teachers, and have weak maintenance and generalization (e.g., Corrigan, 1995; Herman and Tramontana, 1971; Miltenberger, 2000; Musgrove, 1981). According to Miltenberger, the complexity of a token economy determines the amount of effort required in implementation and use. Each of the components of a token economy can have varying degrees of complexity. Therefore, in designing a token economy for a preschool classroom, the system should be simple to implement and use so that it does not interfere with the class activities, and so that the preschool children understand the token economy. For example, Storey et al. conducted a study in which the teachers' aides implemented a simple token economy with no response cost (i.e., praise and stickers given for social interactions) in order to increase social interactions during free play. According to reports by the teachers' aides, the token economy was easy to implement and use (Storey et al.), suggesting that simple token economies entail little effort from the teacher, which in turn, would disrupt the class activities less often than a complex token economy.

Research suggests that teachers, as well as parents, find token economies and response cost procedures to be highly acceptable (Elliott, Witt, Galvin, and Peterson, 1984; Jones, Eyberg, Adams, and Boggs, 1998; McGoey and DuPaul, 2000; Reynolds and Kelley, 1997; Witt, Elliot, and Martens, 1984). Specifically, Elliot et al. and Witt et al. conducted studies in which they used the Intervention Rating Profile (IRP) to determine teachers' acceptability

ratings of behavioral procedures. In the study by Elliot et al., experienced teachers participated, whereas in the study by Witt et al. preservice teachers participated. The implemented procedures varied with respect to complexity (e.g., token economy is more complex than praise) and severity of child behavior problems (e.g., daydreaming to destruction of property). The authors found that teachers rated positive interventions (i.e., token economies, praise, and home-based reinforcement programs) as more acceptable than negative interventions (i.e., time out, response cost, and ignoring). In contrast, McGoey and DuPaul found that teachers rated a response cost procedure as more acceptable than a token economy in their study. In addition, the teachers reported that the response cost procedure was easier to implement.

Jones et al. (1998) found similar results concerning token economies. More specifically, mothers of children with behavior problems rated 6 behavior management strategies using the Treatment Evaluation Inventory-Short Form (TEI-SF; Kelley, Heffer, Gresham, and Elliott, 1989). These strategies included: positive reinforcement, response cost, time out, differential attention, overcorrection, and spanking. Mothers rated positive reinforcement and response cost procedures as the most acceptable interventions compared to the others. Therefore, both time out and response cost procedures are acceptable to parents and teachers which is important because behavior management strategies that are more acceptable are more likely to be implemented efficaciously (Witt and Martens, 1983).

Some token economies have been shown to be developmentally sensitive so that preschool children can understand them (e.g., Jones et al., 1992; Swiezy, Matson, and Box, 1992; Titus et al., 1990). However, in order to be developmentally sensitive, there are several aspects of the token economy that must be considered. For example, token economies meet the developmental needs of preschool children when they are characterized by structure, predictability, simplicity, brightly-colored tokens, playfulness, visibility, and accommodations that are readily made for individual differences (Jones et al.; Kysela, 1972-1973; McGoey and DuPaul, 2000; Titus et al.). Exchange rates should be simple, and specific criteria for earning tokens should be set to facilitate understanding among preschool children. For example, research suggests that at about age 2 children begin to use numbers symbolically (Berger, 1998).

Swiezy et al. (1992) used a developmentally sensitive token economy with no response cost in their study. Specifically a bear puppet, "Buddy Bear," was used to explain the requirements of the token economy to children, and the tokens were brightly colored felt shapes that were age and gender appropriate (i.e., dinosaurs for boys, smiley faces for girls).

Other practical considerations include the financial cost of the rewards or backup reinforcers (Corrigan, 1995; Miltenberger, 2000), and the fact that teachers may have two to four children in their classroom with behavior problems. Given that the prevalence of behavior problems is increasing (Clark and Cheyne, 1979; Lavigne et al., 1996, 1998), teachers will continue to have more children that require behavior management programs. Therefore, teachers may have 2 to 4 token economies for different children in their class at one time. This may be overwhelming for the teacher because each token economy may use different tokens, different exchange rates, and different target behaviors.

Research suggests that token economies do not maintain or generalize reliably (e.g., Corrigan, 1995; Epstein, Masek, and Marshall, 1978; Herman and Tramontana, 1971; Miller and Schneider, 1970; Musgrove, 1981; Odom, Hoyson, Jamieson, and Strain, 1985). A few studies, however, suggested some generalization effects. For example, Swiezy et al. (1992)

found that behavioral gains generalized across therapists but not across settings. In addition, behavior change was found to generalize to a non-intervention condition in a study by Miller, McCullough, and Ulman (1981). However, these results were obtained during a multi-element manipulation. Some authors suggest that using a fading procedure may aid in the maintenance of behavioral gains after the withdrawal of the token economy (e.g., Kysela, 1972-1973; Martin and Pear, 1996; Miltenberger, 2000; O'Leary, Poulos, and Devine, 1972; Storey et al., 1994). In addition, Corrigan suggests that implementers should foster realistic expectations in teachers concerning the lack of maintenance and generalization. Specifically, Corrigan stated that "no one expects that positive effects of psychopharmacological agents administered for a short time can be maintained over time and across settings after the agents are withdrawn" (p. 1260). Thus, it may be unrealistic to expect lasting results from a brief token economy intervention after it is removed.

Increased occurrences of generalization are likely if the creator and implementer of the token economy first identify in which situations the target behavior occurs in order to promote generalization in that situation (Miltenberger, 2000). Also, identification of natural contingencies of reinforcement that will be available in the target behavior stimulus situation will promote generalization. The token economy should be designed to incorporate the stimulus situation and natural positive contingencies, and target behaviors should be monitored to determine if generalization is successful (Miltenberger). Continued assessment and manipulation of contingencies should continue until generalization is maintained.

Thus, token economies appear to be easy to implement and use in the classroom, acceptable to teachers and parents, and developmentally sensitive for preschool children. However, financial considerations, maintenance and generalization, as well as some philosophical issues should be considered with the use of token economies with preschool children.

Philosophical Considerations

Some authors have suggested that philosophical issues are important when conducting research using token economies (e.g., Davidson and Bucher, 1978; Ford and Foster, 1976; Kohn, 1993, 2000; O'Leary et al., 1972; Turnbull, 1988). Specifically, philosophical issues concerning teachers, parents, and children may affect research in this area. However, these concerns, if addressed at the beginning of a study, may not result in complications throughout the study.

For example, authors of theoretical articles and chapters have suggested that because token economies are straightforward (i.e., tokens are provided for specific target behaviors), the teachers' creativity and innovation with other behavior management skills may decrease (O'Leary et al., 1972; Turnbull, 1988). Furthermore, this decrease in creativity and innovation may extend to the curriculum in the classroom such that the teacher may become overly dependent on the token economy (Kohn, 2000; O'Leary et al.). For example, the teacher may use the token economy to hold the children's attention rather than developing a fun and exciting curriculum. However, supporters of using token economies (e.g., Miltenberger, 2000) continually recommend fading out the use of token economies so that natural contingencies begin to maintain target behavior. Therefore, the likelihood that teachers would become dependent on using a token economy would be minimized.

The possible decrease in "intrinsic motivation" that may result from using a token economy with preschool children has been researched extensively (e.g., Davidson and

Bucher, 1978; Ford and Foster, 1976; Levine and Fasnacht, 1974; Kohn, 1993, 2000; Molloy, 1979; O'Leary et al., 1972; Roane, Fisher, and McDonough, 2003). For example, Lepper, Greene, and Nisbett (1973) conducted a study in which preschool children were rewarded for using specific drawing markers. Results suggested that they were less likely to use the markers after the rewards were withdrawn. In fact, the children used the markers less often than they did before the rewards were implemented. Thus, some authors have concluded that token economies should not be used with children for this reason. For example, Kohn (1993) argued that being rewarded only once for exhibiting a certain behavior can "kill your interest in it for weeks" (p. 74). Similarly, Levine and Fasnacht stated in a non-empirical article that token economies "should be avoided unless there is a real danger to the person or there is no alternative" because of the potential decrease in "intrinsic motivation" (p. 820).

Contradictory empirical evidence to this concern is abundant (e.g., Davidson and Bucher, 1978; Molloy, 1979; Roane et al., 2003). Results from this research suggested that token economies did not negatively affect intrinsic interest. Specifically, Molloy conducted a study in which 30 children were assigned to one of three conditions: token economy, expected reward (received reward without earning tokens), or unexpected reward. Tokens (which could be exchanged for rewards) or rewards (depending on condition) were given for drawing with colorful markers. The author found no significant differences between pre- and post-observations of drawing behavior for any of the conditions. In a study with an ABAB design, Davidson and Bucher provided 4 children with tokens for playing with a specific activity (i.e., house or clown). Results indicated that children did not engage in the reinforced activity less than they did during baseline once the reinforcement was withdrawn. Roane et al. conducted a study in which a 14-year-old male with delays was provided with a reward (20 s play with toy telephone or radio) for sorting silverware. Roane el al.'s findings suggested that when the participant was rewarded for sorting, his sorting behavior decreased, and when it was not reinforced, the behavior increased to above baseline levels. Thus, rewards did not decrease the participant's intrinsic interest in the task, but increased his interest.

Recently, Cameron, Banko, and Pierce (2001) conducted a meta-analysis using research over the past 30 years to determine the overall effects of rewards on "intrinsic motivation". They found that rewards produce no harmful effects during task performance. Specifically, results indicated that rewards produced positive effects on "intrinsic motivation" during low-interest tasks, and during high-interest tasks when they were explicitly tied to behavior and success. Negative effects on "intrinsic motivation" only were found when the rewards were expected, tangible, and not tied to the behavior. Thus, the authors concluded that rewards have no pervasive negative effects on "intrinsic motivation".

Kohn (1993, 2000) has suggested, in his books, that token economies create controlling environments that decrease children's self-esteem because children exhibit certain behaviors (e.g., drawing with specific markers) only to receive the external rewards and not because they enjoy exhibiting that behavior. Kohn (1993) also has suggested that token economies promote competition among preschool students (i.e., children compete to receive the most tokens) which decreases teamwork and helping behaviors. Furthermore, this competition may lead to increased levels of anxiety in children because they are concerned with receiving tokens and rewards. Another concern raised by Kohn (1993) was that children may become dependent on receiving rewards and, therefore, may not engage in the targeted behaviors without expecting to receive tokens. According to Kohn (1993), this dependence is evident when the targeted behavior decreases after the withdrawal of the token economy. However,

some authors (e.g., Reitman, 1998) have shown that Kohn (1993, 2000) ignored research (e.g., Dickinson, 1989; Vasta and Stirpe, 1979) that contradicted his viewpoints.

Concerns with fairness and the rewarding value of the classroom without the token economy are two other philosophical issues that have been discussed in conceptual works (Kohn, 1993; Skinner, Cashwell, and Dunn, 1996; Turnbull, 1998). Specifically, children with behavior problems may not exhibit targeted behaviors (e.g., sharing, compliance) frequently enough to receive the reward (Kohn; Skinner et al.). Therefore, they may not even attempt to receive tokens (Kohn). However, research has indicated that no disturbing effects have been found concerning the behavior of children who do not receive rewards (Okovita and Bucher, 1976). In addition, the token economy rewards may be more rewarding than the regular class activities, especially if the rewards are activity-based. Thus, the children may perceive the regular class activities as less rewarding after the token economy has been implemented (Turnbull).

Several issues have been raised in the theoretical literature concerning parents. For example, if token economy charts are displayed in the classroom, the potential exists that other parents could have access to information regarding any child's behavior. Kohn (2000) has recommended that parents remove their children from classrooms in which behavioral charts (e.g., start charts) are displayed because it is evidence that students are being ranked and compared against each other. In addition, parents may not approve of using token economies if their children do not receive the rewards with enough frequency, and, as stated previously, children with behavior problems may not exhibit the targeted appropriate behaviors with enough frequency to earn the rewards (Kohn, 1993; Skinner et al., 1996). Similarly, Corrigan (1995) suggested that parents may feel that their children are being humiliated if they do not receive the rewards. Preliminary research (Filcheck et al., in press) in which parents responded to questions regarding these concerns suggests that most parents remain unconcerned about these issues.

In sum, several practical and philosophical issues exist with regard to using token economies in the preschool classroom. However, some research suggests that token economies may be a promising classroom intervention to manage disruptive preschool behavior (e.g., Baker et al., 1972; McGoey and DuPaul, 2000; Wolfe et al., 1983). Literature discussing the effectiveness of this intervention strategy follows.

Effectiveness of Token Economies

Little research has been conducted using token economies specifically to manage behavior problems in preschool classrooms (Baker et al., 1972; Filcheck, McNeil, Greco, and Bernard, in press; McGoey and DuPaul, 2000; Wolfe et al., 1983). However, research has examined the effectiveness of token economies with no response cost components in managing preschool-aged children's disruptive behavior in non-classroom settings (e.g., home, hospitals) (e.g., Barkley, 1987; Budd, Leibowitz, Riner, Mindell, and Goldfarb, 1981; Herman and Tramontana, 1971; Murray, 1980; Musgrove, 1981; Swiezy et al., 1992). Also, the use of token economies to manage behavior problems in the classroom has been effective in decreasing disruptive behavior in elementary-aged children (e.g., Anhalt et al., 1998; Bahl et al., 2000; Drege and Beare, 1991).

Non-classroom Settings

Herman and Tramontana (1971) conducted a study in which a token economy with no response cost was implemented in an experimental classroom with 6 preschool children with disruptive behavior. In addition, they attempted to generalize the resulting behavioral gains to a Head Start classroom. Group and individual token reinforcement procedures were used for appropriate rest-time behavior (i.e., staying on mat, making no verbalizations). In the experimental room, tokens were given for appropriate behavior during a game (i.e., throwing balls into a bin). Observations of appropriate rest-time behavior, then, were conducted in the classroom. Results suggested that when instructions regarding appropriate behavior for the game were given to the participants, they engaged in more appropriate behavior than when instructions were not given. In addition, differential effects concerning type of reinforcement (i.e., group or individual) were not found, and the results did not generalize to the regular classroom. Floor effects may have been a concern with this study causing any differences between group and individual contingencies to be undetected. Specifically, when instructions were given regarding appropriate behavior, the amount of inappropriate behavior decreased to near zero.

In a study by Rowbury, Baer, and Baer (1976), 7 "deviant" preschool children participated in two experiments, the "Baseline Experiment" and the "Guidance Experiment." In these experiments, a mock preschool classroom was used with a teacher for experimental sessions. In the "Baseline Experiment," the children received tokens for either one, two, or three task completions which could be exchanged for access to a play area. In the "Guidance Experiment," the procedure was the same, differing only in the addition of analysis of teacher guidance (i.e., praise, prompts, instructions). Data obtained through behavioral observation indicated that the children's task completion behavior increased significantly when teacher guidance was combined with the token economy. However, the effectiveness of each type of teacher guidance (e.g., praise) was not examined.

A study was conducted by Musgrove (1981) in which a token economy with no response cost was implemented in a facility for individuals with mental retardation with 3, 4-year-old preschool children who were emotionally disturbed. However, according to their full scale IQs (i.e., 69, 80, and 93), only one child exhibited mental retardation. During the token economy phase of the ABAB reversal design, children received stickers for targeted behaviors (i.e., staying seated and following commands). Through behavioral observation, results suggested that the token economy was effective in decreasing out-of-seat behavior and increasing compliance. However, these gains were not maintained when the children were transferred to public school. Musgrove suggested that this may have been because the reinforcers used in the school were not valuable to the children. Some concerns with this study are that the training and reliability of the observers was not reported, and the reversal period was only 1 day. Thus, stability was not reached during the reversal phase before the token economy was re-implemented.

Budd et al. (1981) conducted a study in which they taught parents to use a home-based reinforcement procedure. The children were able to earn tokens for absence of disruptive behavior (i.e., off-area, aggression, negative statements) in a summer treatment program. In addition, in the home, parents reinforced their children's appropriate behavior. The methodology included a multiple-baseline design across behaviors for three groups of 6 children who exhibited disruptive behaviors. Behavioral observations were conducted, and results suggested that this delayed reinforcement procedure was effective. However,

improvements were not found in the behavior of 2 of the 18 participants. Data were not collected regarding whether the parents actually gave the children rewards at home. Thus, these findings should be interpreted cautiously.

Swiezy et al. (1992) demonstrated that a token economy with no response cost could have a positive effect on preschool children with behavior problems. The Good Behavior Game, a token economy in which a puppet, "Buddy Bear," gives the children commands, was implemented with 4 children. The children were able to earn stickers for compliance to the given commands. The Good Behavior Game was implemented by therapists in a resource room or school kitchen separately for two dyads of children, and their free play behavior was randomly observed to assess for generalization affects. Results indicated that compliance and cooperation increased significantly during the treatment phase. Specifically, compliance rates increased from 11.7% and 27.3% during baseline to 74.7% and 76.5% during treatment. In addition, generalizability occurred across therapists but not settings. However, only two to four observation sessions during free play were conducted per dyad.

Elementary Classroom Settings

Drege and Beare (1991) used a multiple baseline design across students to examine the effects of a token economy with a response cost component and a time-out component as a backup consequence. Specifically, 3 male students in an emotional/behavioral disorder classroom participated. Children earned points for appropriate behavior (i.e., following rules, raising hand, using an inside voice) and lost points for inappropriate behavior (i.e., breaking rules, speaking out in class, and lying). In addition, time out was used for severely disruptive behaviors (i.e., swearing, verbal aggression, aggression toward others, running away, and destroying property). Behavioral observation data indicated that the children's off-task and disruptive behavior significantly decreased during the treatment phase. However, the token economy and time out were not examined independently. Thus, the relative contributions of each could not be determined.

The use of a whole-classroom token economy has been shown to be effective in decreasing disruptive behavior in elementary classrooms (Anhalt et al., 1998; Bahl et al., 2000). A whole-classroom token economy is characterized by one token economy in which all of the children in the class (disruptive and typical) participate, and all receive the same reward (Anhalt et al.; Bahl et al.). In addition, most of the rewards are activity-based (Anhalt et al.; Skinner et al., 1996). Several practical and philosophical concerns (e.g., time, effort, financial constraints, children being singled out) mentioned earlier are addressed by using a whole-classroom token economy.

In Anhalt et al.'s (1998) study, a whole-classroom token economy with a response cost, The AD/HD Classroom Kit, also called The Tough Class Discipline Kit (KIT; McNeil, 1995; 2000), was implemented in a first grade classroom. Children were placed into groups (e.g., 4 or 5 children) and received labeled praise and happy faces for their group when exhibiting appropriate behavior and a warning and mild aversive consequences (i.e., sad faces) for their group when exhibiting inappropriate behavior. Rewards or backup reinforcers were given to groups with more happy faces than sad faces. Through behavioral observation of a target child (age 6) with disruptive behavior problems, results indicated that the child's level of appropriate and on-task behavior increased during the treatment as compared to the regular classroom discipline program. In addition, the teacher and students rated the KIT as highly satisfying.

Bahl et al. (2000) used the same token economy and response cost program (i.e., KIT) as Anhalt et al. (1998). Bahl et al. implemented the KIT in two first-grade classrooms using a within-subject reversal design (i.e., ABA and BAB). Behavioral observations were conducted with 6 participants. Results suggested that rates of appropriate and on-task behavior were higher in the KIT condition as compared to the school-wide standard condition. Furthermore, teachers and students were highly satisfied with the use of the KIT, and teachers reported that their classrooms were less disruptive during the KIT condition.

In sum, token economies with time out components and whole-classroom token economies with response cost components have been proven effective in elementary classrooms (e.g., Anhalt et al., 1998; Bahl et al., 2000; Drege and Beare, 1991). In addition, token economies without response cost components have been shown to have positive effects on preschool children's behavior. Thus, these types of behavioral classroom management systems may be effective with preschool children. Although only one preliminary investigation of a whole-classroom token economy with preschool children was found in the present literature review (Filcheck et al., in press), a few studies have been conducted using individual token economies to manage disruptive behavior in preschool classrooms (Baker et al., 1972; McGoey and DuPaul, 2000; Wolfe et al., 1983).

Using Token Economies to Manage Disruptive Behavior in Preschool Classrooms

Research has demonstrated the effectiveness of token economies at managing disruptive behavior exhibited by children in preschool classrooms (Baker et al., 1972; Filcheck et al., in press; McGoey and DuPaul, 2000; Wolfe et al., 1983). Specifically, Baker et al. used an ABAB design in which a token economy with no response cost and a time-out procedure were implemented to decrease the disruptive classroom behavior exhibited by 9 preschool children with mental retardation who were part of a larger class. The token economy consisted of praise and poker chips for appropriate behavior, and a 5-min time out for severe inappropriate behavior (e.g., tantrums and aggression). A control group of children in different classrooms who were matched for age and IQ were included. The poker chips could be exchanged for a tangible backup reinforcer (e.g., candy). The authors found that the experimental group engaged in significantly more disruptive behaviors at baseline, and significantly less disruptive behaviors during treatment than the control group. However, the number of time outs was not reported. Also, the authors did not assess the relative influences of time out and the token economy on treatment outcome.

Wolfe et al. (1983) implemented a token economy with no response cost with 3 preschool children with behavior problems in 2 settings (i.e., morning and afternoon classrooms) to examine the effects of a token economy on cooperative play. These children, who were a part of the larger class, received stickers placed on a "happy face chart" when they engaged in cooperative play (e.g., shared interaction between two children) for an entire min. The children could exchange a certain amount of stickers (i.e., eight or more) for 10 min of outside play. The authors found that when the token economy was in place, cooperative play increased by 50%, and time outs decreased compared to baseline. Furthermore, when the token economy was implemented in the morning, the children exhibited more cooperative

behavior during the afternoon. Thus, generalization occurred between settings. This finding contradicts concerns that token economies decrease "intrinsic motivation."

In a study conducted by McGoey and DuPaul (2000), a token economy and a response cost were implemented with 4 preschool children with Attention-Deficit Hyperactivity Disorder (ADHD) who were a part of the larger class. A single subject reversal design (i.e., ABACABAC and ACABABAC) in two classrooms was used. During the token economy condition, the children could earn buttons for following classroom rules (e.g., keep hands and feet to self, stay in area), and five small buttons could be exchanged for one big button. Three big buttons were needed to receive the reward that was given at the end of the day (e.g., hand stamp, sticker). During the response cost condition, children lost buttons when they broke a classroom rule. In addition, a typically-behaved control child was observed as a peer comparison in each classroom. However, the peer comparison was observed less often than the target children. Results indicated, through direct observation and teacher ratings, that the children's disruptive behavior decreased during the token economy and response cost. Furthermore, teachers rated the response cost procedure as more acceptable than the token economy system. The authors did not report the data concerning the number of children that lost all of their tokens during the response cost phase or the average number of tokens lost.

One preliminary investigation was conducted with the Level System to compare the effectiveness and satisfaction of the system with Parent-Child Interaction Therapy (PCIT; see Hembree-Kigin and McNeil, 1995) skills (Filcheck et al., in press). Specifically, an ABACD treatment comparison design with a 4.5-month follow-up assessment was used in a preschool classroom referred for being "out of control." In this study, condition B was the Level System, and conditions C and D were the Child-Directed Interaction (CDI) and Parent-Directed Interaction (PDI) phases of PCIT respectively. Seventeen children (mean age = 2.9 years) and one teacher participated in the study. The teacher was trained in the use of CDI and PDI skills, as well as the Level System. Behavioral observations were conducted during a videotaped circle time in which the frequency of inappropriate behavior exhibited by any participant in the classroom was coded. Thus, data were combined across children. Results suggested that the frequency of inappropriate behavior exhibited by the children decreased throughout the study while the number of time outs given by the teacher increased throughout the study. Teacher report indicated that she was more satisfied with using PCIT skills than the Level System. However, the teacher chose to use the Level System at the study's end. This preliminary investigation was limited by the lack of reversal of inappropriate behavior during the withdrawal phase, and the low level of teacher treatment integrity with the Level System. However, it provides preliminary support that the Level System may be a viable option for the management of disruptive behavior in preschool classrooms.

In sum, these studies (Baker et al., 1972; Filcheck et al., in press; McGoey and DuPaul, 2000; Wolfe et al., 1983) demonstrate that token economies and response costs are effective in decreasing disruptive behavior and increasing compliance and cooperation among preschool children with behavior problems. However, the current literature search revealed only one study (Filcheck et al.) that was conducted using whole-classroom token economies with response costs in preschool classrooms. The effectiveness of the Level System will be examined in the current study.

The Level System

Because of the effectiveness of individual token economies with preschool children with behavior problems (e.g., Baker et al., 1972; McGoey and DuPaul, 2000; Wolfe et al., 1983), and the effectiveness of a whole-class token economy with elementary school children (Anhalt et al., 1998; Bahl et al., 2000), it was hypothesized that a whole-class token economy for preschool children would be effective in managing minor disruptive classroom behavior (e.g., whining, yelling, noncompliance). Thus, the Level System (McNeil and Filcheck, in press) was developed to address the issue of increased numbers of children with behavior problems in the preschool setting. The Level System incorporates several of the techniques (e.g., labeled praise, warning signal) that are involved in the KIT (see Anhalt et al.; Bahl et al.; McNeil, 1995; 2000). However, the techniques have been made developmentally appropriate for preschool children. The Level System also was designed to address several practical and philosophical concerns regarding the use of token economies (i.e., ease in implementation, developmental sensitivity, small financial cost to teachers, fairness, displaying behavioral information).

The Level System is unique in that it is designed for the entire classroom. One advantage of using a whole-classroom approach is that no child is singled out. In other words, all of the children will have their behavioral information (i.e., tokens) displayed in the room, and have the opportunity to receive the rewards. This addresses several philosophical concerns discussed previously. In contrast, an individual token economy (e.g., star chart) only allows for one child's tokens to be displayed and for that child to receive rewards, which may be seen as unfair by other children or parents. In addition, the Level System meets the needs of the entire class because effective behavior management strategies (e.g., praise, tokens, response cost) are integral to the program (Cooper et al., 1987; Martin and Pear, 1996; Miltenberger, 2000).

The Level System consists of a chart with seven levels. The top three levels, the "sunny area," contain pictures of suns with smiling faces, and the bottom three levels, the "cloudy area," contain pictures of clouds. Between the two areas is a neutral level. Each child is assigned a certain shape on the System (e.g., dinosaur, boat, train, heart), and that child's name is written on the shape, which is placed in the neutral area at the beginning of each reward period. Consequences are given for both appropriate and inappropriate behavior at least 10 times per hr. Specifically, the children's shapes are moved up a level for appropriate behavior and down a level for inappropriate behavior. The children's shapes need to be placed at a specified level (i.e., any of the sunny levels) in order to receive a reward.

The Level System has been designed to address several practical concerns when considering use of token economies. Specifically, it was designed to be developmentally sensitive for preschool children and practical for teachers. For example, the Level System is developmentally sensitive in that children's shapes simply are moved up a level on a chart after engaging in appropriate behavior, and down a level after engaging in inappropriate behavior. Therefore, instead of earning tokens for appropriate behavior and exchanging them for rewards (which requires mathematic skills), all children that are in the sunny area on the chart at a particular time receive a reward. The behavioral goals of the Level System are developmentally sensitive in that the pre-established classroom rules (e.g., keeping hands and feet to self, staying in area, playing gently with toys, following instructions) will be the "appropriate" behaviors that will be reinforced to increase the compliance with these rules.

The developmental sensitivity of the Level System extends to the classroom materials it utilizes as well. For example, the chart contains brightly-colored shapes (e.g., circle, airplane, truck) that are familiar to 2- to 5-year-old children.

In addition, this system has been developed to be practical for preschool teachers. For example, because the teacher simply moves the children's shapes on the chart, and all children receive the same reward, the teacher would not have to dispense tokens or different rewards to each child, which could be time consuming. Also, training in the Level System requires approximately one hr, whereas other methods of training to manage disruptive behavior may require more time and effort. Specifically, McIntosh, Rizza, and Bliss (2000) trained a preschool teacher in the use of Teacher-Child Interaction Therapy (TCIT), an intervention using positive skills (e.g., praise, description), giving effective commands, time out, role plays, homework, and in vivo coaching of skills, to manage disruptive behavior. Twelve 1-hr sessions were required in order for the teacher to learn the entire program. Therefore, developing an intervention that requires much less training time and effectively manages disruptive behavior would benefit teachers as well as professionals consulting in the classroom.

As mentioned before, children's shapes are moved up for appropriate behavior and down for inappropriate behavior. In addition, when their shapes are moved up, they are given a labeled praise for the appropriate behavior (i.e., specific praise such as AThank you for sitting in your seat@) by the teacher. Also, children are given a warning for inappropriate behavior before their shapes are moved down a level. For example, the teacher would hold up two fingers and say, "You have two choices. You can either play gently with the blocks, or you will move down a level." If after the warning, the child does not begin to behave appropriately, the teacher moves the child's shape down a level. Teachers are instructed to use a monotonous tone while giving a warning to provide minimal attention to inappropriate behavior. Teachers are encouraged to give frequent and immediate feedback (i.e., enthusiastic labeled praise, warnings, moving shapes) for appropriate and inappropriate behavior.

At the end of a certain period of time (e.g., after circle time), all children with shapes in the sunny area of the Level System receive the same reward (e.g., snack, activity, sticker), and all children with shapes in the cloudy area do not receive the reward. The children who do not receive the reward will participate in the regular classroom activity (e.g., coloring, painting) while the other children participate in the reward. After the reward is given, the children who received the reward go back to the regular classroom activity. The rewards are printed on cards, and the teacher chooses a reward card from the stack to employ. The teacher must provide each reward on the cards once before reusing any reward. Most of the rewards are activity based (e.g., opportunity to play a game such as charades) to reduce cost of backup reinforcers to the teacher (Kysela, 1972-1973; Miltenberger, 2000) and address a practical concern. In addition, all of the children receive the same reward to reduce the time involved with providing the rewards. The rewards are distributed one to two times in the morning and one to two times in the afternoon because children with behavior problems need frequent feedback and consequences (i.e., positive and negative) to manage their behavior effectively (e.g., Barkley, 1987; Hembree-Kigin and McNeil, 1995).

After the reward is given to the children, all shapes are placed back in the neutral area, and a new period begins during which they can earn a reward. The children, essentially, are starting over for the next period in order to maintain their motivation level. In other words, if

a child who was at the bottom of the cloudy zone did not receive "another chance" at acquiring a reward, he or she may not be motivated to behave appropriately.

Summary

In sum, research has indicated that token economies are an effective means of managing disruptive behavior exhibited by preschool children. In addition, whole-classroom token economies have been proven effective in elementary classrooms. However, only one study (Filcheck et al., in press) was found that examined the effectiveness of a whole-classroom token economy in managing behavior problems in preschool classrooms. Most of the studies conducted with this population thus far have used individual token economies for each child (e.g., star charts). A whole-class behavior management system seems essential with the increasing amount of preschool children with disruptive behavior problems and the need for teachers to have a simple, time-efficient and effective way to manage classroom behavior.

Purpose

The purpose of the present research was to examine and compare the effectiveness of two classroom management strategies in managing disruptive behavior exhibited by preschool children: the typical classroom management strategy (i.e., baseline, no intervention) and the Level System (i.e., whole-classroom token economy). Specifically, the current study evaluated whether or not the children's appropriate behavior increased and inappropriate behavior decreased while the Level System was used in the classroom, as compared to the strategies already utilized by the teachers. The effectiveness of these classroom management approaches was determined by behavioral observation and teacher report of disruptive behavior. In addition, satisfaction with the intervention was assessed by teacher and parent report of satisfaction as well as which approach the teachers chose to continue after termination of the study. Lastly, possible negative effects on "intrinsic motivation" were examined by visual inspection of the data. For example, decreases in appropriate behavior to below baseline levels upon removal of the Level System would have suggested that the children were no longer "intrinsically motivated" to engage in appropriate behavior (see Davidson and Bucher, 1978; Ford and Foster, 1976; Levine and Fasnacht, 1976; Kohn, 1993, 2000; Molloy, 1979; O'Leary et al., 1972). Because the Level System is a whole-classroom approach, it is important to assess behavioral changes in children with varying levels of disruptive behavior. Therefore, children with behavior problems and children with typical behavior participated.

METHOD

Setting

Data were collected from October through April in a rural preschool with one class and 5 preschool teachers. This preschool was arranged such that the class of children rotated through 2 teachers per day for 1 hr classes in the morning. The classes included: arithmetic, Spanish, computer, reading, and science. For example, the class may be with the computer teacher from 9:00 a.m. to 10:00 a.m., and then move to the reading teacher's room from 10:00 a.m. to 11:00 a.m. The participating class included 13 children (*M* = 3.5 years, *SD* = .52, range = 3-5 years). Most of these children were from homes in which their parents were married (85.2%), had professional jobs (74.1%), obtained either advanced (25.9%), master's (22.2%), or bachelor's (22.2%) degrees, and made over $60,000 per year (55.6%). All conditions of the study were conducted in the regular classroom with the acting primary teacher (one of five) and teacher's aide who changed frequently (i.e., many different individuals were hired for this position). If the teacher was absent, the data for those observations were not included because the substitute teacher was not expected to use the behavior management approaches in the same manner that the teacher would use them (i.e., substitute teachers were not trained by the experimenter in the use of the Level System). This occurred twice throughout the study. If, on the other hand, a child participant was absent, data collection continued for the participants who were present.

Participant Selection

Parental informed consent was obtained for 100% of the children in the class. Thus, they all were considered for participation in the study. Two preschool children with typical behavior and 2 preschool children with disruptive behavior were selected for participation based on teacher's report on the Conners' Global Index (CGI, Conners, 1997). Even though all the children in the classroom received the intervention, only the behavior of these 4 children were assessed. Children with the high scores on the CGI (i.e., gender and age-corrected T-score $\geq$60) were considered children exhibiting disruptive behaviors, and children with scores that approximated the average of the class (i.e., gender and age-corrected T-score 45-55) were considered children exhibiting typical behavior. Three children met criteria for the disruptive behavior category. Therefore, the participants for this category were randomly chosen. Four children met criteria for the typical category. Participants in this category were chosen to match the race and gender of the children with disruptive behavior. Teachers were unaware of which children were participating in the study.

Participants

The 2 children with disruptive behavior who were selected for participation were "Luke" and "Cody." Both of these children were 4 year-old Caucasian males from two-parent homes. The children's scores on the CGI were averaged from all of the teacher's ratings. On the CGI,

Luke received a T-score of 60.44 and Cody received a T-score of 70.44. Both of these scores were considered to be in the disruptive category. The 2 children with typical behavior who were selected for participation were "Tim" and "John." Both of these children were 4 year-old males and from two-parent homes. Tim was Caucasian and received a T-score of 45.20 on the CGI, and John was Bi-racial and received a T-score of 45.00 on the CGI. Additionally, 5 teachers ("Patricia," "Colleen," "Lori," "Chad," and "Rachel") participated in the study (4 female and 1 male). They ranged in age from 25 to 63 (M = 40.8, SD = 15.6), and all were Caucasian. All teachers possessed a bachelor's degree, and Colleen and Chad were working to obtain master's degrees. Amount of teaching experience ranged from 2 to 10 years (M = 6.0, SD = 3.8). The names of all children and teachers were changed for confidentiality purposes.

MEASURES

Participant Selection Measures

Conners' Global Index (CGI). The CGI is a shortened 10-item version of Conners' (1969) original scale that had 39 items. The CGI assesses disruptive behavior as well as hyperactivity. It contains disruptive behaviors rated on a 4-point Likert scale ranging from "not at all" (0) to "very much" (3). This index is sensitive to detecting behavioral changes due to treatment, and it requires a short amount of time to administer (Conners, 1997; Wainwright and MHS Staff, 1996). Several studies demonstrate the reliability, validity, and usefulness of this measure (e.g., Brown and Wynne, 1982; Diamond and Deane, 1990; DuPaul, 1991; DuPaul and Barkley, 1992; Epstein and Nieminen, 1983). Specifically, it demonstrates high inter-rater reliability (.85) and high internal consistency (.90) (Margalit; 1983). The teachers completed a CGI for every student in the class at the beginning of the study as well as after each condition.

Demographic Questionnaire

This form is a short questionnaire that includes the child's age, gender, race, marital status of caregivers, family employment, and education and income level of caregivers. It was used to determine whether demographic differences exist between the children with typical behavior and the children with disruptive behavior. All parents were asked to complete a short demographic questionnaire.

Effectiveness Measures

Revised Edition of the School Observation Coding System (REDSOCS)

The REDSOCS (Jacobs et al., 2000) is a behavioral observation coding system that is the revised version of McNeil, Eyberg, Eisenstadt, Newcomb, and Funderburk's (1991) School Observation Coding System (SOCS) which operationalized several classroom behaviors (e.g., appropriate vs. inappropriate, on-task vs. off-task, and compliance vs. noncompliance). However, in the current study, only the appropriate and inappropriate behavior categories of

the REDSOCS were recorded. This behavioral category was chosen because preschool children do not often have "tasks" that they must attend to because much of the class is unstructured. Even during circle time, the children are not required to be "on-task," only to behave appropriately. In addition, Bahl et al. (2000) found that little information was gained from the compliance category because many teacher commands are indirect or implicit. Thus, behaviors falling into these categories were not recorded. In addition, the definition of "cheating" within the inappropriate behavior category was not used in the current study because it is inapplicable to the preschool classroom.

The REDSOCS is designed to measure disruptive classroom behavior and uses a partial-interval coding system. Specifically, the REDSOCS uses a 10-s observation system in which behaviors are marked at the end of the interval with no pause except to rotate children at the end of each min. The recording procedure for the current study was a 10-s observe, 5-s record schedule conducted for one participant at a time for approximately 15 min during structured morning activities with the order balanced across participants. Thus, the recording procedure was modified. This behavioral observation system was used to code the behavior of the 4 participants in the current study. Jacobs et al. (2000) demonstrated that the REDSOCS has good psychometric properties. Specifically, inter-rater agreement of the coders for appropriate and inappropriate behaviors were .85 and .83 respectively.

Class Management Rating

The teachers were asked to complete a daily manageability assessment of the children's behavior. This rating was made on a 5-point Likert scale from "completely unmanageable" (1) to "completely manageable" (5). This assessment provided information about how manageable the class as a whole was during different conditions.

Time-Out Log

The time out log was completed daily by the teachers throughout the study. The log included which children received time outs each day, why they received time outs, and how long the time out lasted. Although time out was not addressed directly by the intervention in the current study, this information aided in assessing whether more time outs occurred in one condition as compared to the others, and thus, the effectiveness of the behavior management procedures (i.e., Level System and regular classroom strategies).

Satisfaction Measures

Intervention Rating Profile (IRP)

The IRP (Witt and Martens, 1983) is a 20-item teacher report measure that assesses acceptability of interventions on a 6-point Likert scale from "strongly disagree" (1) to "strongly agree" (6). The inventory results in one major factor as determined by factor analysis, overall acceptability of the intervention. Higher scores represent greater acceptability. Research suggests that the IRP is reliable (.91), and sensitive to differences concerning the acceptability of different treatments (Witt et al., 1984; Witt and Martens). The teachers completed this measure at the end of each condition and at the follow-up assessment.

Parent Interview

The parental interview is a 15-item form that was constructed for this study to assess parental views concerning classroom management strategies (e.g., redirection, token economies, the Level System). The first 10 items are rated on a 6-point Likert scale from "very unacceptable" (1) to "very acceptable" (6), and the last 5 items are in an open-ended format. Parents completed this form once, at the end of the study.

Treatment Integrity Measures

Training Coders

Two advanced undergraduates were trained as research assistants to complete the classroom behavioral observations using pilot training videotapes and definitions of child appropriate vs. inappropriate behaviors as well as teacher behaviors. Teacher behaviors included: praise, warning signal, providing a child with time out, moving shapes up a level, moving shapes down a level, criticism, and other behavior. A time out was coded when a teacher indicated placing a child in "time out." "Other" included interactions between the teacher and the child that did not meet the requirements of the other codes (e.g., reading a book, sitting on the teachers lap, engaging in an activity). Training occurred until the research assistants independently obtained 80% agreement for three consecutive training sessions with the author on videotaped observations of preschool classrooms for all behaviors. Then, the coders conducted live observational recording in the classroom independently.

Interobserver Agreement

Agreement was assessed throughout data collection for 30-35% of the observations on the following variables: inappropriate behavior, praise, moving shapes up a level, moving shapes down a level, time out, warning, criticism, and other. Agreement observations were chosen randomly throughout data collection. A dual headphone jack was used and the observers had as much distance as possible between them. If on any of these observations, agreement fell below .75 Kappa, which is considered excellent (Fleiss, 1981), or 80% mean occurrence/nonoccurrence agreement, for 2 consecutive observations, the research assistants were retrained before independent coding continued. The Kappa statistic fell below .75 for 2 consecutive observations 2 times for the "other" category of teacher behavior (range .211 - .828). According to the mean occurrence/nonoccurrence agreement, this occurred 2 times (range 25.3% - 86.1%) as well. Therefore, retraining of coders occurred twice throughout the study. The mean Kappa for each behavioral category was as follows: inappropriate behavior = .83, praise = .83, criticism = .80, moving shapes up a level = .96, moving shapes down a level = .98, time out = 1.0, warning = .88, and other = .77. Additionally, the mean occurrence/nonoccurrence agreement for each behavioral category was as follows: inappropriate behavior = 84.8%, praise = 84.8%, criticism = 84.4%, moving shapes up a level = 96.2%, moving shapes down a level = 97.9%, time out = 100%, warning = 88.7%, and other = 78%. The research assistants were unaware of the participants' assignment and the study's hypotheses.

Treatment Integrity Measures

Treatment integrity measures included behavioral observation of the teachers' responses to the children's behaviors (e.g., labeled praise, moving child's name up a level, warning, moving child's name down a level, time out, criticism, other), as well as the daily completion during the treatment condition of an integrity checklist by the coders. These measures assessed the accuracy of the teachers' implementation of the Level System. The teachers were informed that these measures were completed. A score of 85% or greater on the treatment integrity checklist was considered an accurate and successful implementation of the treatment for that observation. If treatment integrity on the checklist was less than 85% for 2 consecutive observations, the data for those particular observations would not have been included and the teacher would have been retrained in the procedure of the Level System. Data collection would not have begun again until integrity reached 85%. However, this criterion was never met throughout the study (range 0%-100%; M = 92.1). Integrity was below 85% on 2 observations, but they were not consecutive (58.3% and 0%). Thus, retraining did not occur. Integrity reached 0% when a teacher forgot to use the Level System. Data for the observations with questionable integrity were not used.

Additionally, the teachers were asked to construct a list of which children received and did not receive rewards to ensure that most children received the rewards on most days. Specifically, this measure indicated that approximately 2 children did not receive rewards during each observation. However, the children not receiving the rewards changed. On one occasion, on observations 5, 6, and 7 during the first Level System Condition, this measure indicated that a target participant with disruptive behavior did not receive the reward. Thus, it was discussed with the teachers that the individual expectations for this child be changed so that he had the opportunity to receive the reward. At no other time during the study did this occur.

PROCEDURE

Teacher Training

The teachers were trained in the use of the Level System 3 days before the baseline condition ended. Teacher behavior on these 3 days was monitored to ensure no changes in teacher behavior occurred before implementation of the Level System (Condition B). Visual inspection of teacher praise and criticism and child appropriate behavior indicated that no differences were evident. The experimenter and Cheryl McNeil, Ph.D., provided a 2-hr workshop to the teachers to explain the use of the Level System. In addition, the teachers were trained to use labeled praise and avoid criticism which are integral parts of the Level System (i.e., social reinforcement). At the beginning of the Level System condition, the experimenter provided in-vivo coaching to the teachers in the use of the Level System until 85% treatment integrity was reached. Integrity was reached for each teacher after one coaching session. Finally, the experimenter provided feedback to the teachers throughout data collection regarding his or her treatment integrity. Specifically, after each observation, treatment integrity checklists were reviewed, and the teachers were provided with verbal feedback regarding their implementation once a week.

Classroom Observations

Classroom observations were conducted separately by two research assistants approximately four to five times each week, in the morning, except for 30-35% of all observations which were conducted jointly by a research assistant and the experimenter to assess inter-rater agreement. These observations were conducted during one class period per day in the morning for approximately 1 hr. As stated earlier, the REDSOCS was used to record the exhibited behaviors on a 10-s observe, 5-s record partial-interval system conducted for 1 participant at a time for 15 min each with the order balanced across participants. Additionally, the research assistant recorded the teachers' responses to the child's behavior (e.g., labeled praise, moving child's name up a level, warning, moving child's name down a level, time out, criticism, other) using the same observe/record partial-interval system during the same observation periods. In other words, the child and teacher behaviors were coded concurrently. The coders used an audiotape with earphones to cue them to the child to be coded and when observations and recordings were to occur.

Experimental Conditions

The proposed study used a single subject withdrawal design (i.e., ABAB) with a 1-month follow-up assessment. Two conditions were included in this design: the classroom management strategies that the teachers already used ("A"), and the Level System ("B"). The teachers were asked to use strategies already in place and the Level System until stability was reached or at least 15 observations had passed, whichever was shorter. Stability was defined as at least 8 observations of data collection as well as no clear trends in any child's appropriate behavior for the last 3 consecutive observations of data collection. Even though some participant's data appeared to be stable in some conditions (e.g., see baseline for Cody in Figure 1), all participants' data was not stable for any condition. Therefore, the stability criterion was never reached in any condition, thus, each condition was maintained until each child was observed for at least 15 observations. Conditions were held for an increased amount of time to ensure that any changes in data were the result of treatment. Condition A was held for 19 observations. Each of the Level System conditions was held for the following number of observations respectively: 17, 20. After the withdrawal of the Level System (i.e., withdrawal phase), condition "A" was to be in place until stability was reached, plus 1 week, to examine possible negative effects on "intrinsic motivation." However, because stability was not reached, this condition remained implemented until each child was observed for 15 observations, plus 1 week, totaling 24 observations. The teacher used whichever management strategies were most satisfying after the experimental conditions ended. Thus, a 1-month follow-up assessment was conducted to determine which intervention was being used and the amount of disruptive behaviors exhibited by the participants. The follow-up assessment was to last at least as long as the shortest condition. Therefore, this condition was conducted for 17 observations. If the teachers were using the Level System at the 1-month follow-up assessment, treatment integrity was to be assessed. However, none of the 5 teachers was using the level system during follow up.

Strategies already Used in the Classroom

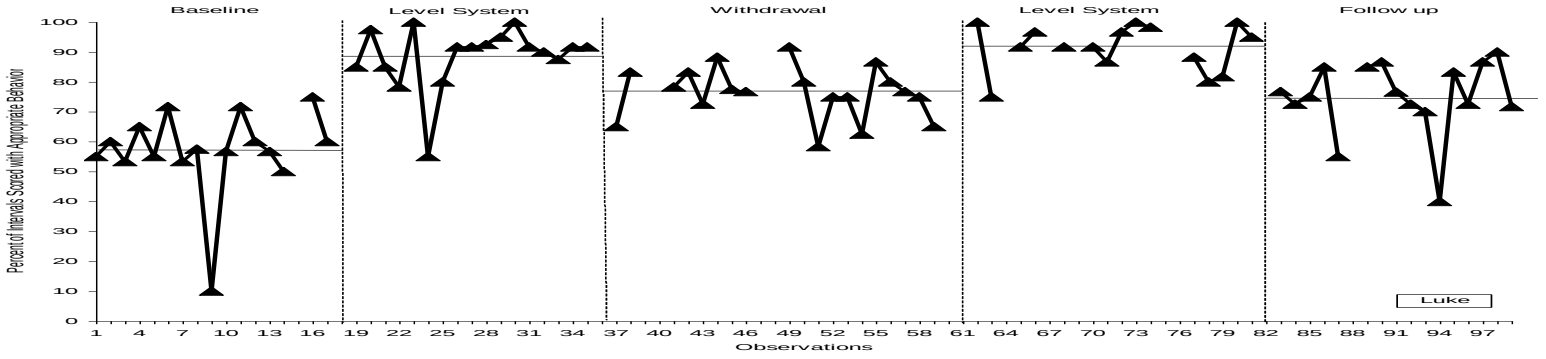
The teachers were asked to use the techniques that they already used to manage classroom behavior during the first and third conditions of the study. These conditions served as the baseline and withdrawal phases, respectively. Strategies utilized by the teachers included: verbal reprimands, yelling, redirection, time out, and removal from the class.

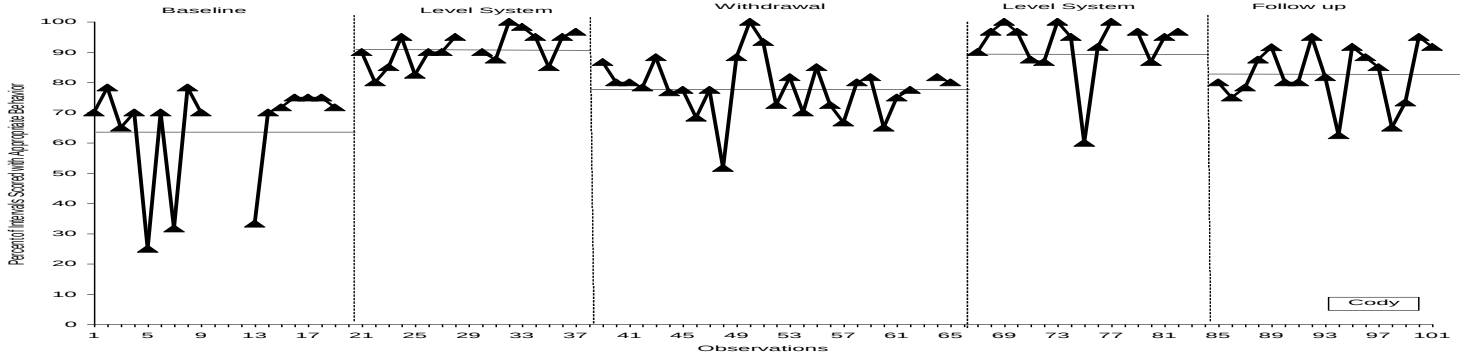
The Level System

The teachers were asked to use the Level System, with integrity, during the second and fourth conditions. These conditions served as the treatment. The teachers were required to obtain and maintain 85% integrity using the Level System. If integrity was less than 85% for 2 consecutive observations, retraining would occur. However, the teachers provided the intervention with acceptable levels of integrity, and retraining never occurred.

Criteria for Discontinuation of Data Collection

To protect against compromising the integrity of the study, specific criteria, if met, would have resulted in the discontinuation of data collection and beginning the study in a new classroom. Specifically, the study would have begun in a new classroom if: (a) there were ceiling effects (i.e., the behavior of the children exhibiting disruptive behavior was above 80% appropriate during baseline), (b) more than one teacher left the daycare, (c) more than one participant left the daycare, (d) retraining the teachers on the Level System occurred more than three times. None of these conditions was met. Specifically, the level of appropriate behavior exhibited by the children with disruptive behavior was 56.9% and 64.4%, no teachers or participants left the daycare, and retraining the teachers on the Level System did not occur.





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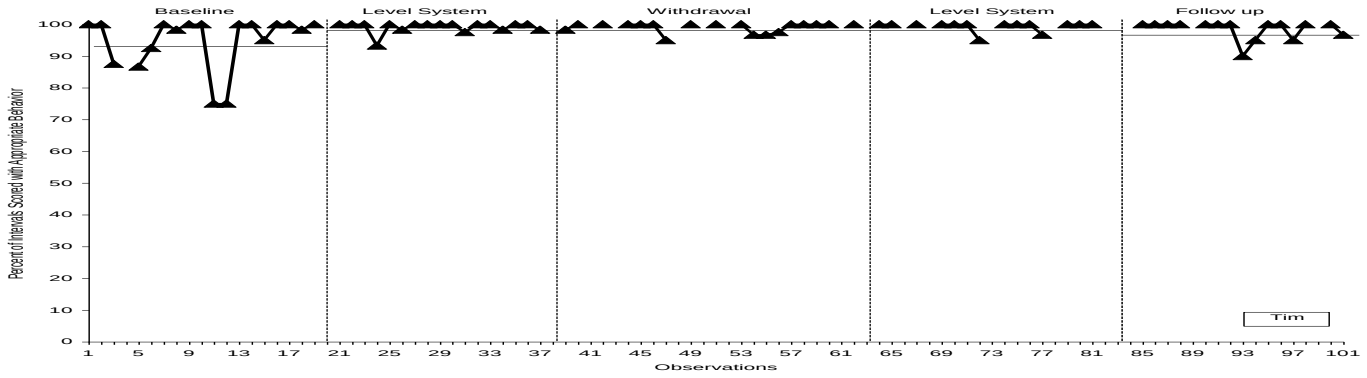


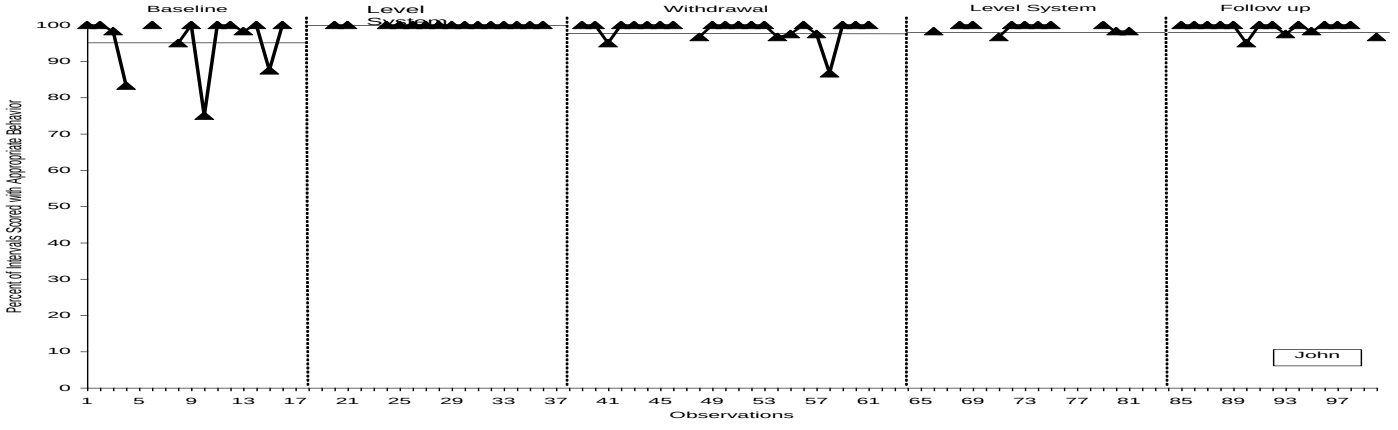


Figure 1. Percentage of intervals scored with appropriate behavior exhibited by each participant across teachers with horizontal lines indicating means for each phase.

RESULTS

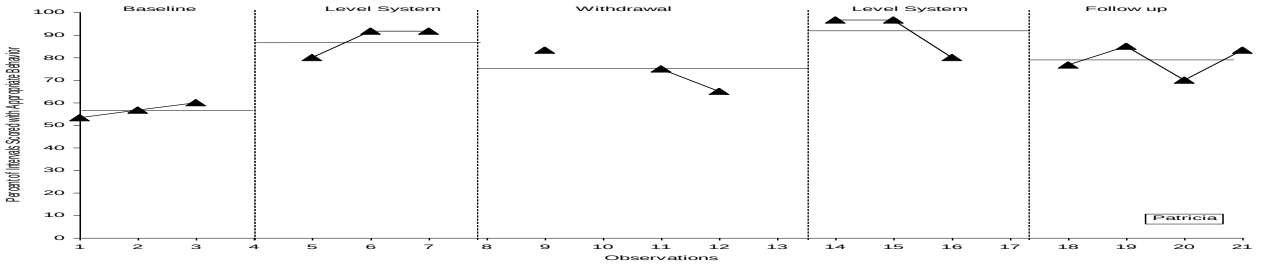
Effectiveness

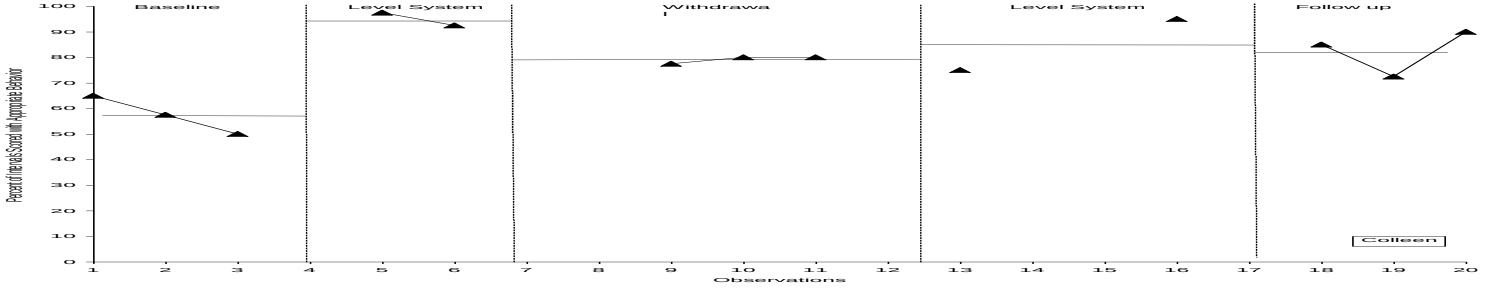
The effectiveness of the strategies already used in the classroom and the Level System was examined by visual and numerical inspection of the data obtained from behavioral observations (i.e., REDSOCS), the CGI, the Class Management Rating, and the Time-Out Log.

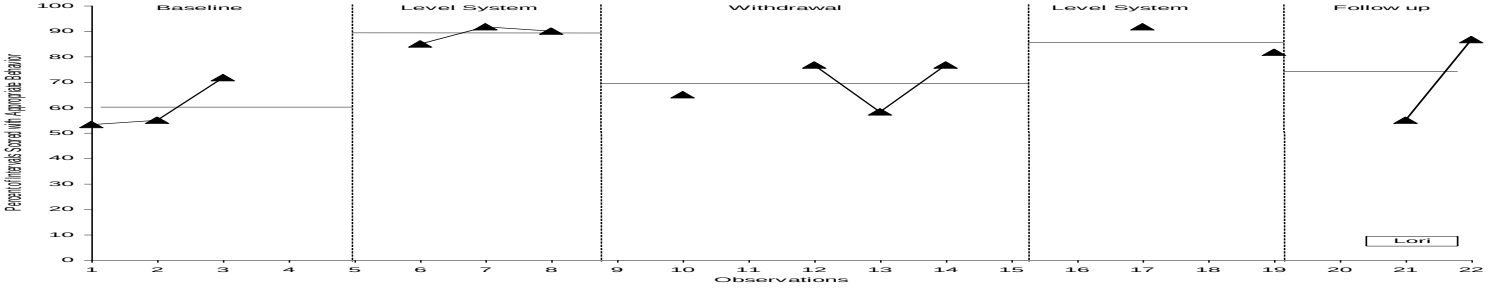
Redsocs

The behavioral observation data were graphed after each observation and examined in four ways: (a) percentage of intervals of appropriate behavior for each target child per observation, (b) percent differences of appropriate behavior from one condition to another for each child, (c) average percentage of appropriate behavior across conditions for each child, and (d) overall averages for observation percentage, percent differences, and average percent across all children's data. Data were graphed averaged across teachers as well as individually. Percent differences were calculated by subtracting the percentage of behavior for one condition from the previous condition and then dividing by the percentage of behavior in the prior condition.

The percentages of appropriate behavior exhibited by individual participants in the classroom across teachers is displayed in Figure 1, and the percentage of the same behavior with individual teachers is displayed in Figures 2 through 5. The average percentages of appropriate behavior per condition per participant across teachers are depicted in Figure 6. The same data are presented by individual teacher in Figure 7. Average percentage data reported when considering child behavior with individual teachers should be accepted cautiously as many of these means are based on only two to four observations. When participants were absent from class, no data point appears on the Figures. Therefore, some data points were not connected.







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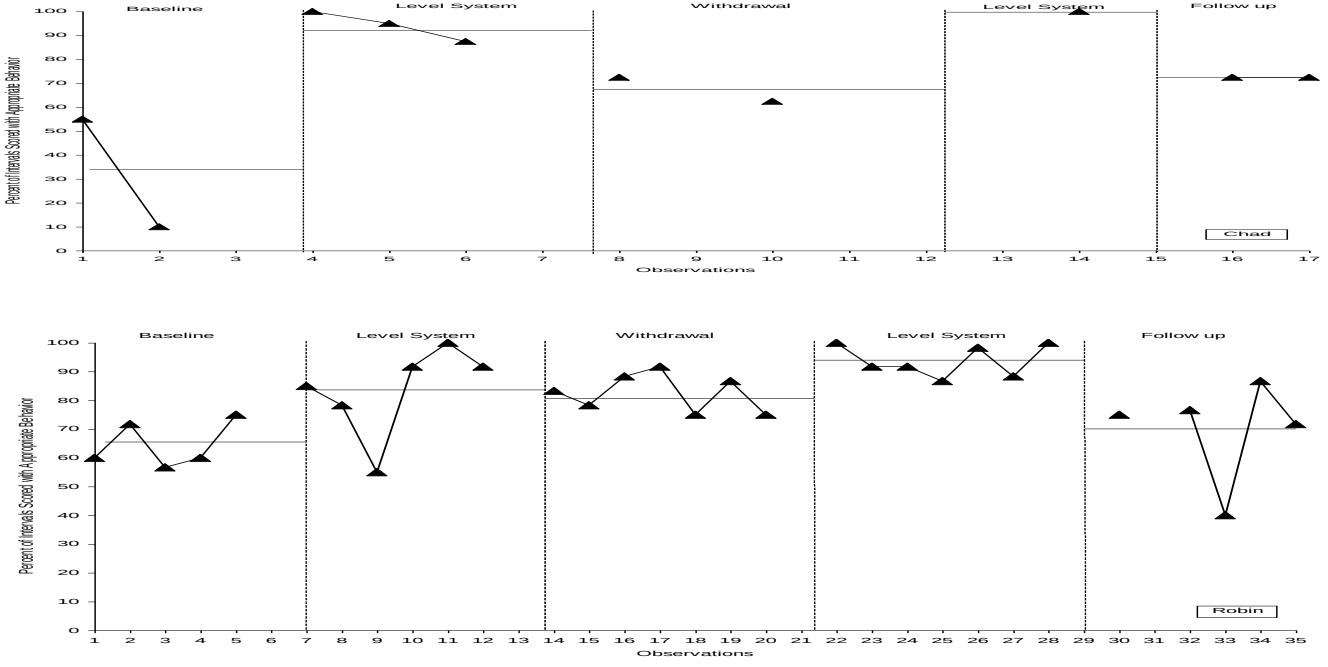
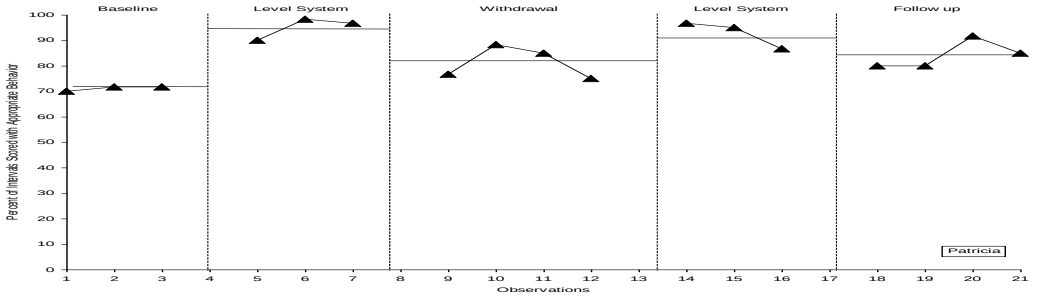
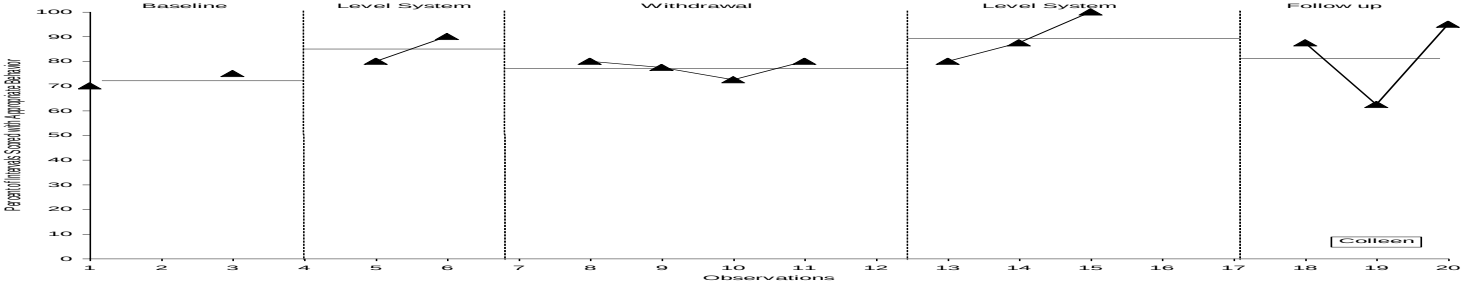
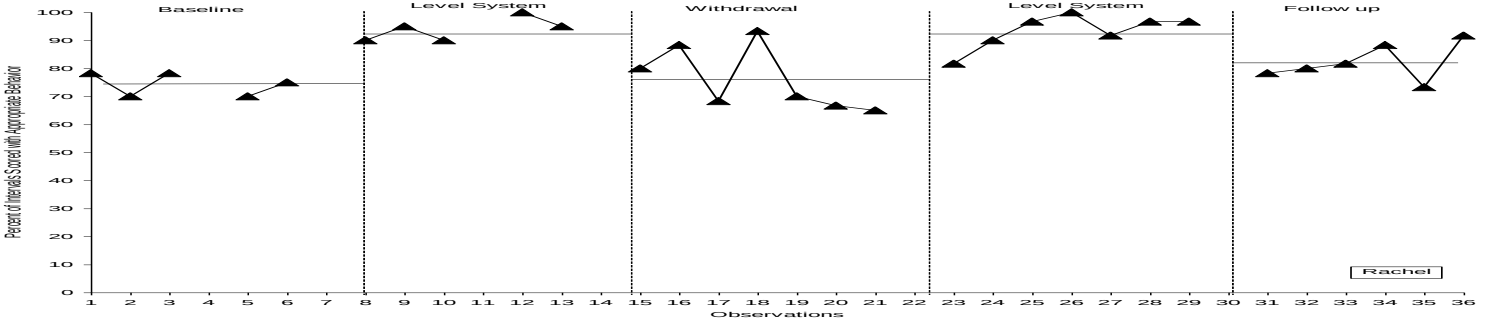


Figure 2. Percentage of intervals scored with appropriate behavior exhibited by Luke in each teacher's class with horizontal lines indicating means for each phase.







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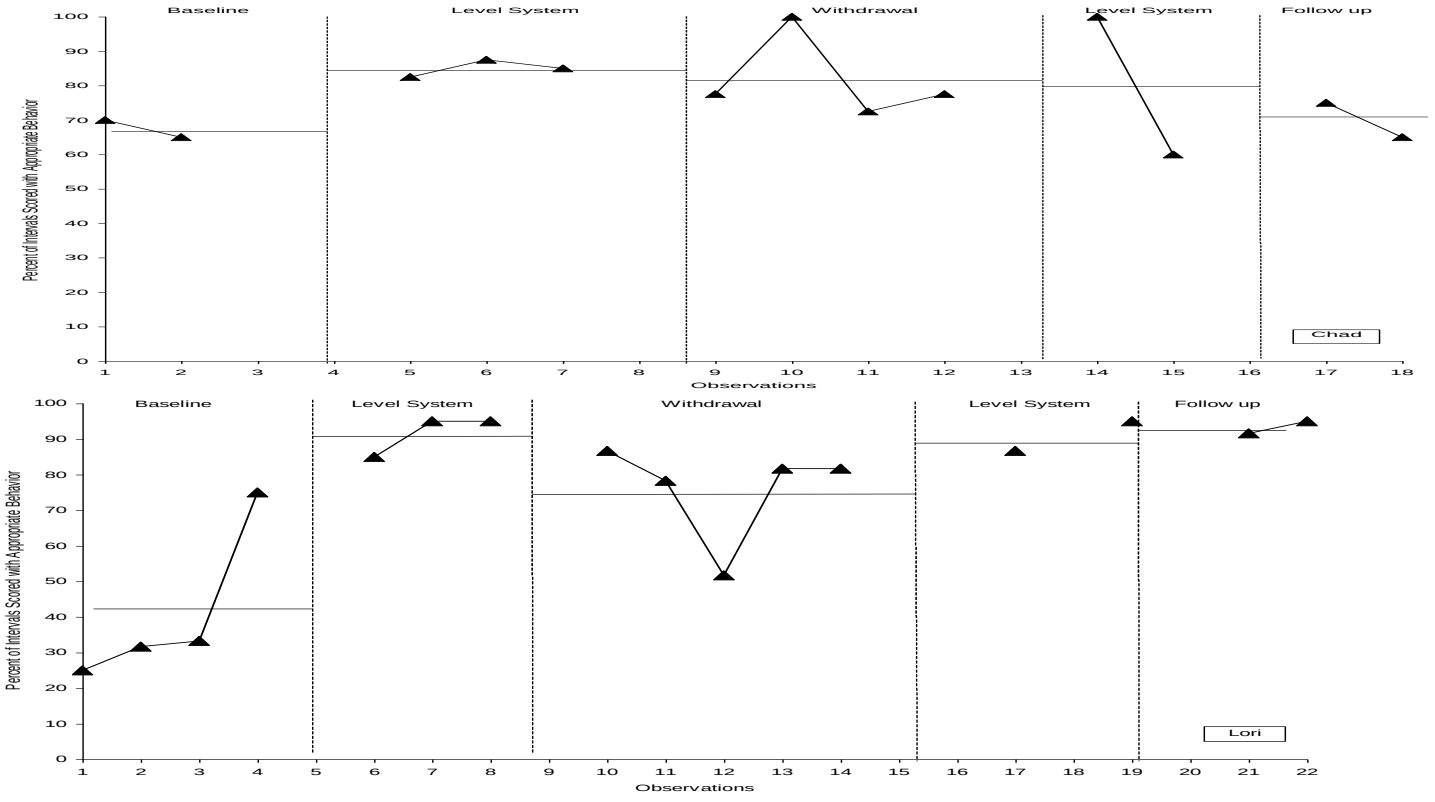


Figure 3. Percentage of intervals scored with appropriate behavior exhibited by Cody in each teacher's class with horizontal lines indicating means for each phase.

Luke

Luke was considered to be a participant exhibiting disruptive behavior. He was observed to exhibit variable behavior throughout the conditions (see Figure 1). However, the percentage of his appropriate behavior was higher in the Level System conditions than in the baseline, withdrawal, and follow-up conditions. Additionally, during the withdrawal and follow-up phases, Luke's percentage of appropriate behavior was higher than it was during baseline. These trends are made evident when the means of each condition are compared. Specifically, mean frequencies of appropriate behavior were 56.9% during baseline, 88.5% while using the Level System, 76.4% during the withdrawal phase, 91.6% during re-implementation of the Level System, and 74.9% during follow-up (Figure 6). These same general results were evident when Luke's appropriate behavior was inspected according to individual teachers (see Figure 2). However, mean levels of appropriate behavior were variable across different teachers (see Figure 7). Luke's appropriate behavior increased 55.4% during the Level System condition, decreased 13.7% during the withdrawal condition, increased 19.9% during re-implementation of the Level System, and decreased 18.1% during follow up (no Level System).

Cody

Cody also was considered to be a participant in the disruptive behavior category. Likewise, he was observed to exhibit variable behavior throughout the conditions (see Figure 1), and the percentage of his appropriate behavior was higher in the Level System conditions than in the other conditions. Additionally, during the withdrawal and follow-up phases, Cody's percentage of appropriate behavior was higher than it was during baseline. Mean frequencies of appropriate behavior for conditions A, B, A, B, and F were: 64.4%, 90.9%, 78.1%, 90.6%, and 82.5% respectively (Figure 6). These same general results were evident in Cody's appropriate behavior when he was in Colleen's and Patricia's classes (see Figure 3). However, in Rachel's class, the percentage of appropriate behavior that he exhibited during baseline was comparable to the appropriate behavior during withdrawal (Figure 3). When considering his appropriate behavior in Chad's class, there was significant overlap in the amount of appropriate behavior exhibited in the Level System conditions and the withdrawal condition (Figure 3). In other words, when the Level System was withdrawn, his behavior did not change. In Lori's class, Cody engaged in more appropriate behavior during follow up, with no Level System in place, than in any other condition (Figure 3). These differences are evident when mean levels of appropriate behavior across teachers are compared (see Figure 7). Cody's appropriate behavior increased 41.3% during the Level System condition, decreased 13.7% during the withdrawal condition, increased 16.1% during re-implementation of the Level System, and decreased 9 % during follow up (no Level System).

Tim

Tim was a participant exhibiting typical behavior. The percentage of appropriate behavior that he exhibited was highest in the Level System and withdrawal conditions (including follow up) (Figures 1 and 6). Additionally, his behavior became more stable after baseline. Mean frequencies of appropriate behavior for each condition were as follows: 94.9% (baseline), 99.2% (Level System), 99.1% (withdrawal), 99.4% (Level System), 98.5% (follow up). Similar results were found when considering each teacher's class individually (see Figures 4). The similar patterns of results across teachers are evident when mean levels of

appropriate behavior across teachers are compared (see Figure 7). Tim's percentage of appropriate behavior increased 4.5% during implementation of the Level System, decreased 0.04% when the Level System was withdrawn, increased 0.29% when the Level System was re-introduced to the classes, and decreased 0.97 % at 1-month follow up (no Level System).

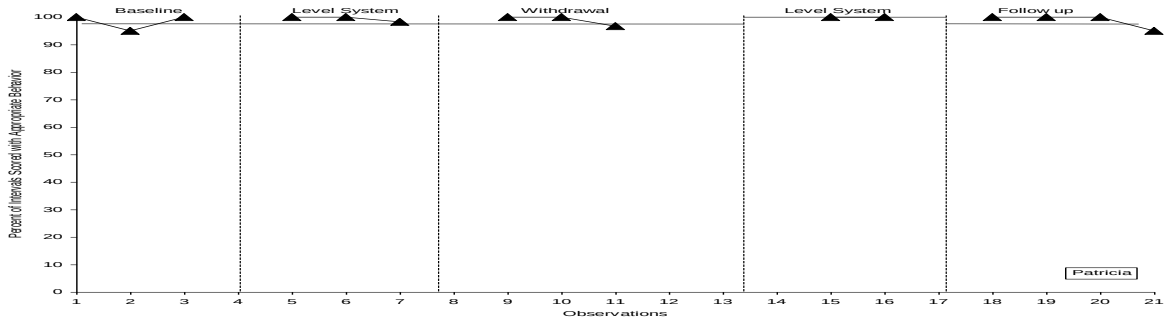
John

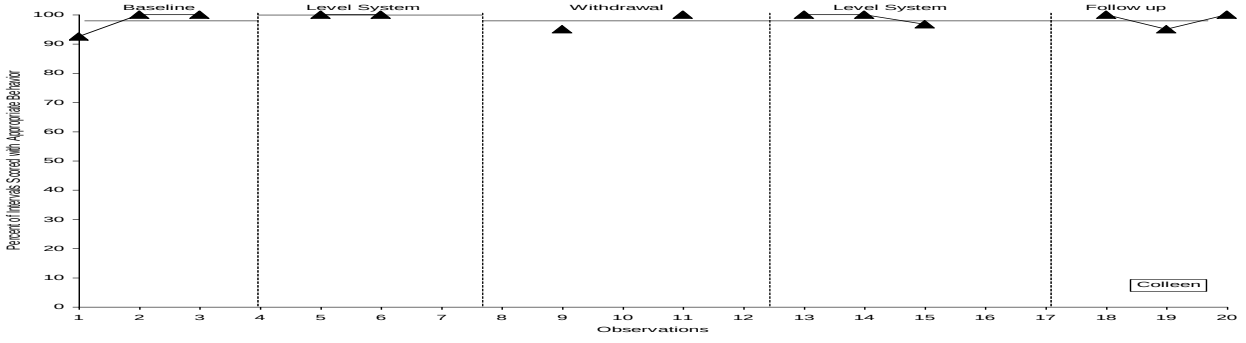
John also was a participant considered to be exhibiting typical behavior. He exhibited more appropriate behavior in the Level System conditions and in the withdrawal and follow-up conditions than during baseline (Figures 1 and 6). Furthermore, his behavior became more stable during the Level System conditions when compared to the other conditions. Figure 6 depicts trends with a comparison of the means of each condition. Specifically, mean frequencies of appropriate behavior were 95.5% during baseline, 100% while using the Level System, 98.6% during the withdrawal phase, 99.2% during re-implementation of the Level System, and 99.2% during follow up. Similar results were found when considering each teacher's class individually (see Figure 5). Although, when considering John's behavior while in Lori's class (Figure 5), the percentage of appropriate behavior exhibited during the withdrawal condition was below that which it was during all other conditions, including baseline. Figure 7 displays mean levels of appropriate behavior across teachers. John's percentage of appropriate behavior increased 4.7% during the Level System condition, decreased 1.4% during the withdrawal condition, increased 0.6% during the second Level System condition, and decreased 0.07 % during the 1-month follow up condition (no Level System).

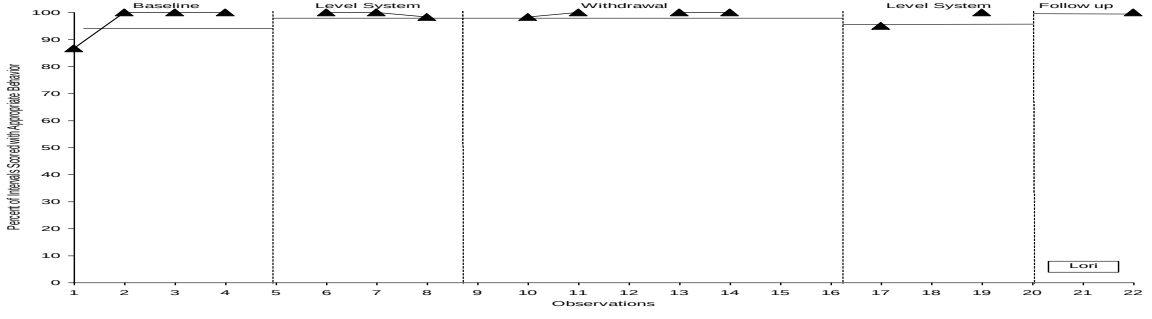
CGI

Raw scores on the CGI were converted to age- and gender-based T-scores for interpretation. T-scores were obtained at the beginning of the study and after each condition and examined in a similar manner to the behavioral observation data (e.g., averages, percent differences). Data were obtained across teachers and target children as well as individually. Additionally, CGI data were averaged across all children in the class and examined.

Mean T-scores for each target child for each condition are displayed in Table 1. Additionally, the same data were considered for each teacher individually (see Table 1). As discussed previously, T-scores between 45 and 55 were considered typical and T-scores above 60 were considered to be in the disruptive range.







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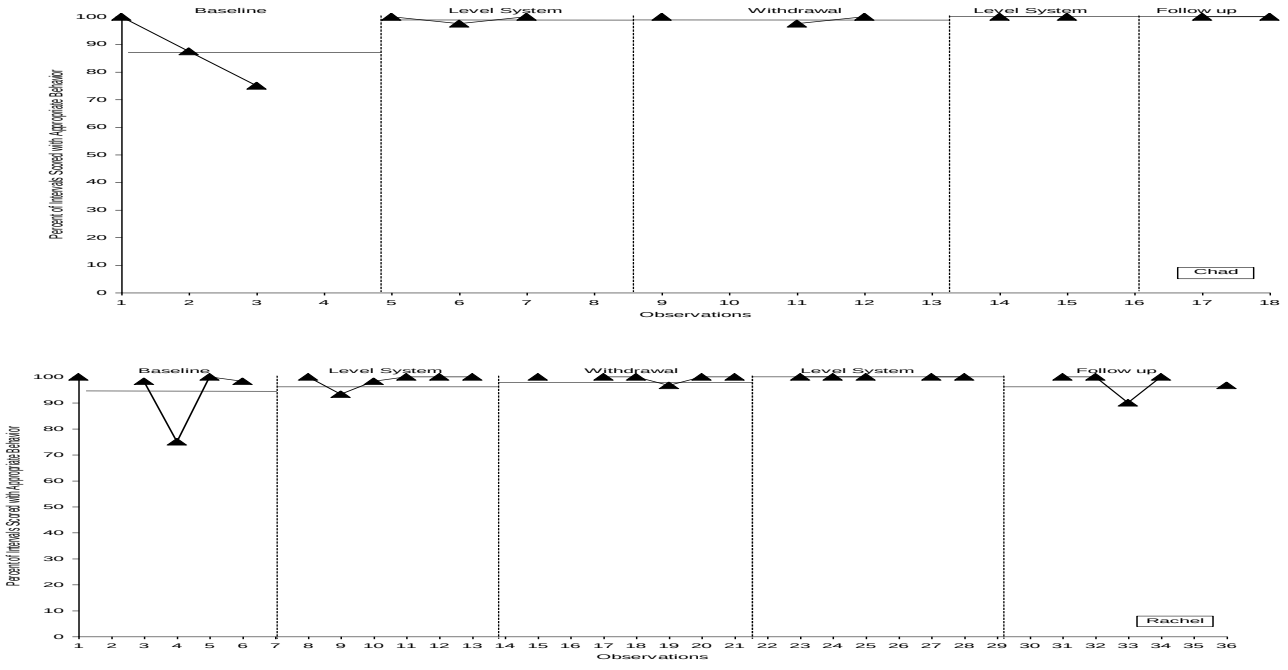
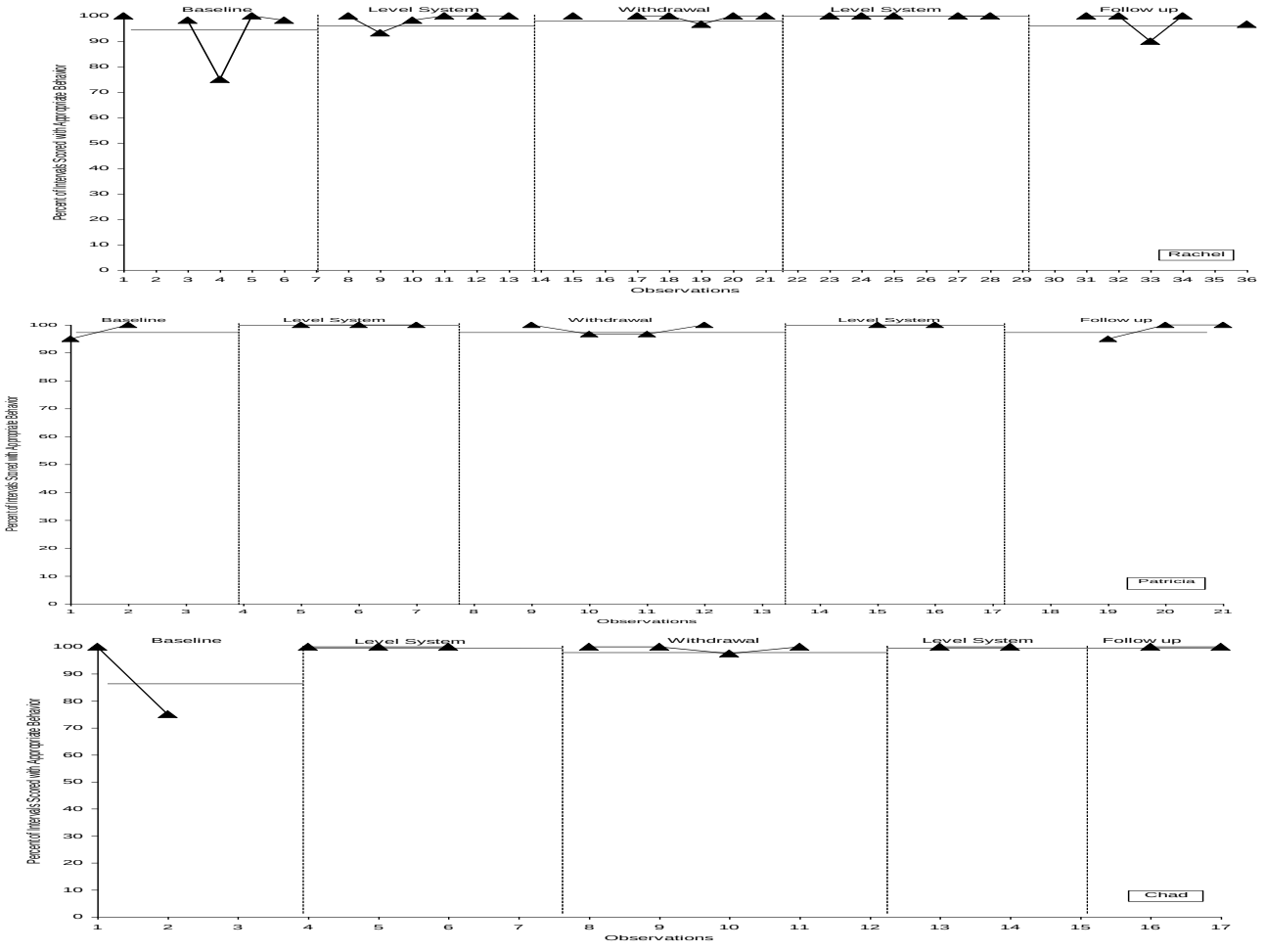


Figure 4. Percentage of intervals scored with appropriate behavior exhibited by Tim in each teacher's class with horizontal lines indicating means for each phase.



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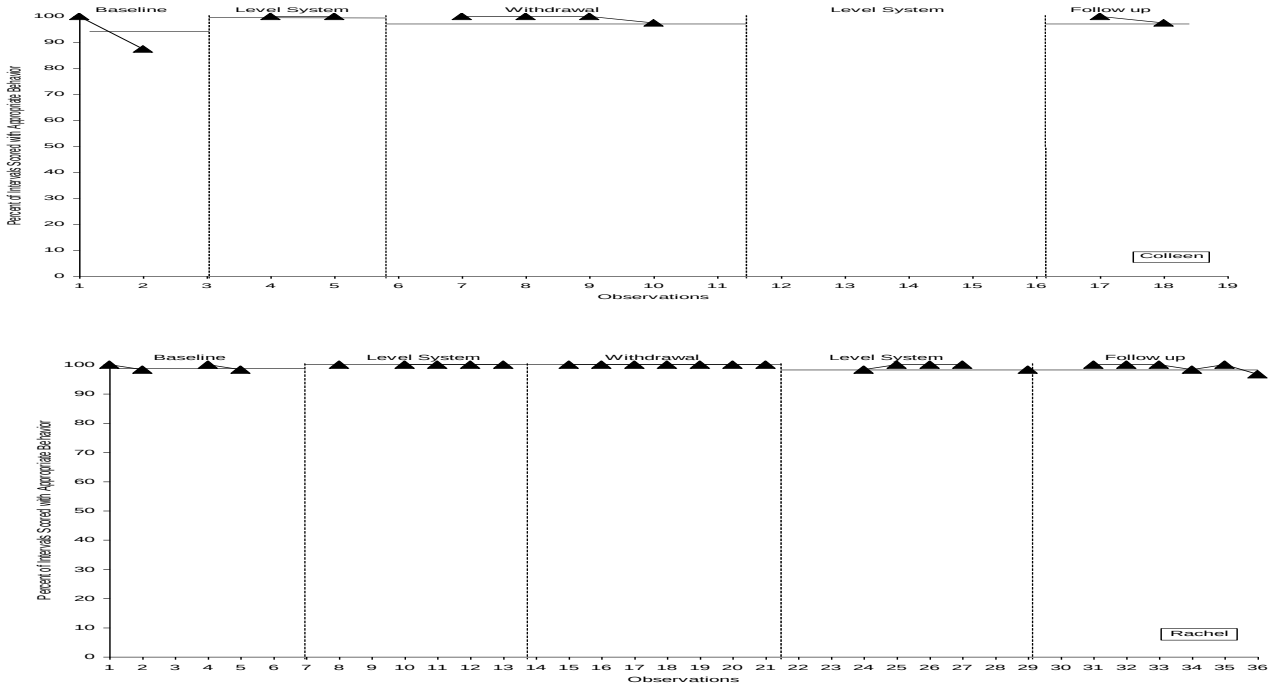


Figure 5. Percentage of intervals scored with appropriate behavior exhibited by John in each teacher's class with horizontal lines indicating means for each phase.

Luke

Overall, Luke's T-scores averaged across teachers indicated that even though these scores decreased during the first Level System condition, they always remained in the disruptive range (70.4-59.8) (Table 1). This trend also is evident when considering Patricia and Colleen's individual data. However, during the first B condition, Luke's T-scores were in the typical range according to these two teachers (T-score = 53). No other systematic changes were evident across conditions. Luke's mean T-scores decreased 8.5% during the baseline condition, decreased 7.1% during the Level System condition, increased 8.3% during the withdrawal condition, decreased 0.62% during re-implementation of the Level System, and increased 0.62% during follow up (no Level System).

Table 1. T-Scores of Participants on CGI by Teacher per Condition

	Teacher					
Participant and condition	Patricia	Colleen	Lori	Chad	Rachel	All[a]
Luke						
Selection	69	69	71	70	73	70.4
Baseline	66	64	63	70	59	64.4
Level System	53	53	64	69	60	59.8
Withdrawal	66	66	66	70	56	64.8
Level System	64	67	64	70	58	64.4
Follow up	64	69	62	70	59	64.8
Cody						
Selection	63	52	70	64	53	60.4
Baseline	50	50	61	62	62	57.0
Level System	55	55	60	62	60	58.4
Withdrawal	64	58	66	64	55	61.4
Level System	68	50	59	67	54	59.6
Follow up	44	50	56	66	52	53.6
Tim						
Selection	44	46	47	46	43	45.2
Baseline	45	45	45	46	46	45.4
Level System	44	44	44	45	46	44.6
Withdrawal	44	45	42	45	43	43.8
Tim						
Level System	44	47	45	45	42	42.4
Follow up	44	46	46	47	42	45.0
John						
Selection	46	42	47	47	43	45.2
Baseline	42	42	42	43	42	42.2
Level System	42	42	42	42	42	42.0
Withdrawal	42	42	42	42	42	42.0
Level System	42	42	43	43	42	42.4
Follow up	42	42	43	43	42	42.2

Note. aThe values represent mean T-scores of teacher responses combined.

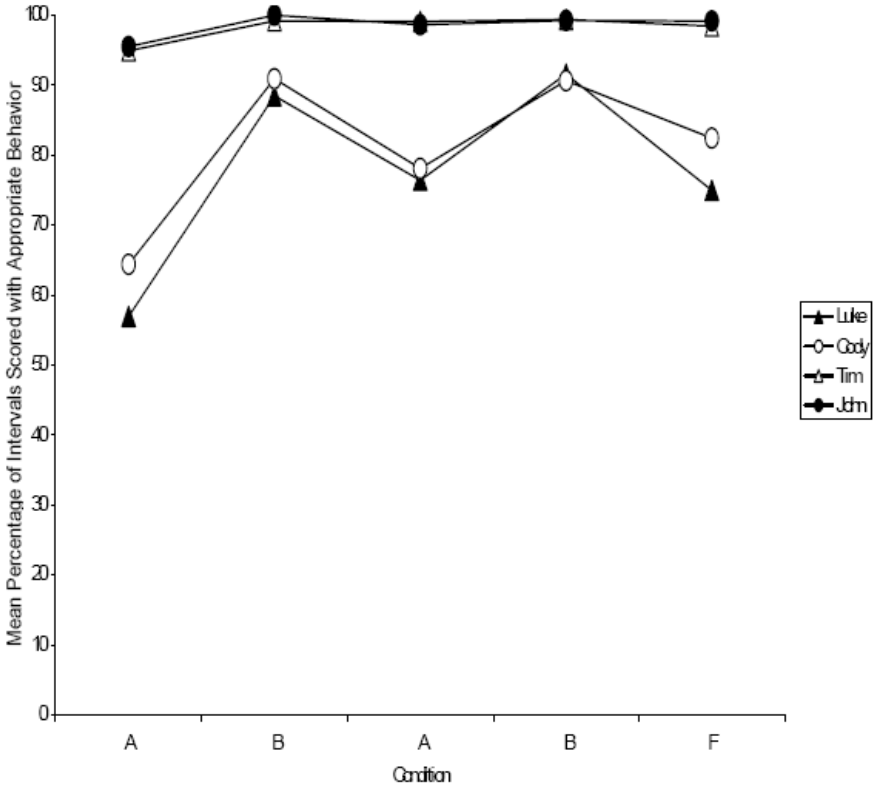
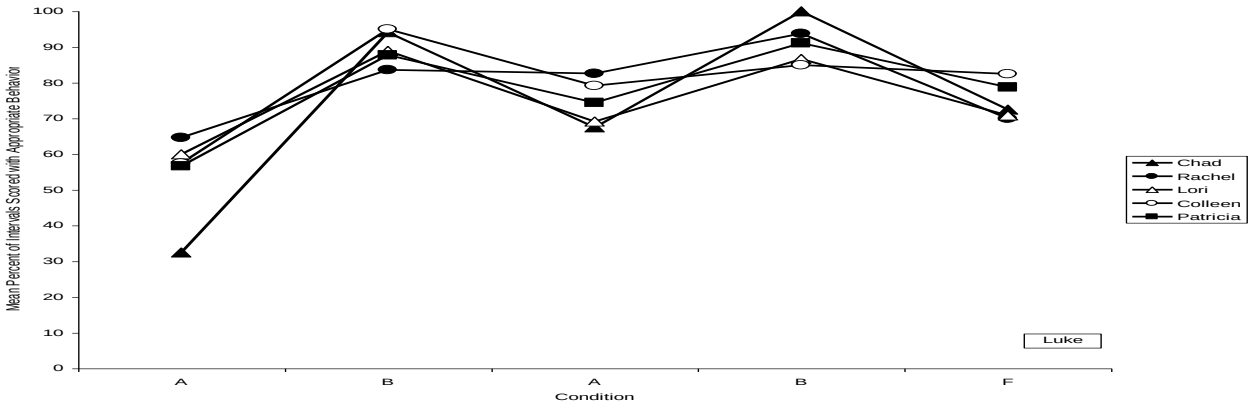
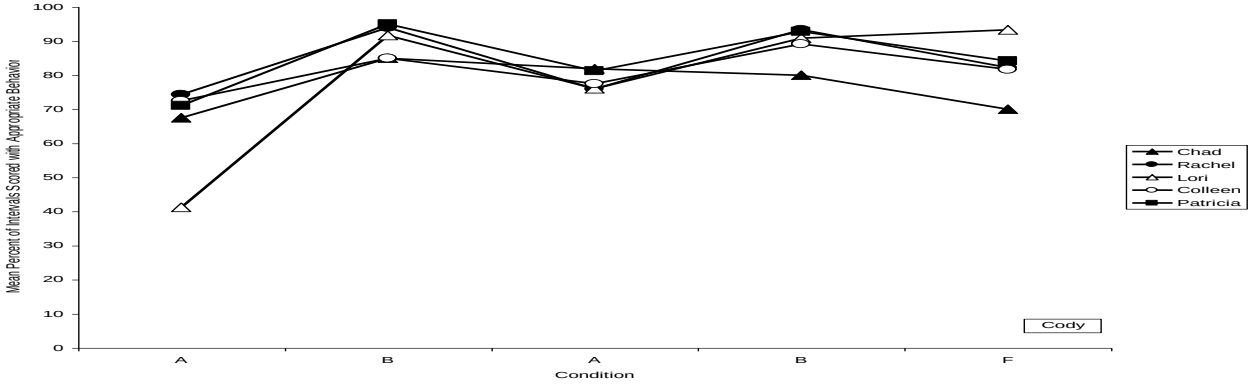


Figure 6. Mean percentage of intervals scored with appropriate behavior exhibited by each participant across teachers.

Cody

Cody's T-scores averaged across teachers were relatively stable throughout the study. However, his mean T-score decreased during the follow-up condition to within typical limits (T-score = 53.6) (Table 1). Cody's T-scores by individual teachers were more variable, except for Chad's ratings which were similar to overall ratings. For example, according to Patricia, Cody's T-score decreased during baseline to within typical limits and then increased steadily until follow up (T-score = 44). Colleen rated Cody's behavior as in the typical range throughout all conditions except withdrawal. According to Lori's ratings, Cody's T-scores were in the disruptive range during all conditions. Also, his T-scores were the highest during selection and the withdrawal phase. Cody's T-scores from Rachel indicate that they increased during baseline and then decreased throughout the rest of the study. Cody's mean T-scores on the CGI decreased 5.6% during baseline, increased 2.5% during the Level System condition, increased 5.1% during the withdrawal condition, decreased 2.9% during re-implementation of the Level System, and decreased 10.1 % during follow up (no Level System).





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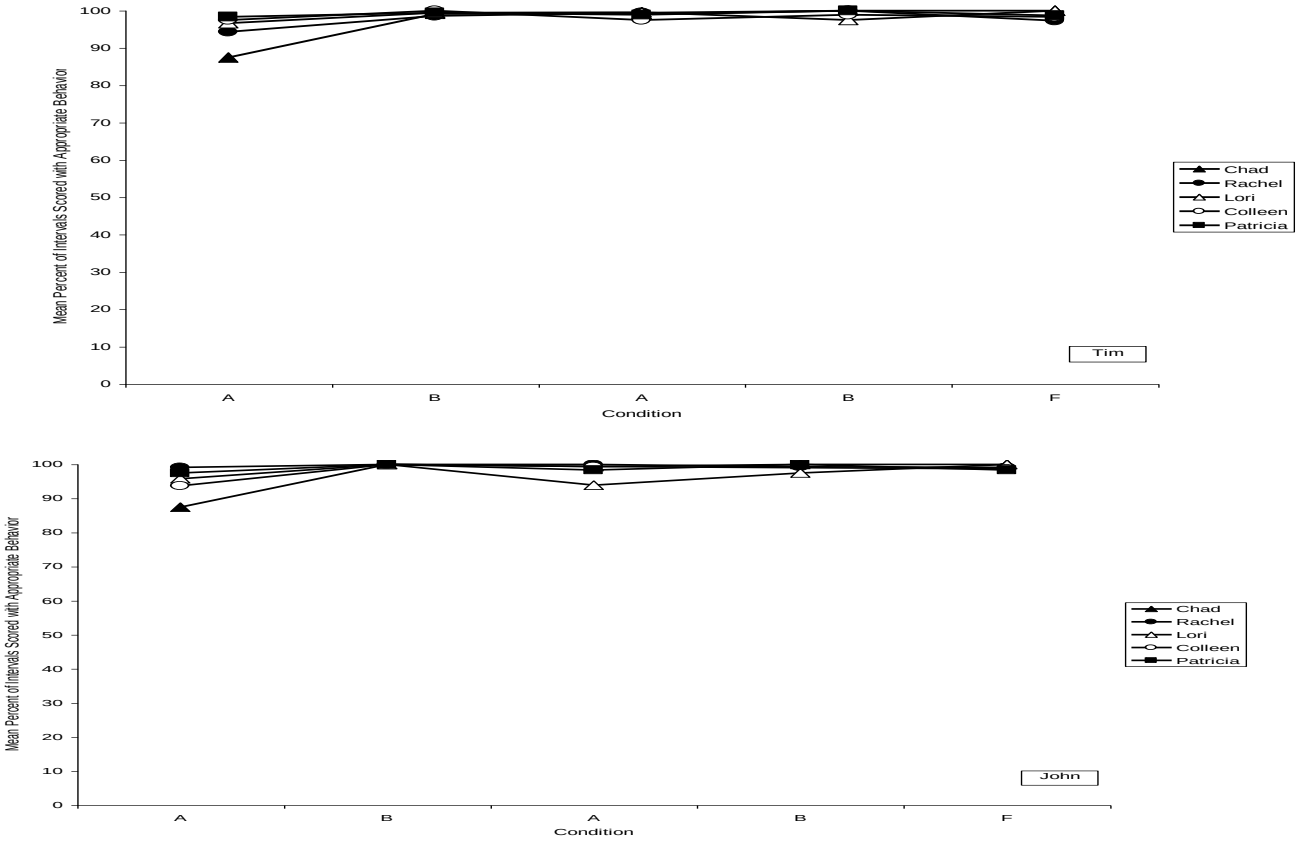

Figure 7. Mean percentage of intervals scored with appropriate behavior exhibited by each participant in each teacher's class.

Tim

Tim's mean T-scores across teachers were relatively stable throughout all conditions (Table 1). Scores always were in the typical range, and no systematic changes were evident. Similar results were found when considering each teacher's class individually. Tim's mean T-scores increased 0.44% during baseline, decreased 1.8% during implementation of the Level System, decreased 1.8% when the Level System was withdrawn, decreased 3.2% when the Level System was re-introduced to the classes, and increased 1.7 % at 1-month follow up (no Level System).

John

Similar to Tim, John's mean T-scores indicate no systematic changes across conditions, and scores remained in the typical range (Table 1). Similar results are found when considering each teacher's scores individually. John's mean T-scores decreased 6.2% during baseline, decreased 0.47% during the Level System condition, remained unchanged during the withdrawal condition, increased 0.95% during the second Level System condition, and remained unchanged during the 1-month follow-up condition (no Level System).

All Children in the Class

No systematic changes across conditions were evident when considering all of the children in the class across teachers or by individual teachers. Mean T-scores ranged from 50.4 to 48.4.

Class management rating

The Class Management Rating was completed after each class. The rating was a 5-point Likert-type scale in which "1" indicated extreme unmanageability and "5" indicated extreme manageability. Table 2 indicates class management ratings of teachers combined, and by individual teachers. Mean class management ratings suggest that, although relatively stable throughout the study, ratings of class management increased steadily and then decreased slightly at follow up. Specifically, mean ratings were as follows: 4.3 during baseline, 4.4 during implementation of the Level System, 4.5 during withdrawal, 4.8 during re-introduction of the Level System, and 4.6 during follow up. Overall, class management ratings across teachers increased 4.1% in the Level System condition, increased 1.2% in the withdrawal condition, increased 6.1% in the second Level System condition, and decreased 4.5% in the follow-up condition. Colleen's ratings follow the same general trend (see Table 2). Patricia's ratings of the manageability of her class decreased during the first Level System condition (4.8 to 4.7) and then increased to ceiling levels for the entirety of the study (5 for each condition).

Chad's class management ratings were highest during the first Level System condition (4.3), and then decreased (3.9) and remained relatively stable throughout the study (3.8 and 3.7 for each condition). Lori's class management ratings decreased slightly when the Level system was removed from her class (4.3 to 4.1), and increased to ceiling levels with re-implementation (5). Rachel's class management ratings increased during the withdrawal phase (4.3 to 4.7) and continued to increase until the end of the study (4.9 and 5, respectively).

Time-Out Log

Similar to the other effectiveness measures, data from the time-out log included percent differences among conditions, average score across conditions, and overall averages. Data were analyzed with all teachers combined as well as by individual teacher. Additionally, data were obtained and examined concerning target children as well as all children in the class. Time-out logs were completed by the teacher after each class.

The mean frequency of time outs given to target participants with disruptive behavior across teachers and by individual teachers is displayed in Table 3. Because no time outs were given to the participants with typical behavior throughout the duration of the study, these data were not reported. Additionally, Table 3 includes the mean frequency of time outs given to all children in the class (including target participants) across teachers and by individual teachers.

Table 2. Class Management Ratings by Teacher per Condition

	Teacher					
Condition	Patricia	Colleen	Lori	Chad	Rachel	All[a]
Baseline	4.8	4.3	4.3	3.8	4.4	4.3
Level System	4.7	4.7	4.3	4.3	4.3	4.4
Withdrawal	5.0	4.8	4.1	3.9	4.7	4.5
Level System	5.0	5.0	5.0	3.8	4.9	4.8
Follow up	5.0	4.7	4.4	3.7	5.0	4.6

Note. aThe values represent mean class management ratings of teacher responses combined.

Table 3. Mean Number of Time Outs Provided to Participants by Teacher per Condition

	Teacher					
Participant and condition	Patricia	Colleen	Lori	Chad	Rachel	All[a]
Luke						
Baseline	0.44	0	0.78	0.44	0.57	0.76
Level System	0	0.17	0.50	0.17	0.33	0.39
Withdrawal	0.14	0.13	0.44	0.56	0.29	0.54
Level System	0	0	0.17	0.50	0	0.20
Follow up	0	0	0	0.17	0	0.12
Cody						
Baseline	0.11	0	0.44	0.33	0	0.36
Level System	0	0.17	0.33	0	0	0.17
Withdrawal	0.43	0	0.56	0.33	0	0.46
Level System	0	0	0	0.33	0	0.10
Follow up	0	0	0	0.33	0	0.12
All children in class						
Baseline	0.14	0	0.31	0.19	0.14	2.04
Level System	0	0.08	0.21	0.04	0.08	1.06
Withdrawal	0.14	0.03	0.25	0.22	0.07	1.50
Level System	0	0	0.04	0.21	0	0.35
Follow up	0	0	0	0.13	0	0.24

Note. [a]The values represent mean number of time outs provided by teachers combined.

Luke

Luke was given between 0 and 4 time outs per observation day. However, the number of days in which he received time outs decreased as the study progressed. When considering the means for each condition (see Table 3), it is clear that the number of time outs that he received were fewer during the Level System conditions and follow up. Specifically, mean number of time outs given to Luke per condition were as follows: 0.76 (condition A), 0.39 (condition B), 0.54 (condition A), 0.2 (condition B), 0.06 (follow up). The number of time outs for Luke decreased throughout the study when considering individual teachers. The mean number of time outs given by Patricia, Lori, and Rachel provide evidence for this trend. The number of time outs given by Colleen and Chad increased before they decreased. The overall frequency of time outs given to Luke decreased 48.7% during the Level System, increased 38.5% during withdrawal, decreased 63% during re-implementation of the Level System, and decreased 70% during follow up (no Level System).

Cody

Similarly, Cody received the fewest time outs during the Level System conditions and follow up (Table 3). Cody was provided between 0 and 3 time outs per observation day. The mean number of time outs given to Cody was 0.36 during baseline, 0.17 during the Level System condition, 0.46 during withdrawal, 0.1 during re-introduction of the Level System, and 0.12 during the follow up condition (no Level System). These same trends are apparent when examining the data by individual teacher. The number of time outs that Cody received decreased 52.8% when the Level System was in place, increased 170.6% when the Level System was removed, decreased 78.3% when the Level System was put back in place, and increased 20% during follow up, when no Level System was in place.

All Children in the Class

Table 3 reveals the mean frequency of time outs that were given to all of the children in the class during each condition across all teachers and by individual teacher. Data indicate that more time outs were given during the conditions when the Level System was not being used, except during follow up. Specifically, the average number of time outs was as follows for each condition: 2 (baseline), 1.1 (Level System), 1.5 (withdrawal), 0.35 (Level System), 0.24 (follow up). These same trends are apparent when considering the mean number of time outs provided by individual teachers. However, the data suggest that the mean number of time outs given by Lori does not follow this trend. Instead, the number of time outs that she gave steadily decreased throughout the study. Overall, the number of time outs provided to the children in the class decreased 48.3% during Level System, increased 42.1% during withdrawal, decreased 76.7% during Level System, and decreased 32.8% during follow up.

Satisfaction

Teacher treatment satisfaction was determined by calculating and interpreting the scores on the IRP at the end of each condition, and comparing the scores between conditions. Whichever condition resulted in higher scores on the measure, and whichever management strategies that the teachers used after the last experimental session was considered the system in which the teachers were the most satisfied.

Parent treatment satisfaction was determined by a parental interview that assessed the parent's acceptability of the Level System and the behavioral principles that are used with the Level System. High scores on the interview would indicate satisfaction with the Level System.

Intervention Rating Profile (IRP)

The highest possible score on the IRP is a 120. Higher scores indicate greater acceptability of the intervention. The mean satisfaction rating increased slightly between baseline and the first Level System condition, and the second Level System condition and 1-month follow up. A slight decrease in satisfaction was apparent between the first Level System condition and withdrawal, and the withdrawal condition and the second Level System condition. Specific average scores on the IRP for each condition were as follows: 88.8 (baseline), 97.2 (Level System), 87.8 (withdrawal), 86.4 (Level System), and 88.4 (follow up). When considering satisfaction ratings of individual teachers, Colleen's ratings were similar to overall ratings (92, baseline; 108, Level System; 106, withdrawal; 103, Level System; 109, follow up). However, Chad's satisfaction rating increased during implementation of the Level System (85 to 98), but decreased for the remainder of the study (90, 78, 73), and Lori's ratings decreased steadily throughout the study (92, baseline; 89, Level System; 70, withdrawal; 61, Level System; 64, follow up). Additionally, Patricia's scores indicate that she was more satisfied with the Level System (109 and 112) than her regular class management strategies (92 and 106), and Rachel's scores remained relatively stable throughout each condition (83, baseline; 82, Level System; 80, withdrawal; 78, Level System; 81, follow up). Despite overall and individual teacher (Colleen, Chad, and Patricia) reported level of satisfaction with the Level System during the first implementation, none of the teachers chose to use the Level System at follow up rather than their typical classroom management strategies.

Parent Interview

The parental interview was completed at the end of the study by willing parents of child participants in the study. All of the parents completed the measure (13 parents). Five of the parents completed the interview over the telephone with the experimenter, and eight of the parents completed the interview in a face-to-face format at the daycare. Higher scores indicate more acceptability of behavioral management strategies used with the Level System (e.g., positive reinforcement, token economy, response cost). In addition to scored items, this measure included five open-ended items in which parents were asked to list positive and negative concerns regarding the Level System and time out.

Results from the parent interview indicate that the parents were very accepting of use of the Level System in their child's class. Specifically, the mean total score was 52.8 out of 60 (SD = 5.7). On the open-ended items, parents described positive aspects of the Level System to include: rewards, visual learning, and motivation to behave appropriately. Parental concerns regarding the Level System included: competition among children, embarrassing to parents because the Level System is posted for others to see, and embarrassing to children if they do not receive the reward. Concerning time out, parents reported positive aspects to include: modeling of consequences, and provides children time to contemplate their inappropriate behavior. Parents described concerns with time out to include the following: may last too long, and may positively reinforce inappropriate behavior.

Negative Effects

To determine if the Level System resulted in any negative effects on "intrinsic motivation," the appropriate behavior data of the participants were graphed and visually inspected to determine if during the withdrawal or withdrawal condition, the children's rate of appropriate behavior decreased below baseline levels, then increased to baseline levels and remained stable. Additionally, mean percentages of appropriate behavior were compared to determine if the percentage during withdrawal was less than the percentage during baseline. If the rate of appropriate behavior did not decrease below baseline levels, then it would be determined that no negative effects on "intrinsic motivation" were evident from the Level System.

Visual inspection of graphed data as well as comparing mean percentages of appropriate behavior during baseline and withdrawal suggest that no negative effects on "intrinsic motivation" were evident. Specifically, when considering each participant's overall and mean level of appropriate behavior across teachers (Figures 1 and 6) and in individual teacher's classes (Figures 2 to 5, and 7), no negative effects were revealed, except for John when he was in Lori's class (see Figures 5 and 7). John's level of appropriate behavior during the withdrawal condition was below the level during baseline. Specifically, John's mean percentage of appropriate behavior was 95.8 during baseline and 93.9 during withdrawal. In other words, the percentage of appropriate behavior that John exhibited decreased 2% from baseline to withdrawal. However, no other negative effects on "intrinsic motivation" were found.

Treatment Integrity

The data from the behavioral observations of teacher response to child behavior generally support the results from the treatment integrity checklist, indicating that the teachers were using the Level System with integrity. Table 4 indicates that when the participants were behaving appropriately, appropriate teacher responses were provided (e.g., praise, moving shapes up, no time outs). Also, these behaviors increased when the Level System was being used compared to when it was not being implemented. Furthermore, when the participants engaged in inappropriate behavior, appropriate teacher responses were provided (e.g., warnings, moving shapes down, time outs) (see Table 4). However, some results from the teacher behavioral observations suggest that the teachers were not using the Level System with excellent integrity. For example, teachers occasionally provided participants with praise when their behavior was coded as inappropriate. In addition, although the teachers were providing the children with adequate responses to behavior (e.g., warnings for inappropriate behavior), the percentage of time that they engaged in these responses could be considered low (e.g., 26.2% warnings for inappropriate behavior).

CONCLUSION

The current study was conducted to examine the effectiveness, satisfaction, and potential negative effects of the Level System compared to typical classroom management strategies in managing disruptive behavior in preschool classrooms. Specifically, the current study evaluated whether or not the children's appropriate behavior increased while the Level System was used in the classroom, as compared to the strategies already utilized by the teachers. In addition, satisfaction with the intervention was assessed by teacher and parent report of satisfaction as well as which approach the teachers chose to continue after termination of the study. Lastly, possible negative effects on "intrinsic motivation" were examined by visual inspection of graphic representations of the data, and mean comparisons of data across conditions.

In general, there were four main findings in the current study. First, when examining data from children with disruptive behavior and children with typical behavior, it appears that the Level System is more effective in managing disruptive behavior than previously-used classroom management strategies. Second, the data suggest that fewer time outs were given while the Level System was used in the class compared to while the typical classroom management strategies were used. Third, teacher report of satisfaction with the Level System varied. However, the parents reported high levels of satisfaction with the Level System. Lastly, negative effects on "intrinsic motivation" with use of the Level System were not evident. Several methodological limitations should be considered when interpreting these results. Discussion concerning the main findings, methodological limitations, clinical implications, and directions for future research follows.

MAIN FINDINGS

Overall Effectiveness of the Level System

It was expected that the Level System would result in more appropriate behavior exhibited by children with disruptive behavior and by children with typical behavior in the classroom when compared to conditions in which the Level System was not used. Visual inspection of behavioral observation (i.e., REDSOCS) data provides support for this expectation. When the participants were considered separately and together across teachers and in individual teacher's classes, percentages of appropriate behavior were higher in the Level System conditions than in the other conditions. However, these results are less clear when considering the children with typical behavior because ceiling effects made it difficult to distinguish differences among conditions. Data also appeared to be more stable during the Level System conditions when compared to the conditions that utilized typical classroom management strategies. This may have occurred because the teachers used a more consistent behavioral management program compared to their typical strategies. For example, the Level System requires that the teachers provide consequences each time that a child engages in inappropriate behavior, whereas there is no such requirement in a typical classroom.

Table 4. Percentage of Integrity Behavior Exhibited by Teachers in Response to Child Behavior by Condition

Condition	Praise	Move shape up	Warning	Move shape down	Criticism	Time out	Other
	Child appropriate behavior						
Baseline	5.8	0	0	0	3.3	0	57.8
Level System	18.9	7.3	0	0	.3	0	46.1
Withdrawal	6.4	0	0	0	2.7	0	64.6
Level System	15.8	6.9	0	0	.5	0	29.1
Follow up	5.8	0	0	0	.3	0	22.5
	Child inappropriate behavior						
Baseline	2.6	0	0	0	17.8	3	66.7
Level System	3.6	2.9	26.2	8.5	5.6	1.6	38.8
Withdrawal	1.2	0	0	0	7.9	3.5	61.8
Level System	2.5	0	43	42	12.6	0	52.8
Follow up	0	0	0	0	20.2	1	29.3

Note. The values represent mean percentages of teacher behavior.

On teacher report measures, the effectiveness of the Level System was less evident. For example, visual inspection and mean comparison of class management ratings suggest that the teachers perceived themselves to be better able to manage their class as the study progressed, except at the 1-month follow up. This result may have occurred because the teachers felt better able to manage their class as the school year continued. Another possible explanation is that the teachers felt more confident managing their classes when they received feedback concerning their management behavior. Then, during follow up, after 1 month without feedback from the experimenter, they felt less confident managing their classes. Furthermore, on the CGI, significant treatment effects were not evident. Specifically, no changes in CGI scores were apparent for the children with disruptive behavior or the children with typical behavior.

The lack of convergence between teacher-report measures and behavioral observation data may have occurred because the teachers were not sensitive to the behavior change that was evident by behavioral observation (Bahl et al., 2000). A potential explanation for these findings is that the CGI measures behaviors that the Level System did not address (e.g., fails to complete tasks, short attention span). Alternatively, it is possible that the teachers "labeled" children as challenging early in the school year and had difficulty noticing the positive behavior improvements because of the negative effects of the label (Polyson, 1979). Finally, it is important to consider the possibility that improvements evident on a highly sensitive behavioral observation measure were not as noticeable in the children's daily behavioral functioning.

Overall, these results suggest that the Level System resulted in more appropriate behavior exhibited by children with typical and disruptive behavior in the class. However, the changes in behavior may not be as evident to the teachers. Thus, only preliminary support is provided

to the effectiveness of the Level System. In order to ensure that teachers will use strategies that are found to be effective in the classroom, it is pertinent that measures of change be used and provided to teachers that evaluate behaviors that are important to teachers so that changes in these behaviors are more evident to teachers.

Time Out

Generally, the number of time outs given by the teachers was lower when the Level system was used than when typical classroom strategies were used, except for follow up. The number of time outs provided to the children was lowest during follow up. This trend was evident among the children with disruptive behavior as well as all of the children in the class. For the most part, this trend was clear when considering the number of time outs given by individual teachers. The frequency of time outs given to the children probably decreased during the Level System conditions because the teachers were taught to use the system to manage minor misbehaviors and to prevent minor misbehaviors from escalating to more severe disruptive behavior. However, this does not explain the finding that the fewest time outs were provided during follow up. Potentially, this result might be due to generalization of the behavioral management skills that were taught with the use of the Level System (e.g., positive reinforcement, differential attention, warnings) after the Level System was removed.

Satisfaction

Parents appeared to be satisfied with the Level System. Specifically, no parents reported that their child would be humiliated or embarrassed by having their name in the "cloudy zone" of the token economy, only by not receiving the reward. Additionally, most parents stated that they would not be embarrassed if their child's name was in the "cloudy zone." This was, however, a concern for some parents. Overall, parents described the Level System positively.

Teacher satisfaction with the Level System was not as evident as parent satisfaction. Specifically, the teachers appeared to be more satisfied with the Level System than they were in the baseline phase; however, after removal of the initial implementation of the Level System, teachers reported more satisfaction when the Level System was not in place. This is not surprising since the percentage of appropriate behavior exhibited by the participants did not decrease to baseline levels during the withdrawal phase. In other words, the participants behaved more appropriately during the withdrawal phase than baseline, therefore, the teachers may not have considered re-implementation of the Level System necessary. On the other hand, if the children's behavior had returned to baseline levels, the teachers may have considered re-implementation of the Level System to be worth the time and effort. This reason also may account for the teachers choosing not to use the Level System during the follow-up assessment. Another potential explanation for this finding may be that once the teachers learned more effective behavior management strategies (e.g., positive reinforcement) from using the Level System, benefits gained from adding the Level System were not worth the time and effort of implementation. The teachers may have learned skills (e.g., praise) that allowed them to better manage their classrooms without the use of a token economy.

Teachers reported to the experimenter that they used the skills that were taught to them, but that they felt that using the Level System took too much time and was too difficult without a stable teacher's aide. It should be noted that for the current study, teachers were required to complete several daily questionnaires and forms (e.g., class management rating, time out log) that would not be required when using the Level System clinically. Teachers reported that they would have been more likely to use the Level System if additional forms were not required.

Negative Effects

Because the children's level of appropriate behavior did not decrease below baseline levels during the withdrawal phase, it was determined that no negative effects on "intrinsic motivation" were evident with implementation and use of the Level System. Individually, only one child in one class potentially met the current study's criteria for loss of "intrinsic motivation" and that was in the presence of only 1 of the 5 teachers. Because no other children (considered individually or combined) met this study's criteria in the presence of any teacher (considered individually or combined), the current study supports previous research that token economies do not result in a loss of "intrinsic motivation" (e.g., Cameron et al., 2001). Further support is added to this result because of the length of the withdrawal phase. Specifically, the withdrawal phase was held for stability (i.e., 15 observations for each child) plus 1 week. Previous studies may have found a "loss of intrinsic motivation" because the length of the withdrawal phase was very short. Behaviorists often predict a decrease in behavior below baseline immediately following the removal of a reward program because of satiation with the reinforced behavior or a negative contrast effect (e.g., Cameron et al.; Reitman, 1998). The longer withdrawal phase was included in this study to allow time for temporary effects to stabilize. In the current study, however, the percentage of appropriate behavior exhibited by the participants did not even return to baseline levels, such that the longer withdrawal was not necessary.

METHODOLOGICAL LIMITATIONS

Participant Selection

It appeared that teacher report on the CGI for selection and behavioral observations coincided when considering the children with disruptive behavior. However, inconsistencies were found between teacher report for selection and behavioral observations for the children with typical behavior. This is evident because the children that the teacher's reported as engaging in typical levels of appropriate behavior were observed to exhibit extremely high rates of appropriate behavior during baseline. As a result, a ceiling effect occurred and made it difficult to distinguish differences among conditions when considering the appropriate behavior of the children with typical behavior.

Observation Assessment

Redsocs

The observation assessment that was used for the current study produced approximately 15 min of data on each child per observation. Thus, only a limited amount of data was collected for each participant which may have contributed to the variability in the children's behavioral data. It is important to note, however, that clear differences were evident across conditions even with the use of limited observations.

Teacher response data

One measure of treatment integrity used in the current study was behavioral observation of teacher response to child behavior. This measure may have underestimated the amount of integrity with which the teachers used the Level System. Teacher responses were coded toward the particular target child being observed at the time. Therefore, any teacher response to another child's behavior was not coded. For example, a teacher may have been moving several children's shapes up for appropriate behavior, but if these children were not being observed, this adherence would not have been recorded. Therefore, the percentage of time that the teachers engaged in the integrity behaviors may have been underestimated.

Because the data collected concerning teacher behavior are preliminary and the codes were created for the current study, the results are difficult to interpret. The percentage of time that the teachers should be spending engaging in each of the integrity behaviors to consider the Level System as implemented accurately is unclear. For example, even if the teachers were implementing the Level System perfectly, it would be unreasonable for them to praise and move shapes up 100% of the time for appropriate child behavior, and warn and move shapes down 100% of the time for inappropriate child behavior. If this were to occur, the teachers would not meet their teaching requirements or attend to the behavior of other (non-target) children in the class. Thus, teacher response data (e.g., greater use of praise for appropriate behavior during Level System conditions) provide some support that the Level System was used with integrity throughout the study, but to what extent is uncertain.

Experimental Design

A significant limitation of the current study is that stability was not reached for all conditions for either of the children with disruptive behavior when considering their behavior across teachers. Stability, however, was reached for all conditions for the children with typical behavior, but, as stated previously, this is a limitation itself because ceiling effects occurred. When inspecting the children with disruptive behavior's data with individual teachers, stability was reached on a few occasions (e.g., Cody's baseline data with Patricia), however, no clear trends are present. It may have been difficult to achieve stability with the current population. Specifically, preschool child behavior is variable and depends on numerous factors (e.g., sleep, breakfast). Additionally, the environment of the current study may have made it difficult to achieve stability because the children rotated through 2 teachers each day, and their behavior may have been different in each teacher's class. To circumvent lack of stability from affecting the results of the current study as much as possible, each condition was held for a minimum of 17 days.

Another limitation concerning the experimental design of this study is that the participants' behavior did not reverse to baseline levels during the withdrawal condition or follow up assessment (i.e., no Level System). This carryover effect, or incomplete withdrawal (Parsonson and Baer, 1986) obfuscates the effects of the intervention on the children's behavior. A carryover effect is "characterized by the experimenter's inability to retrieve original levels of baseline responding" (Barlow and Hersen, 1984, p. 99). Researchers suggest (e.g., Barlow and Hersen) that carryover effects occur for several reasons. For example, they may occur due to changes in instructions concerning the intervention across conditions (Kazdin, 1973), new conditioned reinforcers that are established (Bijou et al., 1969), differences in stimuli across conditions (Kazdin and Bootzin, 1972), and naturally occurring contingencies in the environment that may maintain the new behaviors (Krasner, 1971). To circumvent carryover effects, Bijou et al. recommend shortening the intervention conditions so that new conditioned reinforcers are less likely to be established. However, as stated previously, in the current study, conditions were held longer in an attempt to obtain stability. A possible explanation for the carryover effect in the current study is that the teachers learned to use skills with the Level System that could have been used when the Level System was removed. For example, the teachers were taught to use labeled praise when implementing the Level System, and labeled praise can be used without the Level System in place. Therefore, the teachers' behavior (i.e., labeled praise) "carried over" affecting child levels of appropriate behavior.

Teachers' Aides

The class of children in the study had a rotating teacher's aide. Specifically, there was an aide present on random occasions. Additionally, the aide changed often. At the beginning of the intervention condition, the current teachers' aide on staff was trained in the use of the Level System, and data were to be collected concerning the aide's implementation of the Level System. However, once it was discovered that the teachers' aide was not always present (i.e., she attended the class approximately 1 day per week), and shortly after the implementation of the Level System (5 observations), the teacher's aide changed (i.e., a new aide was hired), it was determined that this data would be sporadic. Therefore, two future teachers' aides were not trained in the use of the Level System, and data were not collected concerning their behavior.

During the first 5 observations of the first Level System condition, the teachers' aide was using the Level System. However, because she did not attend the class every day, she was in the class on the first observation of this condition. From visual inspection, it appears that her presence with using the Level System did not affect the participants' behavior.

Setting

The environment in which the study was conducted is another limitation of the current study. Specifically, the setting was a privately-owned preschool that served mostly middle-class families. Thus, similar results may not have been found if the study was conducted in a Head Start classroom in which the children are at a higher risk for disruptive behavior

problems. Additionally, different results may have been found with teachers that were not as well-trained as those that participated in this study. All of the teachers in the current study received bachelor's degrees, and had several years of teaching experience. Because of the setting of the preschool, the teachers interacted with each other on a daily basis. Therefore, it is likely that discussions took place concerning the Level System. Some teachers may have decided not to use the Level System at the study's end because other teachers were not using the system.

CLINICAL IMPLICATIONS

Several clinical implications are apparent from the current research study. First, it is interesting that when using the Level System the number of time outs given by the teachers decreased. This result may be due to an increased number of low-level consequences (i.e., moving children's shapes down a level) for minor misbehavior. These consequences may have prevented the children's behavior from escalating to disruptive behavior requiring a higher level consequence of time out. This is an important consideration when determining which behavior management strategies to use in the classroom. Specifically, some parents or teachers may not approve of using time out procedures because they may require more physical guidance. Therefore, using a whole-class token economy such as the Level System may circumvent using higher level consequences for disruptive behavior.

Another clinical implication is evident when considering the teachers' satisfaction with the Level System. The teachers appeared to be more satisfied with the Level System when they first began using it than when they used it in their classroom a second time. This finding implies that teachers may be satisfied using the Level System for a short period to learn to better manage their classroom, but not using the token economy for an extended length of time. Implementation of the Level System resulted in a 47.9% increase in appropriate behavior from the children exhibiting disruptive behavior. This increase appears to be clinically significant as evidenced by the teachers' increase in satisfaction with the first implementation. Therefore, it may be better to use the Level System in the classroom for disruptive periods, and then fade out use of the system. For example, teachers could implement the Level System at the beginning of the school year to teach children class rules and expectations within the classroom, and then fade the system out once natural contingencies (e.g., positive reinforcement from peers, access to activities) take over. Additionally, the teachers reported that they were not completely satisfied with the Level System because they felt that it took time away from teaching. Therefore, using the Level System in the classroom may be more appropriate when a steady teacher's aide is available to assist with behavior management.

Lastly, this study provides evidence that the Level System resulted in no negative effects on preschool children's "intrinsic motivation." Additionally, the Level System was proven to be effective in increasing appropriate behavior exhibited by both children with disruptive behavior and children with typical behavior. Therefore, introducing a whole-class token economy, such as the Level System, should be considered by clinicians and school consultants at the preschool level when referrals are made concerning children with disruptive behavior problems.

DIRECTIONS FOR FUTURE RESEARCH

This study provides preliminary support for using a whole-class token economy, the Level System, to manage disruptive behavior in a preschool classroom. Thus, future research should confirm and expand upon the current findings. Specifically, because the current evaluation of the Level System was conducted with one class across five teachers, it is important to evaluate this system with numerous classrooms each with a different teacher. This would provide evidence as to the generalizability of the current results. Furthermore, the Level System should be evaluated with diverse populations. For example, determining the effectiveness of this token economy with children with developmental disabilities, learning disabilities, and other mental health concerns (e.g., ADHD) would aid in determining the applicability of the Level System with diverse preschool children.

A series of systematic examinations of the specific components of the Level System may yield valuable information. These investigations could examine if both the token economy and the response cost components of the Level System are required to obtain significant changes in appropriate behavior exhibited by participants. Additionally, it would be interesting to evaluate the effect of the addition of a structured time out procedure to the Level System to conclude if similar results would be obtained with regard to the number of time outs given by the teachers compared to the results of the current study. Another component that should be evaluated is the visual display of the chart. Specifically, given that some parents expressed that they would be embarrassed if their child's name was in the cloudy zone, research should address the issue of the need for the chart to be displayed during use of the Level System to obtain changes in levels of appropriate behavior.

Other future research should focus on determining if a whole-class token economy, such as the Level System, would be beneficial and produce similar results during playground activities. Throughout the current study, teachers requested the need for such a system to use during outside time. Additionally, because teacher satisfaction with the Level System was inconsistent, it should be researched further. If teachers are not completely satisfied with the time and effort involved in using the Level System, then, perhaps it only should be implemented when a teacher's aide is available for implementation. Alternatively, it may be possible to make modifications to the system to make it less time consuming (e.g., have children move their pieces up and down, use it only during transitions, provide rewards less frequently). Thus, future research is needed before conclusions can be drawn about the general efficacy, practicality and ecological validity of a whole-classroom token economy for managing preschool behavior problems.

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In: Preschool Children: Physical Activity… ISBN: 978-1-60876-026-8
Editors: L. Colombo and R. Bianchi. pp. 183-198

Chapter 11

A QUALITATIVE COMPARISON OF FRUIT AND VEGETABLE CONCEPTS AND KNOWLEDGE BETWEEN PRESCHOOLERS AND THEIR PRIMARY CARE PROVIDERS AND CHILDCARE PROVIDERS

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ABSTRACT

The purpose of this study was to provide nutrition educators with a baseline understanding of how preschoolers' current concepts and knowledge of fruits and vegetables relates with their primary care providers (i.e. parents, grandparents, or foster parents) and childcare providers. The exploratory, theory-based, qualitative study design involved interviews with preschoolers (n=24) and their primary care providers (n=22) and childcare providers (n=2). Maps were used to qualitatively compare similarities in responses to questions regarding fruits and vegetables between a preschooler and her primary care provider and childcare provider. The concepts expressed by the preschoolers were shared minimally with their primary care providers and childcare providers. Further work is needed in understanding how to utilize primary care providers and childcare providers and the underlying preschool contextual setting to increase preschoolers' concepts and knowledge of fruits and vegetables.

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Keywords: preschoolers, fruits and vegetables, nutrition education.

INTRODUCTION

Childcare settings are important—yet under-studied—social environment within which food-related behaviors among preschoolers are developed (Nicklas, et al., 2002). An estimated 12 million, or 61%, of the 19 million U.S. children 5 years of age and younger are in some form of childcare on a regular basis from persons other than their parents (Anne E. Casey Foundation, 2006; Federal Interagency Form on Child and Family Statistics, 2006). The majority of low-income preschoolers receive care at Head Start (U.S. Department of Health and Human Services, 2006). Head Start provides services to an estimated 915,000 at-risk preschoolers and aims to promote early childhood development by helping strengthen the skills of preschoolers, as well as, their primary care providers (i.e. parents and grandparents) (U.S. Department of Health and Human Services, 2006(a); U.S. Department of Health and Human Services, 2006(b)).

Food-related behaviors among children are increasingly problematic. For example, obesity rates have doubled among children and rates tend to be higher among low-income children (Centers for Disease Control, 2006). Close to 80% of children fail to eat the recommended number of servings of fruit and vegetables (Krebs-Smith, et al., 1996; Munoz, et al., 1997; Carlson, et al., 2001). The majority of children also consume too much fat, sugar, and sodium. Low-income children generally have unhealthy eating patterns and are at-risk to maintain these patterns into adulthood.

Both primary care providers and childcare providers can influence preschooler's eating practices by controlling availability and accessibility of foods, meal structure, food modeling, food socialization practices, and food-related parenting styles (Davison and Birch, 2001). While interventions to improve the diets of children, such as promote fruit and vegetable consumption among children in school settings, show potential (French and Stables, 2003), the childcare setting has not been extensively explored. The studies conducted in childcare settings tend to focus on children's nutrient intake or parent participation in nutrition education programs. Parent studies demonstrate that parents tend to have low knowledge on basic nutrition and child-feeding concepts (Hobbie, et al., 2000). In addition, parents are rarely involved in planning meals or participating in other aspects of the nutrition program in childcare centers (Briley, et al., 1999). Entities including the American Dietetic Association and American Academy of Pediatrics provide guidance to assist primary care providers and childcare providers in feeding young children and educating preschoolers on health (American Dietetic Association, 2004; American Academy of Pediatrics, et al., 2006; American Dietetic Association, 2005). Despite this, few studies examine the relationships between preschoolers and their primary care providers and childcare providers nor the partnership between primary care providers and childcare providers.

Head Start is increasingly focusing on preschoolers' school readiness, in addition to improving the literacy of program primary care providers. Nutrition educators have used books to increase acceptance of a novel vegetable in Head Start preschoolers (Byrne and Nitzke, 2002). Nonetheless, little has been conducted to integrate and evaluate the lessons a child is learning in the classroom with the lessons she is learning at home. Studies focused on

parent and teacher agreement on child issues typically demonstrate a lack of agreement between parent and teacher; however, most of these studies focus on behavior, social competence, or educational parameters and not on food and nutrition issues (Cai, et al., 2004; The National Academy of Sciences, 2006; Fagan, 2000).

Designing a study, educational materials, or an intervention for low-income preschoolers can be especially problematic due to the lack of research on this population. According to the Theory for the Ecology of Human Development (Bronfenbrenner, 1979), the Theory of Meaningful Learning (Novak and Gowin, 1984), and the Ecological Model of Predictors of Childhood Overweight (Davison and Birch, 2001), effective dietary interventions must incorporate the targeted audience's context. That is, a thorough investigation of a preschooler's concepts of fruits and vegetables involves understanding a preschooler's settings (i.e. home and childcare), as well as, activities (i.e. eating or helping with food prep and grocery shopping) the preschooler may engage in (Bronfenbrenner, 1979). In addition, the interpersonal relationships a preschooler may have with his primary care provider or childcare provider can provide insight into how that preschooler is developing. For example, when a childcare provider expresses to a preschooler that she does not like bananas, a preschooler can dynamically follow the childcare provider's lead and not eat the banana provided to her at snack. This example illustrates how a childcare provider can serve as a positive or negative role model for a preschooler.

Concepts, according to the Theory of Meaningful Learning (Novak and Gowin, 1984), are a perceived regularity in events or objects designated by some label; are what individuals think with; and are useful in trying to determine an individual's knowledge of a subject. The meaning of any given concept is derived from the interrelationships that concept has with other concepts. One reason, therefore, that early childhood education is important is that it provides a rich base of concepts from which all future learning can proceed. If that base is impoverished, then future learning will be impoverished as well. Thus, a preschooler with few concepts of fruits and vegetables may have a weak foundation for understanding the more complex, but important concepts of fruits and vegetables later in life such as how antioxidants in fruits and vegetables help prevent chronic diseases.

Based on a qualitative study informed by the Theory for the Ecology of Human Development (Bronfenbrenner, 1979) and the Theory of Meaningful Learning (Novak and Gowin, 1984) that compared preschoolers' nutrition concepts to their parents, the study investigator (Achterberg, 1986) concluded that shared meaning on a food and nutrition concept was found to be negotiated between individuals and it is not established between a preschooler and his parents unless there is a defined need, interest or super-ordinate goal to which the parent and preschooler can direct their attention, have an opportunity for social interaction on the subject, and conduct a meaningful discussion about the topic. In the absence of this discussion or exchange, preschoolers created their own meanings for that particular topic. Similarly, preschoolers created their own meanings for particular topics when receiving mixed messages, i.e., from their parents and their childcare providers.

The Theory of Meaningful Learning (Novak and Gowin, 1984) stresses that misconceptions are difficult to change and become increasingly hard to correct as the meanings grow in complexity. Theoretically, nutrition educators need to examine a preschooler's current concepts of fruits and vegetables. Explorations of a preschooler's interaction in his home and childcare center are essential to understanding where to start

educating a preschooler and his primary care provider and childcare provider about fruits and vegetables.

The purpose of this exploratory, qualitative study was to provide nutrition educators with a baseline understanding of how preschoolers' current concepts and knowledge of fruits and vegetables relates with their primary care providers and childcare providers.

METHODS

Description of Participants and Procedures

An Institutional Review Board at a major research university approved all study protocols. Child assent, parental informed consent, and individual primary care provider and childcare provider consent were obtained. Assent from the preschoolers were obtained once in front of their primary care providers. The preschoolers were also asked for their assent at the beginning of each of their individual interviews. All preschoolers and their primary care providers and childcare providers, with the exception of one primary care provider who could not participate due to her time constraints, agreed to participate. Compensation included child-size water bottles for preschoolers in all six of the center's classrooms. Participating primary care providers and childcare providers received a ten-dollar gift certificate to a local grocery store. Nutrition education for all of the preschoolers, primary care providers, and center staff was provided after data collection.

Study Design and Sample

The primary study center was a Head Start childcare center that had six classrooms. Each classroom was composed of twenty preschoolers and had two childcare providers (one lead teacher and an assistant). This center was located and served a primarily low-income, African American community. The interviewed preschoolers, primary care providers, and childcare providers were recruited from three randomly selected classrooms at the primary study site during January through August, 2002.

The first classroom (n=11 preschoolers; n=10 primary care providers; and n=1 childcare provider) served as a pilot. Based on the pilot findings, revisions to improve the protocol were made including asking the study participants what the word "healthy" means. The subsequent two classrooms (n=24 preschoolers; n=22 primary care providers; and n=2 childcare providers) were used for primary data collection. All of the preschoolers and primary care providers in the primary data collection lived in households below the poverty guidelines and were African American. The preschool sample included twelve boys and twelve girls. The preschoolers' ages were as follows (n=the number of children participating of that age): three-years-old (n=5), four-years-old (n=11), and five-years-old (n=8).

The primary care provider sample included sixteen women and six men. The participants' ages were as follows (n-the number of primary care providers participating of that age): twenty-nine-years-old and younger (n=7), thirty-years-old to forty-nine-years-old (n=13), and fifty-years-old and older (n=2). The participants' martial status was as follows (n=the number

of primary care providers participating with that martial status): single (n=9), married/two-parent household (n=9), and divorced (n=4). The number of children in the participants' household was as follows (n=the number of primary care providers participating with that number of children in the household): one child (n-3), two to three children (n=10), and four or more children (n-9).

The two childcare providers' demographics were as follows: one was African American while the other was Caucasian; one was in her upper thirties and the other was older than 50-years-old; both were female; and, both were married with two children.

The interviews were designed according to the study's theoretical framework (Davision and Birch, 2001; Bronfenbrenner, 1979; Novak and Gowin, 1984) and the content of the interviews were used to explore the preschoolers, primary care providers, and childcare providers' knowledge and current concepts of fruits and vegetables. The interviews were also used to explore ways in which primary care providers and childcare providers might partner to influence their preschoolers' fruit and vegetable knowledge and consumption. A prior study demonstrated that semi-structured interviews with preschoolers and their caregivers is a valid means of obtaining information about what the preschooler knows, is learning, and may be exposed to (Achterberg, 1986). Another study showed success with qualitative methods in studying fruit and vegetable procurement and consumption in an inner-city, African American sample (Shankar and Klassen, 2001).

Data Collection

Cards of fruits and vegetables were used throughout the preschoolers, primary care providers, and childcare providers' interviews and included: apple, banana, broccoli, canned peaches, carrot sticks, collard greens, corn, French fries, grapes, green peas, orange, and salad. The fruits and vegetables were selected based on a review of the childcare center's menus and foods thought to be available and commonly consumed in the community. The cards were placed in front of the participants in groups of two or three. Naming the food picture cards was one of the first tasks. The names that a particular preschooler, primary care provider, or childcare provider gave the fruit and vegetable cards were used throughout the participant's interviews.

The audio-taped and transcribed interviews used a structured set of questions with follow-up probes that each study participant was asked to answer. The set included such questions as: what are fruits; which foods here are fruits; where do fruits come from; do you eat fruits; do you eat fruits with other foods; are fruits healthy or not healthy for you; what does healthy mean; and what do fruits do for the body? The caregivers were also asked to discuss nutrition education, grocery shopping, mealtimes, and their interaction with the childcare setting or household. All the interviews of the study participants took place at the center, except for one primary care provider, which took place at the field researcher's home. The order of the questions—i.e., fruit questions first, then vegetable questions—was switched equally among the study participants so as not to bias one section over the other. The preschoolers' interviews were usually about 10 to 30 minutes and took two to six interviews to complete the protocol. The caregivers generally only took one meeting that lasted on average from 90 to 180 minutes.

Data Analysis

The Theory of Meaningful Learning guided the data analysis (Novak and Gowin, 1984). We analyzed the level of shared meaning by comparing an individual preschooler's concepts of fruits and vegetables with their primary care provider and childcare provider's concepts of fruits and vegetables. We also collectively combined and compared the preschoolers, primary care providers, and childcare providers' responses.

The figures or maps used for this study noted the central concept, i.e., fruits or vegetables, in the middle. Then, branching from the central concept were selected questions from the interview protocol. The boxes stemming from the branching selected questions illustrate the study participants' responses to these questions and how they related to their respective preschooler, primary care provider, and childcare provider's responses. Frequency scores were given to each concept to note the number of times this concept was generated amongst the entire sample. Misconceptions were noted with an M. The maps were first developed separately for fruits and then vegetables for each participant. Then, the maps were combined to compare the level of shared meaning amongst a preschooler and her primary care provider and childcare provider. Qualitative comparisons were made based on similarity in responses. Figures or maps selected represent the range in similarities from shared meaning to lack of shared meaning.

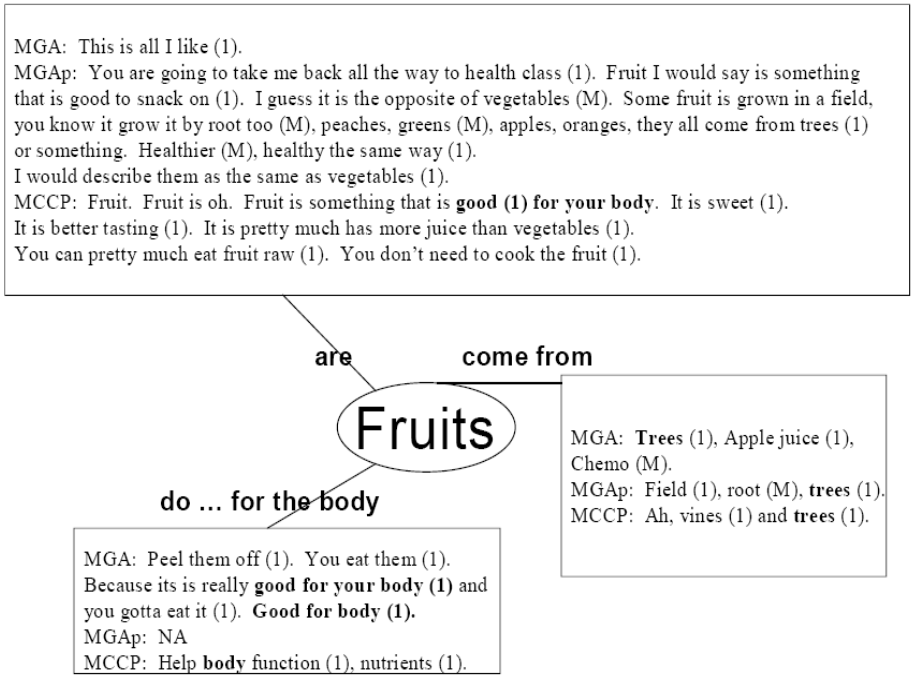
Inter-rater reliability was conducted by three independent assessments, including the field researcher. All researchers individually read through each study participant's responses to the study questions. Independently, the researchers noted a study participant's responses to the questions and then constructed and scored a map based on these responses. The researchers also made and compared maps that contained the responses generated by a preschooler and her primary care provider and childcare provider. Agreement on the responses, maps, and concept scores were 89%.

RESULTS

Table 1 demonstrates that the concepts expressed by the primary care providers and childcare providers are similar. On the other hand, this table illustrates that the concepts expressed by the preschoolers were shared minimally with their primary care providers and childcare providers. Common concepts that frequently emerged in the preschoolers, primary care providers, and childcare providers' interviews were dental issues, but these issues did not come out as much in the responses to the fruit and vegetable questions. Children often discussed how candy hurt their teeth and fruit was good for their teeth. Primary care providers voiced the same messages. For example, MBYp explained that healthy is "as in not cavities, not getting any cavities." His four-year-old son had tooth decay and had several teeth pulled during the school year. These dental comments emerged in the fruit discussions, as well as, the primary care providers' discussions on what were their primary health concerns regarding their children. Limited fruit and vegetable availability, as expressed by a preschooler's (MGRp) "no more, no more" description of fruit, was reinforced by her dad (MGRp) who explained that keeping fruits and vegetables, especially fresh fruits, in a full house, on a regular basis was hard.

Table 1. Comparisons between the Preschoolers and their Primary Care Providers and Childcare Providers' Answers for Selected Questions (Number of Times the Concept was Mentioned)

Primary Care Providers (n=22)	Preschoolers (n=24)	Childcare Providers (n=2)
Question: Where do Vegetables Come From?		
Ground, trees, etc. (22)	Store (7) Out of the woods, etc. (6) Home (5) School (5) Bowl (3) I don't know (3) Stove (3) Meals (2) Barn (1) Cows (1) Food (1)	Ground, plants, etc. (2)
Question: What do Fruits do for the Body?		
Gives the body vitamins and/or minerals (7) Cleans system out (5) Strengthens body (5) Maintain health (4) Prevent diseases (3) Fight infections (2) Keeps you hydrated (2) Sustains life (2) Keeps weight down (2) Makes you feel better, not bloated (1) I'm not really sure of fruit (1) Makes skin healthy (1) Cavities (1) Healthier than candy (1)	Makes you strong (5) Good for you, help your body (4) Eat (4) Negative things, i.e. make you sick (4) Make you comfortable (3) I don't know (2) Things for particular body parts, i.e. eyes (2) Taste (1) Make you grow (1) Make you happy (1)	Gives it vitamins and/or minerals (1) Feed the bones and muscles (1) Helps the body function (1) Provides the body nutrients (1)
Question: What Does Healthy Mean?		
Good for you/helps body (10) Eating the right things (4) Lots of energy, not sluggish (4) Absence of disease and sickness (4) Have vitamins and/or minerals (4) Have good eye sight (4) Fit (4) Provide nutrition/nutrients (2) Sustains life (2) Good blood (2) Regular, good bowel function (2) Doesn't have a lot of sugar (1) Strong (1) Growing (1)	Helps specific body parts such as carrots are good for the eyes (11) You eat certain foods (9) Good (7) Keeps you from getting sick (6) Bad (5) I don't know (5) They help you (2) Taste (1)	Good for the body (1) Gives you energy, stamina (1) Helps the body function properly (digestive system) (1) Provides nutrients (1) Gives you vitamins and/or minerals (1)



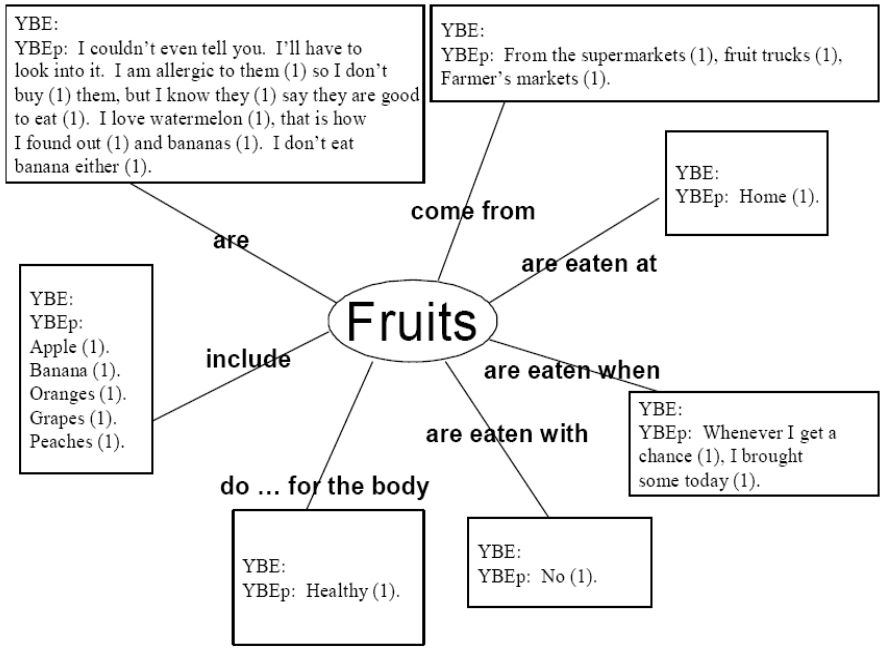
What is healthy?
MGA: It keeps your **body** un-sick. It keeps your **body good**. Keeps **body healthy and good**, bony.
MGAp: If I had to define healthy, umm how about something fit. Something that you know is **good** for your lifestyle, **good for your body**, you know like Campbell's or whatever they play that is. You know for your **body**, your cholesterol. You know your nutrients is **your body** and stuff. Fruits and vegetables help different parts of your **body** grow and things like that they say.
MCCP: **Good for body**, energy, stamina, helps **body** function properly, gives it the nutrients.

Figures 1. An Example of Shared Meaning between a Preschooler (MGA(5)) and her Primary Care Provider (MGAp) and Childcare Provider (MCCP) on Fruit.

Similar to the collective sample comparisons, table 2 illustrates that minimal shared meaning was found in the individual preschooler-primary care provider-childcare provider comparisons. One of the few examples of shared meanings is demonstrated in figure 1. That is, figure 1 illustrates how a concept was shared between a preschooler (MGA), primary care provider (MGAp), and childcare provider (MCCP). Figure 2, in contrast, represents the more common finding in this sample: lack of shared meaning. Indeed, figure 2 captures how a primary care provider's (YBEp) response about being allergic to fruit adds insight to her preschooler's (YBE) lack of concepts on fruit.

Even though limited shared meaning in this sample was found, the qualitative map construction process revealed possible activities that the preschooler, primary care provider, and childcare provider engage in that might help or hinder a preschooler's concepts and knowledge of fruits and vegetables. For instance, in figure 3, YGH expressed several important concepts of fruits and vegetables. Her concepts may have been enhanced by her primary care provider, YGHp, who worked at the childcare center and communicated with

the field researcher that she tried to re-enforce lessons taught at the center such as: "She should eat up, 'cause they (vegetables) are good for the heart." Nonetheless, YGHp's vegetable misconceptions, such as: "keep acids out, put acids in," may be a contributing factor to YGH's lack of clarity on whether or not vegetables help or "hurt" the heart.



Figures 2. An Example of Lack of Shared Meaning between a Preschooler (YBE(4)) and his Primary Care Provider (YBEp) on Fruit. This map also illustrates how a mother's "allergy" to fruit may have influenced her son's lack of fruit concepts.

Table 2. The Concepts Generated by a Preschooler (n=24) that Matched the Concepts Generated by their Primary Care Provider (n=22) or Childcare Provider (n=2)

Preschooler-Primary Care Provider-Childcare Provider Matching Concept	Frequency of Match
Fruits/vegetables come from trees, ground	6
Vegetables make you strong, gives you muscles	3
Fruits/vegetables are good for the body/you	3
Eat fruit as a dessert	1
Preschooler-Primary Care Provider Matching Concept	
Good for the body/you	4
Vegetables help you grow	2
Fruits/vegetables clean out your system	2
Doesn't eat vegetables at home (child) and don't care for them, didn't eat them (primary care provider)	1
Named broccoli for do you eat vegetables with other foods	1
An apple a day keeps the doctor away	1
Fruits/vegetables are good for teeth	1
Fruits/vegetables help you get healthy, not sick	1
Preschooler-Childcare Provider Matching Concept	
Fruits comes from a tree, bush	2

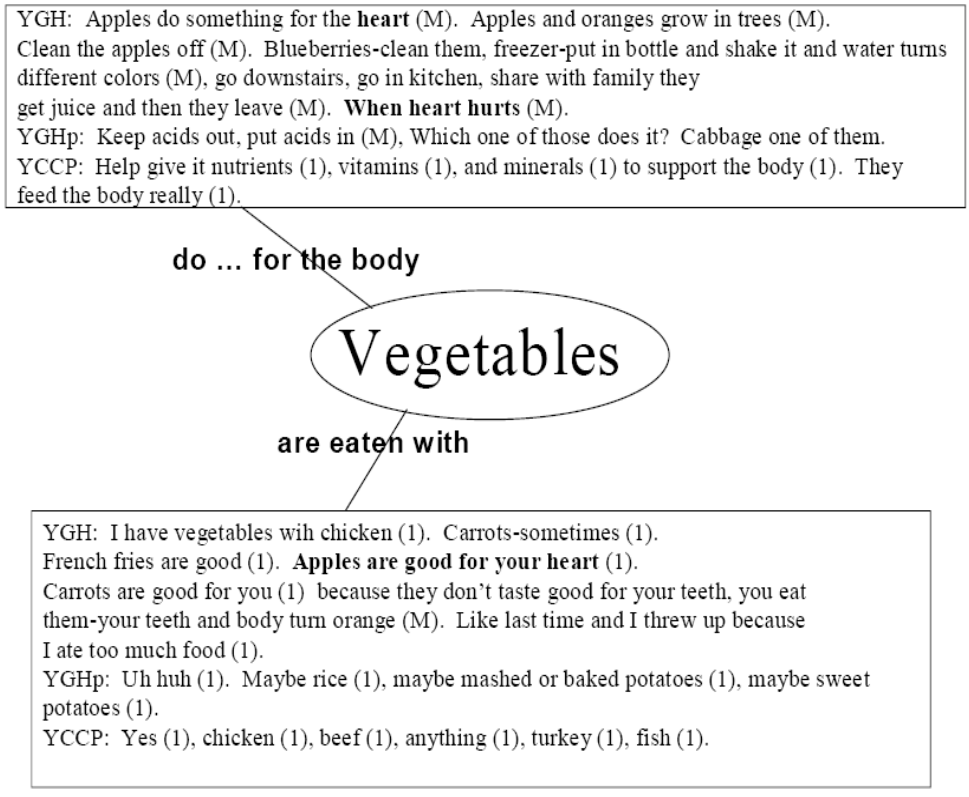


Figure 3. An Example Combined Vegetable Concept Map for a Preschooler (YGH(4)) along with her Primary Care Provider (YGHp) and Childcare Provider (YCCP) Illustrating how Lessons Taught at Head Start such as "Fruits and Vegetables are Good for the Heart" can be Reinforced by the Primary Care Provider (Discussed How She Reminded YGH about the Heart at Dinner) and Childcare Provider (Taught Lesson in Class); But, These Lessons if not Properly Instructed and Reinforced may Contribute to Misconceptions.

Besides shared experiences at the childcare center, a preschooler's concepts and knowledge of fruits and vegetables were enriched in settings where the preschooler engaged in frequent one-on-one time with her primary care provider during a common meal or while grocery shopping. Primary care providers who worked in food service or regularly cooked meals tended to have preschoolers who expressed more accurate and frequent concepts of fruits and vegetables.

The child-feeding practices of the primary care provider and childcare provider frequently emerged during the qualitative interviews and their practices tended to facilitate misconceptions in the preschooler. That is, the primary care providers and childcare providers often mentioned neophobia or the idea of dealing with a "picky eater." Childcare providers explained how they would not serve preschoolers foods "they didn't like" and said: "Oh, they're just picky eaters." Not surprisingly, several preschoolers explained how they would not try any "vegetables" because they did not like a certain vegetable (such as carrots).

One primary care provider (YGKp) discussed how her child's doctor informed her that her child is overweight and is probably going to have diabetes in a couple years. YGKp explained how she would use food as a reward and tried very hard to restrict "the good stuff"

(referring to chips, soda pop, and candy) from her daughter with little success. YGK explained that she eats food when she wants to and often until her stomach hurts.

Other types of child-feeding practices or messages that emerged included: "Eat it," "You eat fruit, after you clean your plate," "No juice unless you eat your vegetables, " and "Don't you want a happy plate (clean plate)?" Every primary care provider except one (YGHp) expressed that they portion their preschooler's plate. YGH explained a couple times during her interview how: "If you're hungry, I'll pick some and put it on a plate." The childcare providers did not practice family-style eating, i.e., a child serves her/himself.

The majority of the primary care providers explained that they rarely talk to the childcare providers about food and nutrition issues, but the primary care providers tried to talk to their preschoolers about what they ate at school. One of the childcare providers (MCCP) explained: "We (the primary care providers and I) might talk about food. We might talk about does so and so eat such and such at home because here they don't like it or whatever." The other childcare provider (YCCP) added: "You are not only educating the child, but in a way, you are educating the parents."

DISCUSSION

The results of this exploratory, qualitative study are novel and provide data that may be applied to the development of new nutrition education data collection methods, materials, and programs. Concepts and knowledge of fruits and vegetables in this sample appears to be primarily learned through eating and personal experiences with food.

Limited shared meaning between the preschoolers and their providers implies the participants have limited familiarity with the subject or infrequent meaningful discussion on the subject. Nonetheless, the meanings or lack of meanings preschoolers ascribe to fruits and vegetables appears to have been influenced by their primary care providers and childcare providers' activities (e.g., one-on-one meal time, grocery shopping, or cooking) or child-feeding practices (e.g., don't eat fruit until you have a "happy plate")).

Preschoolers can provide important insights into their food, nutrition, and health experiences (Achterberg, 1986); however, there are challenges to conducting qualitative interviews with preschoolers (Irwin and Johnson, 2005). In this inner-city Head Start childcare center, the linguistic needs and limitations of the participating preschoolers had to be appropriately handled during the interview process and data analysis. Similar studies (Achterberg, 1986; Matheson, et al., 2002) provide a benchmark for our sample as to what is age and cognitively appropriate. Comparatively, our sample demonstrated similar abilities and responses; yet, our sample generated fewer concepts and shared meaning with their primary care providers. In light of the cognitive and educational assessment research on inner-city preschoolers who attend Head Start or not (Karoly, 1998), a finding of limited concepts and knowledge of fruits and vegetables in this sample is logical.

The Theory of Meaningful Learning advocates that educational programs should build on preschooler's past experiences. These preschoolers are aware of fruits and vegetables and can incorporate lessons on foods into their cognitive structure. Therefore, nutrition education data collection methods, materials, and programs based on the preschooler's day-to-day experiences with fruits and vegetables, particularly in the childcare setting, rather than

abstract lessons on food groups and food classification, may be more effective in enhancing their concepts and knowledge of fruits and vegetables, as well as, shaping their behavior. Since preschoolers often expressed how they couldn't get fruit until they have a "happy plate," educators may consider working with the preschoolers and their providers on not using fruit as a reward or in a contingent matter (e.g., you must have a "happy plate" in order to eat fruit). Future research could investigate how childcare providers properly naming the fruits and vegetables during mealtime and discussing these foods with the preschooler's impacts their concepts of the served foods and mealtime in general. For example, preschoolers hearing the names of the foods while eating may increase their knowledge of the foods and may even influence their preference for these foods. Early childhood investigators may also consider using mealtime as a more systematic educational venue given that in most childcare settings preschoolers consume at least two meals and a snack—translating into at least one-third of their entire school day.

Misconceptions also play an important role in learning. According to the Theory of Meaningful Learning, if YGHp (as illustrated in figure 3) continues to give her granddaughter mixed messages, such as "keep acids out, put acids in," on fruits and vegetables, then YGHp may actually be interfering with her granddaughter's new learning. Misconceptions are difficult to change. Qualitative research must collect, analysis, and build on the misconceptions communicated by their sample. While this sample did not generate many misconceptions (which is a good thing), the preschoolers and even some providers had difficulty in differentiating between actual fruit and fruit-flavored juices, candies, and snacks. In order to be effective, educators need to know what their participants know and why, such as has misleading marketing messages or product packaging lead their sample to believe fruit-flavored juice is fruit. If educators properly identify the misconceptions and the possible sources of confusion in their sample, then the design of educational messages, materials, and programs will be more effective.

Shared meaning or lack of meaning provides early childhood educators useful data that can be applied to the development of new childcare curriculum and programs. Unfortunately, tables 1-2 demonstrate that the concepts expressed by the preschoolers were shared minimally with their primary care providers and childcare providers. Achterberg (1986) hypothesized that shared meaning about food and nutrition can only occur between parents and preschoolers on topics with which both are familiar. Given that neither the preschooler nor the providers in this sample expressed many concepts about fruits and vegetables, it is not surprising that extensive shared meaning between these individual groups did not take place. Future educational efforts should work on increasing the concepts and knowledge of fruits and vegetables in preschoolers, primary care providers, and childcare providers.

Increasing concepts and knowledge in this sample is a vital step in educating this sample on fruits and vegetables, because Novak and Gowin (1984) explain that concepts tend to stick better when they have multiple meanings attached to them. In other words, providing the preschoolers, primary care providers, and childcare providers with a basic rationale about why to eat fruits and vegetables or a visual explanation of how water, sun, and soil enables fruits and vegetables to grow may facilitate the development of more meaningful messages. These messages also provide a varied venue in which reinforcing groups a.k.a. primary care providers, childcare providers, and other influencing parties (such as the government and health organizations) can build on and branch off of.

Future educational efforts should ensure that primary care providers and childcare providers are trained on appropriate mediums and methods of transferring their knowledge to their preschoolers. In order for shared meaning to be established, Achterberg (1986) suggested that there be an opportunity for that individual to make choices, i.e. to express his or her preference and a social setting where those preferences are observed by, and perhaps discussed with, other family members. This idea of creating opportunities to express preferences or thoughts about fruits and vegetables in this sample may be one medium by which these preschoolers, primary care providers, and childcare providers can increase their concepts of fruits and vegetables. Having the preschoolers express their thoughts about fruits and vegetables to their primary care providers and childcare providers may facilitate more opportunities for the primary care providers and childcare providers to promote meaning, particularly shared meaning, in their preschoolers.

The Theory for the Ecology of Human Development (Bronfenbrenner, 1979) and the Ecological Model of Predictors of Childhood Overweight (Davison and Birch, 2001) emphasize the influence activities can play in a preschooler's development. The primary activities the preschoolers engaged in where they seemed to learn the most about fruits and vegetables was: mealtime, grocery shopping, and cooking. Future work is needed in exploring how activities such as mealtime, grocery shopping, and cooking in either the childcare or home setting may serve as fruitful methods of educating preschoolers. These activities give providers the opportunity to talk and show preschoolers fruits and vegetables. In addition, these activities serve as consistent, familiar, convenient, and fun outlets where fruits and vegetables can be purchased and consumed. For example, health professionals can research the effectiveness of table talk, i.e. lessons a preschooler can learn while eating, such as food identification. Educators should give special attention to the local fruit and vegetable availability when designing curriculum in low-income populations where limited fresh produce is available or affordable.

Books did not emerge as a critical point of learning about fruits and vegetables in this sample; however, given the school readiness focus of Head Start (U.S. Health and Human Services, 2006(a); and U.S. Health and Human Services, 2006(b)), health professionals could potentially develop, implement, and evaluate the use of literacy-based fruit and vegetable lessons, i.e. the use of books. Moreover, further work is needed in understanding how to encourage providers to use role modeling to encourage food acceptance in preschoolers (Hendy and Raudenbush, 2000). Child-feeding practices are instrumental in creating healthy dietary patterns and messages in preschoolers. Our data imply that further work is needed in exploring the child-feeding practices in this sample. Early childhood educators may want to team with child psychologists to develop means of managing preschoolers' behavior without using food as a reward.

Both of the childcare providers expressed how they communicated with the preschoolers and the primary care providers about food. The childcare providers felt as if they were educating not only the preschooler but also the primary care provider. More work is needed in understanding how to connect concise and precise communication efforts between the preschooler, childcare provider, and primary care provider. Educators may consider the use of the center menu or posting lessons learned at mealtime by the classroom's sign-in/out sheet.

This was an exploratory, qualitative study based in one community. As one of the first research studies in this center, the study needed to ensure that its procedures, content, and activities were fun, friendly, and feasible for the participants. The study needed to work on

making all methods and interpretations context-sensitive. These steps aided in not only ensuring study collection by enough participants but also set the stage for future projects. We acknowledge the study's limitations: a small sample size and the study focused on only a select sample of fruits and vegetables. The study only used one primary care provider where in some instances multiple caregivers may feed and influence the interviewed preschooler. The sample size of childcare providers (n=2) is particularly small; yet, the size is logical. This sample size provides an understanding of the key childcare providers in the studied preschooler's lives. These exploratory findings do not provide substantial foundation for how concepts and knowledge operate in childcare providers. Nonetheless, the interviews may guide future education efforts and qualitative methodologies on how to connect the preschooler, primary care provider, and childcare provider. Our hope is that future research will address some of these limitations. These findings, in spite of these shortcomings, supplied a foundation for future research and intervening efforts.

CONCLUSION

The environment a preschooler grows up in has a powerful impact on how that preschooler develops and how that preschooler learns. This impact affects more than just the traditionally targeted and measured educational, behavioral, and social competence parameters. The early years are critical to food-related behaviors and health outcomes. Health professionals are increasingly playing a role in how preschoolers' food-related behaviors are developing in the home and childcare setting.

Based on the results of this exploratory study, we conclude that preschoolers in this inner-city Head Start childcare center have limited concepts and knowledge of fruits and vegetables and have a lack of shared meaning on the subject with their providers. More research is needed in understanding how to increase concepts and knowledge of fruits and vegetables in preschoolers and their providers. In addition, further work is needed in exploring methods and mediums of how primary care providers and childcare providers can individually and collectively transfer concepts and knowledge of fruits and vegetables effectively to their preschoolers.

ACKNOWLEDGEMENTS

The United States Department of Agriculture Food and Nutrition Services Food Stamp Nutrition Education Program (Fund Number 89EM) and The Children, Families, and Youth Consortium of The Pennsylvania State University provided financial support. Leann Birch, Linda Burton, Tracy Fleischhacker, Terryl Hartman, Linda Kronheim, and Carla Miller were of great help during the research process. Thanks are also due to the children, primary care providers, and Head Start workers who participated in this study.

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