The impact of preschool inattention, hyperactivity, and impulsivity on social and academic development: a review

Elana Greenfield Spira and Janet E. Fischel
State University of New York at Stony Brook, USA

The literature on the prevalence and stability of preschool problems of inattention, hyperactivity, and impulsivity suggests a number of links to early literacy skills and broader school achievement. Developmental considerations in the assessment of preschool ADHD are reviewed in this paper, along with evidence for the stability of symptoms over time and the relationship between early symptoms of ADHD and elementary school achievement. Emphasis is placed on describing the nature of the connection between preschool ADHD symptoms and academic achievement, as few studies to date have focused specifically on that relationship. Several explanations for the relationship between preschool ADHD symptoms and achievement are analyzed, including an explanation that focuses on the relationship between inattention, hyperactivity, and impulsivity and the acquisition of emergent literacy and language skills. Finally, the evidence for four models that have been proposed to account for the link between behavior and learning is reviewed and critically analyzed. Suggestions are made for future research that might resolve important questions only partially addressed in studies to date. Keywords: Attention-deficit/hyperactivity disorder, preschool children, emergent literacy, attention problems, hyperactivity, impulsivity, assessment, achievement, stability. Abbreviations: ADHD: attention-deficit/hyperactivity disorder; RD: reading disorder; CD: conduct disorder; ODD: oppositional defiant disorder; I/H/I: inattention/hyperactivity/impulsivity.

During the preschool years, children acquire the social, behavioral, and academic skills that allow them to navigate successfully through elementary school. Preschool children learn how to focus their attention on teacher-directed activities, interact appropriately with peers and authority figures, and follow spoken and unspoken rules in the classroom. In addition, they acquire the basic building blocks of later academic success as they learn emergent literacy, math, and language skills. Not all children master these crucial skills before they enter first grade. For some children, difficulties with impulse control, attentional capacity, and hyperactivity hinder the ability to benefit from the valuable lessons of preschool and later academic experiences. In some cases, early difficulties never dissipate; instead, they presage the development of serious disorders such as attention-deficit/hyperactivity disorder (ADHD).

A strong literature exists supporting the connection between ADHD and learning in elementary school-aged children (e.g., Bender & Smith, 1990; Frick et al., 1991; Hinshaw, 1992). That work suggests that children with ADHD are vulnerable to a host of difficulties during the school years and beyond. They are at increased risk for academic and social difficulties, including learning disabilities, peer rejection, and decreased teacher expectations (Ladd, Birch, & Buhs, 1999; Merrell & Wolfe, 1998; Vaughn, Hogan, Lancelotta, Shapiro, & Walker, 1992). These difficulties affect not only their developing sense of self-efficacy, but their future emotional, social, and occupational well-being (National Center for Education Statistics, 2002; Winters, 1997).

In contrast to the extensive research conducted on ADHD in elementary school-aged children, few studies have been conducted on the relationship between preschool inattentive, hyperactive and impulsive behavior and emergent literacy or later learning. The paucity of research in this area is surprising, given the fact that a significant number of young children suffer from the effects of ADHD. It is estimated that roughly 2% of preschool-aged children meet criteria for ADHD (Lavigne et al., 1996). Furthermore, teachers of preschool-aged children often list classroom behavior problems as serious detriments to the integrity of their classrooms and the progress of their students. For example, a telephone survey conducted with a stratified random sample of Head Start directors revealed that 37% of the program directors identified classroom behavior problems, including those caused by attention deficit, as ‘major mental health problems for Head Start children and families’ (Piotrowski, Collins, Knitzer, & Robinson, 1994, p. 135). The prevalence and potential long-reaching consequences of this problem necessitate further exploration and clarification of the mechanisms whereby early behavioral difficulties associated with ADHD may affect future learning and cognitive growth.

This paper will describe the research that has been conducted on preschool children with symptoms of ADHD to date, including a review of the literature.
pertaining to: (a) developmental considerations in the assessment of ADHD in preschoolers; (b) the stability of inattention, hyperactivity, and impulsivity from preschool through adolescence; (c) the relationship of early symptoms of ADHD to elementary school achievement; (d) the relationship of these symptoms to the acquisition of emergent literacy and language; and (e) hypotheses regarding the direction of the relationship between behavior and learning. Further, a critique of existing research will be considered, along with proposals for future research that might resolve pertinent questions.

Definition of terminology

A handful of terms that will appear throughout the paper deserve definition.

Preschool. The term ‘preschool’ is used to refer to children aged 2 through 5, or through the kindergarten year. As Campbell (1995) points out, the transition to formal schooling in 1st grade (around ages 6–7) represents a developmental shift in independence, peer competence, and adult expectations. Thus, although the kindergarten year (age 5) is sometimes referred to as the beginning of elementary school, for the purposes of this review, it is considered to be the end of the preschool years.

Attention-deficit/hyperactivity disorder (ADHD). This paper will focus not only on preschool children who are diagnosed with ADHD, but also on preschool children who might not meet full criteria for ADHD but who might be showing premorbid signs of the disorder. Most studies involving preschool children adopt a dimensional, rather than a categorical, approach to the selection of a sample of children with significant behavior problems. This approach is largely due to the understandable reluctance in research to assign diagnostic labels to young children based on behaviors that may be transient or reflect normative temperamental variations (see discussion below). The dimensional approach to the study of psychopathology affords a number of benefits, including the preservation of more information, superior reliability, and greater power in statistical analyses (Klein & Riso, 1993). Thus, children who are higher on the dimensions of inattention, hyperactivity, and/or impulsivity (the hallmark characteristics of ADHD) are referred to, in this paper, as children with early symptoms of ADHD.

Emergent literacy. The study of emergent literacy involves the skills, knowledge, and attitudes that are presumed to be developmental precursors to conventional forms of reading and writing (Whitehurst & Lonigan, 1998). Within the set of emergent literacy skills, several skills have been identified as strong predictors of children’s reading performance in elementary school. In particular, phonological awareness, oral language skills, linguistic awareness, and print concepts are consistently emphasized as important determinants of children’s later reading ability (Scarborough, 1998). These skills predict reading ability for children from low-income and middle-class homes (Whitehurst & Fischel, 2000).

Prevalence, classification, and comorbidity

Prevalence and classification

As noted earlier, in a recent epidemiological study of psychiatric disorders among preschool children, ADHD was identified in 2% of children between the ages of 2 and 5 (Lavigne et al., 1996). The male-to-female ratio was similar to the school-age population, although somewhat reduced in magnitude, with boys being twice as likely to meet criteria for ADHD as girls (boys = 2.4%; girls = 1.3%). In this sample, the majority of cases (1.8% out of 2%) of ADHD existed in tandem with another disorder, usually oppositional defiant disorder (ODD).

The classification of ADHD has become more precise in recent years, with the delineation of specific subtypes that are characterized by unique symptom patterns. In the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV; American Psychiatric Association, 1994), three subtypes of ADHD are delineated on the basis of two dimensions of symptoms. Children diagnosed with ADHD, predominantly inattentive type, present with difficulties in sustaining attention, distractibility, lack of task persistence, and disorganization. Children diagnosed with ADHD, predominantly hyperactive-impulsive type (HI), present with excessive motor activity and impulsive responding. Children with the combined type exhibit maladaptive levels of both inattention and hyperactivity/impulsivity. The HI subtype was introduced in the DSM-IV and discriminant validity with the inattentive and combined subtypes has been supported by DSM-IV field trials and factor analysis (Burns et al., 1997; Lahey et al., 1994).

In a review of the literature on the distinctions between the three subtypes of ADHD, Milich, Balentine, and Lynam (2001) assert that individuals with these subtypes differ from each other on a variety of dimensions. Children with the combined and HI subtypes have higher rates of comorbid conduct disorder (CD) and ODD and of aggressive symptoms in general than children diagnosed with the inattentive type. Furthermore, children with the combined and inattentive types perform more poorly on measures of academic achievement than normal children. When the inattentive and HI subtypes are compared, children with the inattentive type fare worse on measures of achievement, especially math achievement. When the groups are compared on measures of social impairment, children with all subtypes exhibit problems, but children with the combined and HI subtypes exhibit greater problems...
and are more likely to be actively rejected than children with the inattentive type.

**Identification of ADHD subtypes in the preschool population**

Although the differences between the separate subtypes of ADHD have been examined in a number of studies with elementary school and older children, very few studies document these differences in the preschool population. A recent community-based study by Nolan, Gadow, and Sprafkin (2001) examined the prevalence of ADHD symptoms reported by teachers in a large representative sample of preschool children (n = 413), elementary school (n = 1520), and secondary school (n = 1073) students. Symptoms of ADHD were reported for 18.2% of the preschool sample, with the inattentive type being least common (prevalence rate = 3.9%), and the hyperactive and combined types being equally common (prevalence rates = 6.3% and 7.7%, respectively). This pattern was reversed for the older children in the sample; rates of the hyperactive and combined type dropped after the preschool years, while the inattentive type became increasingly more prevalent. Preschool children had higher severity scores than elementary and secondary students for the hyperactive and combined symptoms, but not for the inattentive symptoms. This pattern is consistent with Barkley’s (1997) observation that inattention is detected later in the course of ADHD. It is also consistent with a wealth of research that finds an earlier age of onset for the combined and hyperactive types than for the inattentive type of ADHD (Milich et al., 2001). The only gender difference found for the preschool children in Nolan et al.’s sample was for the combined type, with males being more at risk than females. These findings suggest that behaviors associated with ADHD are quite prevalent in the preschool population, although symptoms associated with the inattentive subtype are less common for 3–5-year-old children. However, it is important to note that these findings only speak to the prevalence of the symptoms of ADHD in preschool children; as a rigorous diagnostic protocol was not followed, no conclusions can be reached regarding the prevalence of ADHD as a diagnostic category.

Lahey et al. (1998) examined the validity of the diagnosis of ADHD with preschool and primary grade children (age range = 3 years, 10 months through 7 years), focusing on the differences in functional impairment between the three subtypes of ADHD. In addition to teacher and parent ratings of ADHD symptoms, Lahey et al. collected data on the children's intelligence and academic readiness, social competence, peer acceptance, friendship difficulties, and global impairment in adaptive functioning. A total of 126 children (out of a sample of 259) met criteria for ADHD (82 combined type, 31 HI type, and 13 inattentive type). The four groups did not differ in gender, ethnicity, or family income, but they did differ in age; children in the inattentive group were significantly older than children in the other groups.

A number of differences in functional impairment were noted between the three sub-types of ADHD in this preschool population. First, children with the combined and inattentive types had lower intelligence scores than comparison children, while the intelligence scores of children with the hyperactive type were commensurate with those of the comparison group. Second, children with the combined type had more social problems than the other groups, as they were rated as being actively disliked by more classmates than comparison children. Third, children who met criteria for the combined or inattentive types, but not the hyperactive type, had significantly lower mathematics achievement (relative to their intelligence) than comparison children. Fourth, children who met criteria for the combined and hyperactive types, but not the inattentive type, were rated as being more disruptive and less self-controlled than comparison children. Finally, there was a nonsignificant trend for children with the inattentive type to under-achieve in reading compared to controls; this trend was not seen in children with the other subtypes of ADHD. Thus, according to this study, preschool children with the inattentive type of ADHD are most at risk for academic problems, while children with the hyperactive type are at greater risk for social problems and disruptive behavior. However, the inattentive type is less often diagnosed in the early years of preschool, perhaps due to the rarity of tasks requiring sustained attention in the typical preschool classroom.

**Issues of comorbidity: ADHD and ODD/CD**

The separability of distinct categories of externalizing behavior has been a matter of debate in the field for years. A number of studies have established a significant degree of overlap between symptoms of inattention/hyperactivity and aggression/conduct problems; in a review of 29 studies, Biederman, Newcorn, and Sprich (1991) found that ADHD and CD co-occur in 30% to 50% of cases. Thus, there have been those who argue that these symptoms should all be considered as part of a general classification of disordered behavior (e.g., Sandberg, Wieselberg, & Shaffer, 1980). However, Hinshaw (1987), in a seminal paper, concluded that inattention/hyperactivity and aggression/conduct problems are at least partially independent and show divergent validity. In addition, there is evidence for distinct causal pathways to the development of hyperactivity and aggression, with poor self-regulation predicting later hyperactivity and interactions between difficult temperament and a stressed environment predicting later aggressive tendencies (Sanson, Smart, Prior, & Oberklaid, 1993).
Both hyperactivity/inattention and aggression have been found to relate to academic underachievement (Hinshaw, 1992). Further, an interesting developmental progression exists in the nature of these associations. In early and middle childhood, hyperactivity and inattention are more strongly related to underachievement and aggression is related to achievement only through its comorbidity with inattention/hyperactivity. It is not until adolescence that aggression emerges as a clear correlate of underachievement (Hinshaw, 1992). Given that the symptoms of ADHD (namely, inattention, hyperactivity, and impulsivity) are related to academic achievement from an early age, it is critical to understand more completely the nature of that association.

Given the overlap between symptoms of ADHD and ODD in the preschool population, it is often difficult to differentiate children with clear diagnostic patterns at this age. This quandary is reflected in the literature on behavior problems in preschoolers, which often mixes aggressive behaviors with inattention, hyperactivity, and impulsivity in defining a sample of behaviorally ‘at risk’ children. The focus of the present paper is on the cluster of symptoms associated with ADHD; a discussion of the stability and correlates of conduct problems in young children is beyond the scope of this review. However, included in this analysis are studies in which there are children with a mixture of symptoms characteristic of ADHD (inattention, hyperactivity, impulsivity) and ODD (e.g., disruptive behaviors, aggression). When those studies are described, every effort will be made to distinguish children with ADHD from the general cluster of children examined.

Developmental considerations

There are rapid developmental changes occurring between the ages of 2 and 6 years; thus, it is difficult to determine when hyperactive, inattentive, and impulsive behaviors warrant a diagnosis of ADHD and when those behaviors are simply developmentally appropriate. Many researchers are concerned that diagnoses of formal behavior problems such as ADHD in preschool children might include a number of children who will ‘outgrow’ these problems over time (Lahey et al., 1998). Indeed, as Campbell (1995) points out, problems of management, self-control, and aggression typically decline with age. However, accepting the fact that the majority of preschool behavior problems are mild and transient, it is possible that for some children, early problem behaviors are signs of dysfunction that will persist for years.

Over the past few years, researchers have mapped the development of attention and self-control with greater precision than ever before, isolating critical turning points in children’s self-regulatory abilities. It is clear from this work that children’s ability to control their attention and behavior is rapidly increasing over the preschool years. Ruff and Rothbart (1996) maintain that two general systems of attention develop over the first five years of life: (a) the orienting/investigative system, activated in the first year, in which attention is largely governed by novelty; and (b) the system of higher-level controls, which is dependent on social input for its development. The system of higher-level controls emerges towards the end of the first year and gradually becomes more dominant, allowing the child to deploy attention in response to higher-level demands. During the preschool years, increasing demands are made for the child to attend to intrinsically uninteresting events; the average preschool child becomes more and more adept at responding to these higher-order demands and attending appropriately. For example, Levy (1980) found that only 27% of 3–31/2-year-olds complied with all trials on a signal detection task, while 100% of children 41/2 years and older were able to comply with all trials. Ruff, Cappozzoli, and Weissberg (1998) corroborated Levy’s findings, indicating that older preschool children were better able to sustain attention on structured reaction time tasks than younger preschool children. In addition to observations of changes in children’s capabilities around age 4, there is evidence of neurological changes at that age as well. For example, Courchesne (1990) found that a visual event-related potential in the parietal area that is linked to attention (P3b) is not found reliably until between 3 and 3.7 years of age.

The development of behavioral self-control follows a similar pattern to the development of attentional control. As Barkley (1997) notes, response inhibition is well developed by the ages of 3 to 4. Ruff and Rothbart (1996) corroborate this assertion, noting that inhibitory self-control increases through 4 years of age, so that children become more able to inhibit their behavior on instruction from self or others. Children’s increasing self-control is supported by the development of self-speech, which emerges around the age of 3 (Vygotsky, 1978), allowing children to regulate their emotions and their motivation and task persistence, along with their motoric responses. Children’s developing self-control after 3 years is reflected in their increasing ability to follow directions. Under 3 years of age, children are able to follow instructions to initiate a behavior but are less able to follow instructions to prevent or stop a behavior. After 3 years of age, children become more able to inhibit their behavior in response to external demands. This developing ability is reflected in neurological changes that occur throughout the preschool years; continued maturation of the frontal cortex during these years coincides with increased motivation and self-control (Ruff & Rothbart, 1996).

In summary, by 4 years of age, there is a leap in children’s ability to voluntarily direct attention to aspects of the environment that are relevant to a task...
and to inhibit responses to salient but irrelevant aspects. Children at this age are increasingly able to participate in rule-governed, structured tasks that require waiting for instructions, attending to intrinsically uninteresting events, and closely regulating action. In other words, they are gradually gaining the skills necessary to function in a formal classroom setting.

The research reviewed thus far indicates that normally developing children are able to maintain attention and inhibit inappropriate responses. With this developmental perspective in mind, it is possible to explore those cases in which self-regulation of attention and behavior do not develop normally. Research shows that problems with disinhibition (hyperactivity/impulsivity) arise around 3–4 years of age, and those related to inattention emerge later in the course of ADHD, around 5–7 years of age, with entry to formal schooling (Barkley, 1997). It can be argued, however, that basic deficits in attention may exist before the stage of formal schooling and may only be detected later on due to increased demands for attentional control in the more rigorous academic environment of elementary school. Individual differences and environmental factors contribute to variability in children's acquisition of attentional and behavioral capabilities. For example, individual differences in reactivity to stimulation determine the extent to which children can regulate their behavior and attention. Children who are highly reactive to stimulation will have more difficulty exerting attentional and behavioral control in situations with a high degree of external stimulation (Ruff & Rothbart, 1996). In addition, the nature of the child-rearing environment, both at home and in school, will influence the development of self-regulatory skills (Barkley, 1997). Thus, if an environment fails to provide the appropriate structure for the development of self-control, a generally attentive infant may become an inattentive preschooler (Ruff & Rothbart, 1996). Additional correlates and causes of early behavior problems will be discussed in greater detail later on in this paper.

Stability of preschool inattention, hyperactivity, and impulsivity

Given that clinically significant problems of inattention, hyperactivity, and impulsivity (I/H/I) exist in the preschool population, it is important to determine how stable these early problems are. A number of studies have examined the stability of these early behaviors, and most have determined that preschool children who experience these problems are likely to show similar problems throughout the elementary school years and into adolescence (Campbell, 1995). A review of key studies related to stability of early behavior problems follows, with studies grouped according to the nature of the behavior problems studied. Studies that focus on multiple types of behavior problems (e.g., conduct problems, inattention, and hyperactivity) are grouped under the general heading of externalizing behavior problems, while studies that examine more specific behavioral characteristics are reviewed separately.

Externalizing behavior problems

The most comprehensive study to date on the stability of preschool externalizing behavior problems (including conduct problems and problems of I/H/I) was conducted by Campbell and colleagues. A sample of 46 children initially identified by parents and teachers at age 3 as inattentive, overactive, and disruptive was followed for 10 years. These children were assessed at ages 4, 6, 9, and 13 for the presence of continuing behavior problems, and they were compared to a group of 22 normal controls. At age 4, parent ratings and observational measures confirmed that children from the problem group continued to experience problems at home and at school (Campbell, Breaux, Ewing, & Szumowski, 1984). At age 6, 50% of the problem group met criteria for ADD, or were reported to be inattentive/impulsive and/or aggressive by teachers and parents (Campbell, Ewing, Breaux, & Szumowski, 1986). Children who did improve by age 6 differed from those who did not in the initial severity of their symptoms at age 3. At age 9, 48% of the initial sample met DSM-III criteria for ADD and/or ODD, compared with 16% of controls (Campbell & Ewing, 1990). Children whose problems were still apparent at age 6 were more likely to meet criteria at age 9 (67%) than children whose problems improved between preschool and school entry (29%). At age 13, children whose problems had persisted to age 9 were still rated (and rated themselves) as less socially competent and more aggressive than comparison children; in addition, their mothers continued to rate them as more hyperactive than other children (Ewing, 1994, as cited by Campbell, 1995). Despite the relatively small sample size of the studies by Campbell and colleagues, the extensive nature of the follow-up provides strong evidence of stability for behavior problems from preschool through early adolescence.

A longitudinal study by Egeland, Kalloske, Gottesman, and Erickson (1990), which followed children from preschool through third grade, found similar evidence of stability. Egeland et al. identified children in preschool who were classified as ‘acting out’ and/or ‘inattentive’ on teacher ratings scales. Those groups were combined for follow-up purposes, with 17 in the acting out group and 3 in the attention problems group. Their findings indicated relatively strong stability through second grade, with 33% of the problem group evidencing clinically significant behavior problems in first grade and 47% showing clinically significant problems in second grade.
Continuity of problems was less evident by third grade. While the studies by Campbell and colleagues and Egeland et al. (1990) found strong evidence for stability of behavior problems, a study by Hogan, Quay, Vaughn, and Shapiro (1989) calls into question the stability of early clinical classifications of behavior problems. Hogan et al. (1989) examined the stability of teacher ratings of problem behaviors (including attention problems, socialized aggression, and conduct problems) on the Revised Behavior Problem Checklist (Quay & Peterson, 1987) from kindergarten through first grade. They found that stability over 5 months was quite high, while longer-term stability, although still comparable to findings from other studies, was much lower. However, a most interesting finding was that clinical classification of behavior problems was highly unstable, even in the short term. Children whose ratings were greater than or equal to 1.5 standard deviations above the mean (clinically significant) at one point were not necessarily above that cutoff at later time points. On the other hand, children whose ratings were at or below the mean (clinically insignificant problems) in kindergarten rarely rose above that level. In short, normal behavior in kindergarten was more stable than abnormal behavior in kindergarten.

**Hyperactivity**

One study that provides greater clarity on the stability of hyperactivity in particular was conducted by McGee, Partridge, Williams, and Silva (1991). These researchers selected two groups of 3-year-old children with hyperactive behavior to be followed through adolescence: a ‘hyperactive’ group selected based on an observational scale and maternal report and a ‘difficult to manage’ group selected based on maternal report alone. Both groups were compared to a developmental control group that was matched to the hyperactive group on gender, language scores, and family adversity and a general control group with no identified problems. Findings indicated that hyperactivity at age 3 was a strong predictor of increased risk through age 15. At age 5, both problem groups showed significantly more behavior problems according to parent and teacher reports than the control groups. At age 9, the hyperactive children were still significantly higher on parent and teacher ratings of behavior problems than controls; however, the ‘difficult to manage’ group only differed on the number of problems reported by parents. At age 11, 33% of the hyperactive group was diagnosed with ADD. In addition, the hyperactive and difficult to manage groups had significantly more total problems on behavior rating scales than controls.

McGee et al.’s (1991) findings suggest either that the long-term risk associated with early hyperactivity is not highly specific or that the hyperactive symptoms detected at an early age may not be specific to ADHD. At shorter time intervals, hyperactivity was quite stable and the pattern of symptoms that persisted was fluid. However, as the time interval increased, patterns of stability became more complex; children with early hyperactivity were at risk for a host of clinical problems in adolescence, including, but not restricted to, ADD.

In a study conducted by Fischer, Barkley, Edelbrock, and Smallish (1990), one hundred children who were initially identified as hyperactive at ages 4–6 according to multiple criteria were followed for eight years into adolescence. The children who were initially diagnosed as hyperactive manifested a number of problems through ages 12–14; they exhibited significantly poorer sustained attention and impulse control on a vigilance task and more off-task, fidgety, noisy, and out-of-seat behavior on a restricted academic observation than a group of comparison children also followed since preschool. While this study provides strong evidence for the stability of hyperactivity over time, only limited conclusions may be drawn regarding the age at which hyperactivity becomes more stable, as an unspecified number of children were in first grade at the outset of the study.

**Self-control and early temperament**

Instead of attempting to measure the stability of a behavioral syndrome, Shoda, Mischel, and Peake (1990) were interested in documenting the stability and predictive utility of preschoolers’ ability to delay gratification. They found that children’s ability to delay gratification at age 4 in a self-imposed delay situation (e.g., when rewards were exposed and no coping strategies were suggested) was significantly related to their ability to cope with frustration and stress in adolescence (15–19 years old). Children who delayed longer in preschool were rated by parents as being more likely to show self-control in frustrating situations, less likely to yield to temptation, more intelligent, and less distractible when trying to concentrate in adolescence. In addition, parents rated them in the higher ranges on Q-sort items including: is planful, thinks ahead, is attentive and able to concentrate, and uses and responds to reason. These findings are interesting in that they point to the stability of a highly specific self-regulatory ability from preschool through adolescence. One of the major difficulties that children with ADHD sustain is in tasks requiring self-regulation and self-control (Barkley, 1997); thus, the fact that these
qualities are detectable in preschool and are predictive of later competence is highly relevant.

Other researchers have examined the long-term impact of an under-controlled temperament on later behavior. Caspi and Silva (1995) identified a dimension of temperament they labeled 'lack of control,' which is a measure of impulsivity, inattention, and impersistence. They found that children with this temperamental style at age 3 scored high on measures of impulsivity, danger-seeking, aggression, and interpersonal alienation at age 18. Pisecco, Baker, Silva, and Brooke (2001) conducted a retrospective study of the effects of temperament on the development of ADHD. Measures of temperament taken at ages 3 and 5 for 36 boys who met criteria for Reading Disability (RD) and/or ADHD at age 11 were examined. Results indicated that boys with RD and ADHD (N = 26) were described as exhibiting significantly more behaviors suggestive of an under-controlled temperament at ages 3 and 5 than boys with RD only, ADHD only, or normal controls. Interestingly, this study did not find that boys with ADHD at age 11 were more disruptive at ages 3 or 5 than normal controls. These findings suggest that while certain aspects of early temperament may be predictive of some cases of ADHD later in life, they are not a necessary condition for the development of later ADHD.

**Factors associated with long-term stability of behavior problems**

The findings of Hogan et al. (1989), along with those of Pisecco et al. (2001), raise the possibility that prediction of later ADHD based on preschool problem behavior may be quite complex. Specifically, these findings indicate that early behavior problems may be related to later behavior problems, but a number of those early problem behaviors will vanish or dissipate with time, making early classification of ADHD difficult. In light of this fact, some researchers have tried to isolate indicators of more stable behavior problems.

Many researchers have found that children who manifest poorer cognitive functioning and poorer language skills in preschool are at greater risk for continuing behavior problems (Campbell, 1995; Cantwell & Baker, 1991). In addition, Barkley et al. (2002) have examined the utility of adaptive disability (AD), defined as a significant discrepancy between adaptive functioning and intelligence, as an indicator of continued risk for children with early ADHD. Barkley et al. (2002) found that in contrast to children with disruptive behavior alone, children with disruptive behavior and adaptive disability in preschool had more symptoms of ADHD and conduct disorder, more severe and pervasive behavior problems at home, more parent-rated externalizing and internalizing problems, and more behavioral and academic problems at school in second grade.

Another factor that has been found to increase the risk associated with early symptoms of ADHD is the existence of multiple externalizing symptoms. Children with symptoms of aggression, hyperactivity, impulsivity, and inattentiveness in preschool are more likely to show persistent problems over time than children with hyperactivity and impulsivity alone (Fischer et al., 1990; Shelton et al., 1998). In addition, children with a larger range of early externalizing symptoms are at greater risk than children with ADHD symptoms alone for the development of conduct disorder, delinquency or criminal activities, academic underachievement, school behavioral problems, and substance use (Shelton et al., 1998).

Family-related factors have also been cited as predictors of stability in externalizing behavior problems. Ongoing family adversity, including marital stress, stressful life events, single-parent homes, and poorer family relationships are all associated with persistence of multiple behavior problems through childhood (Campbell, 1995; McGee, Silva, & Williams, 1984). In addition, maternal depression (Egeland et al., 1990) and parenting style (Heller, Baker, Henker, & Hinshaw, 1996) have both been related to the stability of behavior problems in children. For example, Heller et al. (1996) found that teacher-identified externalizing problems for first graders were predicted not only from the level of externalizing behavior in preschool, but also from preschool-assessed maternal authoritarian child-rearing practices and maternal parenting stress. In fact, a discriminant function analysis using these preschool variables predicted group membership in first grade for 95% of the cases in the externalizing and comparison groups.

Further research is needed on the longitudinal course of early behavior problems, and the early factors that help determine this course. While many studies have demonstrated the persistence of specific behavioral symptoms or patterns through development, prediction of long-term ADHD from preschool symptoms is hardly 100% accurate. Variables that have been associated with more stable externalizing behavior, such as those listed above, need to be examined with new samples of children in order to document predictive value. Furthermore, more attention should be given to distinguishing factors that predict symptoms of inattention and hyperactivity and those that predict aggression/conduct problems.

**Relationships between preschool ADHD symptoms and later academic achievement**

From the review of stability above, it is clear that some children with symptoms of ADHD in preschool are at risk for long-lasting behavioral difficulties. Additional research suggests that children who manifest behavioral difficulties associated with
ADHD in preschool may be at risk for academic underachievement as well. There is a large literature on the relationship between learning problems and ADHD in elementary-school-aged children (e.g., Bender & Smith, 1990; Frick et al., 1991; Hinshaw, 1992). Estimates of the overlap between ADHD and underachievement in school-aged children range from 10–50%, depending on the definition of learning problems used (Lam & Beale, 1991; Hinshaw, 1992). Overall, there is a strong consensus in the research literature that school-aged children with ADHD are likely to have comorbid learning problems, and children with learning problems are likely to have comorbid ADHD.

In comparison, the relationship between preschool I/H/I and later academic achievement is much less clear. Very few studies have focused specifically on this association. In fact, much of the data on this relationship is buried within the results of studies that have focused on different questions. There are three general types of studies that have addressed the connection between early I/H/I and academic achievement: (a) studies that prospectively examine the multiple outcomes for children with preschool I/H/I; (b) studies that prospectively examine the specific relationship between preschool I/H/I and academic achievement; and (c) studies that address early I/H/I as members of a group of potential predictors of later learning problems.

The multiple outcomes of preschool inattention/hyperactivity/impulsivity

McGee et al.’s (1991) longitudinal study covers the broadest age range of any follow-up study examining multiple outcomes for hyperactive preschool children. As described previously, McGee et al. followed two groups of 3-year-old children with hyperactive behavior, a developmental control group (matched to the hyperactive group on gender, language scores, and family adversity), and a general control group (with no identified problems) through adolescence. They found that children from the hyperactive and developmental control groups had poorer reading scores than the difficult-to-manage and general control groups at ages 7 and 9. In addition, children from the hyperactive and developmental control groups were still significantly behind the other two groups in reading performance at age 15. Furthermore, children from the hyperactive group showed significantly higher rates of reading disability at age 15 (defined in comparison to age norms) than any of the other three groups. In fact, 52% of the children who were initially classified as hyperactive or difficult to manage were reading disabled at age 15, compared to 10% of the developmental controls and 10% of the normal controls.

Richman, Stevenson, and Graham (1982) followed a larger group of children than McGee et al. (1991); 94 children with problem behaviors and 91 control children were identified at age 3 and followed through age 8. Problem behaviors were not defined solely as problems with hyperactivity or inattention; a variety of behaviors (e.g., poor appetite, difficulty settling at night, dependency) were also included in the set of initial screening items. Thus, the follow-up data must be interpreted with caution, since the behavior problems are broadly identified in this sample. Despite this limitation, Richman et al.’s findings provide further evidence of the negative impact of behavior problems (in general) on educational attainment. Boys with behavior problems at age 3 scored significantly lower on measures of intelligence and achievement at age 8 than control children.

Other studies focusing on the long-term outcomes of children with early I/H/I have corroborated McGee et al.’s (1991) and Richman et al.’s (1982) results. For example, MacDonald and Achenbach (1999) examined 3- and 6-year outcomes for children who were initially deviant on attention problems at ages 4 through 16. Since the initial study group was not solely preschool-aged, it is impossible to draw conclusions regarding the outcomes associated with preschool inattention in particular. However, the general pattern of findings parallels that of McGee et al.; children who had attention problems at the initial time point were more likely to receive special education services three years later than children with other types of problems (e.g., conduct problems, internalizing problems). Furthermore, in line with the findings of Shelton et al. (1998) see above), children with both attention and conduct problems were at greater risk for disturbance later on than children with attention problems alone.

MacDonald and Achenbach’s (1999) conclusion that children with early attention problems were more likely to receive special education later on confirmed similar findings by Campbell et al. (1986). Campbell et al., in a 3-year prospective study of children with a variety of externalizing behaviors at age 3, found that problem children were more likely than comparison children to be referred to special school personnel and/or mental health professionals in the community at age 6. In addition, in a structured interview, mothers of these ‘problem’ children reported that they had more academic difficulties and more behavior problems in school than mothers of comparison children. This finding is interesting, but its validity as an actual indicator of academic problems is questionable because mothers’ reports might reflect general frustration with their difficult children’s progress.

Prospective studies of the relationship between preschool I/H/I and later achievement

There have been only a handful of studies focusing on the specific prospective relationship between early I/H/I and later academic achievement.

Elana Greenfield Spira and Janet E. Fischel
Rabiner, Coie, and the Conduct Problems Prevention Research Group’s (2000) longitudinal study of the relationship between kindergarten inattention/hyperactivity and reading achievement was highly specific and methodologically rigorous. These researchers followed a relatively large sample of children (N = 387) from kindergarten through fifth grade and examined the impact of early inattention and hyperactivity on later reading achievement, as measured by a standardized test of single-word reading skills. Simple correlations indicated that both inattention and hyperactivity were significantly correlated with reading achievement, with the correlations between inattention and reading achievement being strongest and most consistent. In order to further explore the relationships between these variables, Rabiner et al. (2000) constructed a path model, looking specifically at the inter-relationships between inattention and reading across the years.

The path weights in their model highlight the complicated nature of the relationship between inattention and reading. Some of their most interesting findings follow: (a) kindergarten inattention was associated with poorer kindergarten reading achievement, which then had a strong effect on first grade reading; (b) inattention in first grade was predictive of poorer reading achievement, even when kindergarten reading achievement, IQ, and parental involvement were controlled; (c) children whose reading scores were normal at kindergarten exit were at risk for poor reading outcomes if they were classified as inattentive in first grade; and (d) 34% of the inattentive children in their sample showed poor reading outcomes in fifth grade. Based on their results, Rabiner et al. (2000) argued for the utility of measuring attention early on.

Fowler and Cross (1986) also examined the impact of attentional problems on later academic achievement, although their design was quite different than Rabiner et al.’s (2000). After administering tests of cognitive and visual-motor skills to 210 preschool children, physicians rated each child’s attention span on a Likert scale of 0–4. When children were followed up in first and second grades, the preschool ratings of attention span were significantly related to reading and math achievement scores. On the other hand, parental reports of attention problems were not significantly related to achievement. While there may not have been an association in this sample, this finding could be due to a lack of specificity in parental reports in general or in the assessment device in particular.

Fischer et al. (1990) focused on the relationship between early hyperactivity and later academic achievement. Fischer et al. classified a group of hyperactive and control children at ages 4–6 and followed them into early adolescence. They found that the initially hyperactive children had significantly poorer scores on a standardized battery of reading, spelling, and math skills at ages 12–14 than the comparison children. In addition, the hyperactive children displayed significantly more off-task, fidgeting, vocalizing, playing-with-objects, and out-of-seat behaviors during a restricted academic observation at the follow-up point. These findings indicate that not only do children with early hyperactivity have difficulty with basic academic skills; they also have difficulty completing academic tasks without engaging in distracted behavior.

**Predictors of learning problems in elementary school**

A number of researchers have tried to determine the possible precipitants of learning problems in elementary school. Horn and Packard (1985) conducted a meta-analysis of 58 studies done between 1960 and 1985 on the early identification of learning problems. They included studies that examined the relationship between various assessment measures administered in kindergarten and early first grade and reading achievement later in elementary school. They found that, across studies, the best predictors of reading achievement were attention/distractibility, internalizing behavior problems, language variables, and general cognitive functioning. These results are impressive, in that attention/distractibility stood out among a multitude of variables as one of the best predictors of achievement. However, the authors included studies that used disparate definitions of poor achievement; some studies examined early identification of ‘low achievers’ (i.e., children who are generally performing at low levels) and some studies looked at ‘underachievers’ (i.e., children who would be classified as learning disabled, due to an achievement-aptitude discrepancy). Since research has shown that these two types of learning problems may be quite different (Whitehurst & Fischel, 2000), it would be useful to examine the predictors of each separately.

Like Horn and Packard (1985), Agostin and Bain (1997) examined a broad range of early predictors of school success. Unlike the former researchers, though, Agostin and Bain looked only at the prediction of first grade achievement. In an attempt to isolate factors that might be associated with early school success, they tested kindergarten children on a wide range of measures, including language, visual-motor integration, and motor activity. In addition, teachers rated the children’s social and behavioral problems on a standardized rating scale. They found that four factors discriminated best between children who succeeded in first grade and children who did not: receptive language, visual memory, cooperation, and self-control. Furthermore, hyperactivity was significantly and inversely associated with reading, math, and language achievement at the end of first grade. These results indicate that hyperactivity is not the only behavioral risk factor for later academic problems; positive social skills, such
as cooperation and self-control, might be equally as important for the attainment of academic success.

Because of the repeated emphasis on preschool behavioral and social capacities as critical predictors of later academic achievement, several studies have focused specifically on those variables in relation to learning disabilities. Jorm, Share, Matthews, and MacLean (1986) looked retrospectively at the kindergarten behavior problems of children who were classified as ‘specific reading retarded’ (i.e., learning disabled, defined as an IQ-achievement discrepancy), ‘general backward readers’ (i.e., children with poor reading achievement, regardless of IQ), and normal readers at the end of second grade. They found that ‘general backward readers’ had significantly more behavior problems in kindergarten than normal children, especially in areas relating to attention-deficit (i.e., inattentiveness, hyperactivity). However, they found that the learning disabled students did not show evidence of behavior problems in kindergarten compared to the other groups.

Vaughn, Hogan, Kouzekanani, and Shapiro (1990) used a similar methodology to examine the kindergarten behavioral and social skills of children who were identified in second grade as learning disabled, low-achieving, average achieving, and high achieving. They found that children who were later identified as learning disabled had significantly more attention problems and poorer social skills in kindergarten than children whose performance was low, average, and high-average in second grade. In addition, children who were low-achieving in second grade had significantly more attention problems in kindergarten than children who were high-achieving in second grade.

When these children were followed through third grade, a similar pattern emerged (Vaughn, Zaragoza, Hogan, & Walker, 1993). Children from the learning disabled and low-achieving groups were lower on social skills and had more behavior problems over time than children from the average/high-average achievement groups. Interestingly, there were no significant differences between the learning disabled and low-achieving groups on behavior problems or social skills; thus, social and behavioral capacities might be related to low achievement in general, rather than to the specific neurological deficits associated with learning disabilities. This similarity between learning disabled and low-achieving children on behavior capacities is in contrast to Jorm et al. (1986), who found that only low-achieving, and not learning disabled, students showed evidence of early behavior problems. This disparity might be explained by the different definitions used in the two studies for learning disabled and low-achievers; nevertheless, the contradiction deserves further study. Although these two studies by Vaughn and colleagues and the study by Jorm et al. are informative, the small sample size for both limits the generalizability of the findings.

Preschool I/H/I, emergent literacy and elementary school achievement

The fact that early problems of inattention, hyperactivity, and impulsivity are consistently associated with later learning difficulties begs the question of why that relationship exists. A number of theoretical models have been proposed to explain this relationship. One model is based on the research outlined above that demonstrates the stability of problem behaviors from early childhood through adolescence. This model posits that preschool problems with I/H/I persist into elementary school, and these problem behaviors in elementary school are associated with learning problems (McGee & Share, 1988). However, as McGee and Share (1988) point out, ‘remediation’ of ADHD does not necessarily lead to improvements in academic achievement. An alternative model has been proposed that includes a third variable as a mediator. This model posits that, in addition to predicting later behavior problems that affect learning, preschool I/H/I hinders the acquisition of emergent literacy skills, which are related to reading achievement in elementary school. Young children with symptoms of ADHD often miss the opportunity to learn the skills taught in their classrooms, either because they cannot maintain attention to the lessons or because of disruptive behavior and removal from preschool (Blackman, Westervelt, Stevenson, & Welch, 1991).

Emergent literacy skills are known to be important predictors of later reading success (e.g., Adams, 1990; Scarborough, 1998). Children who enter school without these skills are more likely to fall behind in reading and less likely to catch up after early reading failure (Spira, Bracken, & Fischel, 2005). Thus, if children with poor attentional and behavioral capacities acquire fewer of these essential skills before formal schooling begins, they might be at a continued disadvantage throughout their academic careers. Velting and Whitehurst (1997) explored this hypothesis using structural equation modeling but failed to confirm their theoretical model. They did find that emergent literacy skills were strongly related to reading skills and hyperactivity was highly stable across the three years of study; however, hyperactivity in preschool was not significantly related to the development of emergent literacy skills.

Two limitations must be noted about Velting and Whitehurst’s (1997) study which might explain the lack of relationship found between preschool behavior and emergent literacy. First, Velting and Whitehurst’s sample was comprised exclusively of children from low-income backgrounds; it is possible that a different relationship might be found in a broader SES range. In addition, the measure of behavior problems used in their study was the Hyperactivity Index from the Conners Teacher Rating Scale (CTRS; Conners, 1969). This index is largely a measure of overactivity, as opposed to...
inattention; thus, it is possible that if a larger range of behavior problems had been measured, a relationship with emergent literacy skills would have emerged. This seems especially plausible given the findings cited above regarding the increased prevalence of academic problems in children with the inattentive type of ADHD (Lahey et al., 1998).

Lonigan et al. (1999) addressed the limitations of Velting and Whitehurst’s (1997) study by measuring inattention in addition to hyperactivity and including children from both low- and middle-income families in their study. In addition, Lonigan et al. used a more comprehensive assessment of emergent literacy skills than Velting and Whitehurst (1997). The goal of Lonigan et al.’s study was simply to assess the overlap between behavior problems and emergent literacy skills in preschool children; unlike Velting and Whitehurst, Lonigan et al. did not longitudinally examine the link to formal reading achievement. Partial-correlations between the measures of problem behaviors and the scores on emergent literacy measures, controlling for nonverbal IQ, conflicted with the results of Velting and Whitehurst (1997). Lonigan et al. found that, while all of the problem behaviors were associated with emergent literacy, attention problems were most consistently and strongly associated with emergent literacy skills in both low- and middle-income groups, with the relationship strongest in the middle-income group. Lonigan et al. explained the difference between their study and that of Velting and Whitehurst with two assertions: (a) inattention, and not hyperactivity, seems to be the strongest correlate of emergent literacy skills; and (b) low-income children may not show the same relationship between inattention and emergent literacy due to the generally impoverished nature of their exposure to early literacy experiences.

Lonigan et al.’s (1999) findings corroborate the findings of an earlier study by Arnold (1997), which examined the co-occurrence of externalizing behavior problems and emergent academic skills in a sample of low-SES preschool boys. In this study, observational measures of attention and off-task behavior were used along with rating scales so as to allow for more precise measurement of inattention. Findings indicated that across measures, externalizing behavior was related to academic problems, and the magnitude of this relationship increased with age. Arnold (1997) also found that children with externalizing behaviors received less teaching than children without behavior problems. Furthermore, path analyses suggested that poor academic skills, even in preschool, might cause disruptive behavior and later learning problems by making it difficult (or aversive) for children to pay attention.

No other study to date has attempted to build upon the results of the three studies summarized above, or to elaborate upon the model of behavior and achievement first hypothesized by Velting and Whitehurst (1997). However, the results of Lonigan et al. (1999) are supported by a number of other studies that demonstrate a link between early symptoms of ADHD and poor emergent literacy skills. Mariani and Barkley (1997) compared 34 preschool boys with ADHD to 30 community comparison boys on a variety of neuropsychological and achievement tests. They found that the boys with ADHD showed significant lags in the acquisition of basic pre-reading and math skills compared to their peers without ADHD. DuPaul, McGoey, Eckert, and Vanbraakle (2001) corroborated these findings, noting that preschool children with ADHD exhibited poorer classroom behavior and scored significantly lower on a test of pre-academic skills than comparison children.

A number of other studies have reported that children with behavior problems in preschool have significantly poorer academic skills (including early literacy and math skills) than their peers with normal behavior (e.g., Barkley et al., 2000; Lahey et al., 1998; Rabiner et al., 2000; Shelton et al., 1998; Vaughn et al., 1992). In addition, studies have found that children with early behavior problems suffer from language deficits (receptive and expressive) compared to their normal peers (Campbell, 1995; Gilliam & DeMesquita, 2000; Kaiser, Hancock, Cai, Foster, & Hester, 2000; McGee et al., 1991). Studies have also found a higher rate of behavior problems (e.g., hitting, crying, screaming, throwing toys) in preschool children with expressive language disorder (Caufield, Fischel, DeBaryshe, & Whitehurst, 1989). Hinshaw (1992), in a review of six studies designed to elucidate the relationship between behavior and learning, noted that in all of the studies, patterns of problem behavior during the initial assessment were correlated with early cognitive-readiness deficiencies.

Thus, while the literature does not decisively support emergent literacy skills as a mediator of the relationship between preschool behavior and later achievement, it also does not reject this model. Additional studies must be conducted with highly specific measures of early behavior and pre-academic capabilities and follow children through elementary school, preferably across a broad range of SES. In order to establish a causal link, experimental studies must also be conducted that demonstrate the long-term effects on achievement of interventions that focus on I/H/I and emergent literacy, separately and combined. If emergent literacy is clearly found to mediate the relationship between behavior and achievement, another avenue for early intervention and possible prevention of serious difficulties in elementary school might be opened.

**ADHD and learning problems: theories of causality**

As the previous two sections illuminate, behavior problems associated with ADHD and learning prob-
lems (especially reading problems) are intimately linked. However, the reasons for this relationship are unclear. The theory explored in the previous section – namely, that early behavior problems are linked to later achievement through their impact on the acquisition of emergent literacy skills – is only one possible explanation in a set of conflicting opinions. In the general literature focusing on the behavior/reading link (i.e., when the focus is not restricted to preschool children alone), four possible models have been proposed: (a) behavior problems are a consequence of children's frustration with their reading difficulties; (b) behavior problems are a cause of reading difficulties; (c) behavior problems and reading difficulties are neither cause nor consequence of each other but share a common cause; or (d) all of the proposed relationships could be active in some sense, with bi-directional or transactional influences best characterizing the relationship between behavior and achievement. In this section, the evidence supporting each of those models will be reviewed.

**Model#1: Reading problems cause behavior problems**

A popular view in many educational circles is that behavior problems are a consequence of frustration with reading difficulties. A learned helplessness model has been proposed to explain this causal relationship, which suggests that repeated academic failure leads to a sense of helplessness, which decreases motivation and increases maladaptive behaviors (Thomas, 1979). McGee and Share (1988) advance this hypothesis, asserting that academic difficulties lead to problems with behavior. They cite as evidence the intervention studies that have focused on the amelioration of ADHD, noting that these interventions cause improvements in behavior but not in achievement. In contrast, they refer to the positive effects of academic interventions on both achievement and behavior. McGee and Share’s analysis is interesting; however, as they admit, no rigorous longitudinal data exist to fully support this perspective. In addition, the academic interventions that the authors cite are actually not purely remedial interventions; they include strong behavioral components (e.g., contingency management, reinforcement contracts) which might partially account for the positive effects on achievement and behavior. McGee and Share’s conclusion is that interventions for children with ADHD and learning difficulties should focus on remediating the academic problems; however, the research they cite might be interpreted to suggest that the focus of intervention should be on improving behavior in the context of academic remediation. Indeed, research by Rabiner, Malone, and the Conduct Problems Prevention Research Group (in press) and Torgesen et al. (1999, 2001) has shown that remedial interventions focusing on academics alone are not effective for children with concomitant behavioral problems (see discussion below).

Few researchers have discussed the possible implications of early academic frustrations on behavior problems, possibly due to the perception that rigorous academic demands are rarely placed on preschool children. However, there is a paucity of research on the attentional demands of current early childhood curricula in preschool and kindergarten classrooms. Further, early receptive or expressive language difficulties could cause significant frustration and associated disruptive behavior for young children. Arnold (1997), in his study on the co-occurrence of externalizing problems and academic difficulties in preschool boys, presents a valuable analysis of the pathway from early academic failure to disruptive behavior. Path analyses in his sample indicate that poor academic skills (e.g., letter learning) might make it difficult for young children to pay attention, resulting in more disruptive behavior in the classroom. Arnold further hypothesizes that this lack of attention might then lead to even less learning, which might cause greater attentional and behavioral difficulties in the future. Arnold is careful to assert that these pathways are speculative and require future research to elucidate mechanisms; however, the possibilities raised by his path analyses are interesting.

A study by Imai, Anderson, Wilkinson, and Yi (1992) presents a similar model to that proposed by Arnold (1997), albeit on a more micro level. Imai et al. (1992) observed the attention of second and third grade children while they participated in classroom reading lessons. They found that errors made in reading led to lapses of attention, and that these lapses of attention further restricted the rate of growth in reading skills. Imai et al.’s model suggests that difficulties in reading are the proximal cause of specific instance of inattentive behavior, and that inattentive behavior may then have a further reciprocal effect on future difficulties in reading. While this model does not address specifically the attentional difficulties characteristic of children with ADHD or RD, it provides a useful framework for thinking about the practical manifestations of a reciprocal relationship between the two disorders.

A number of studies have examined the comorbid relationship between ADHD and RD by focusing on the neuropsychological aspects of each of the disorders. Pennington, Groisser, and Welsh (1993) explored the various possibilities that might explain the comorbidity of these two disorders, and found support for what they refer to as the *phenocopy hypothesis*. Pennington et al. (1993) found that 7–10-year-old boys with RD and ADHD had the same profile of cognitive impairment as boys with RD alone (i.e., deficits in phonological processing) but were distinct in cognitive performance from the boys with ADHD alone (who manifested deficits in executive function). The authors cite this finding as support for
their phenocopy hypothesis: RD produces just the behavioral symptoms of ADHD without producing the cognitive or neurological deficits specific to ADHD. This theory is concordant with the more general assumption that a secondary consequence of reading disabilities is behavioral disturbance. However, the authors did not explore the possibility that ADHD might produce surface symptoms of RD, or general academic underachievement. With one partial exception, the majority of subsequent studies have not supported the phenocopy hypothesis espoused by Pennington et al. (1993), finding instead that individuals with both RD and ADHD exhibit the cognitive deficits associated both with ADHD and RD. In fact, Willcutt et al. (2001) suggest an alternative view, that common etiological influences or cross-assortative mating may account for the comorbidity between RD and ADHD (see further discussion below).

**Model#2: Behavior problems cause reading problems**

A number of researchers who examine the early antecedents of reading difficulties have found that problems with I/H/I predate learning problems (Jorm et al., 1986; Spira, et al. 2005; Vaughn et al., 1990). These researchers have utilized this finding to refute the hypothesis that behavior problems only emerge as a secondary consequence of reading difficulties. Since behavior problems are present in these children before formal reading failure occurs, it appears as if early behavior problems might play some causal role in contributing to future reading problems.

One theory proposed to account for a causal link between behavior and achievement is that problems of I/H/I place children at increased risk for school failure by interfering with the ability to focus on and benefit from instruction. Rabiner et al. (2000) highlighted the importance of attention as a particularly strong determinant of reading achievement. They found that children who were reading normally in kindergarten but were inattentive in first grade showed a significant decline in reading ability between kindergarten and first grade exits and remained more than half a standard deviation below the mean after fifth grade. In addition, after controlling for IQ and kindergarten reading scores, inattentive first graders were almost three times more likely than normal peers to show a discrepancy between IQ and reading achievement (i.e., a reading disability) during kindergarten or first grade. Rabiner et al. also examined the reverse hypothesis (i.e., that reading problems cause inattention) and failed to support it, finding instead that children who were poor readers at the end of kindergarten did not show increased attention problems in first grade.

Rabiner et al.’s (2000) results support the crucial role of early attention problems in shaping children’s reading achievement. They assert that attention problems occurring early on may interfere with the acquisition of critical reading skills in first grade, which may then make it difficult for children to ‘catch up’ later on in reading. In order to test this hypothesis, Rabiner, Malone, and the Conduct Problems Prevention Research Group (2004) conducted an intervention study aimed at remediating reading problems in first grade. They provided intensive one-on-one individual reading instruction to a sample of first grade children at high risk of developing behavior problems. Rabiner et al. (2004) predicted that the reading intervention would counteract the negative impact of attention problems on early reading development by making up for the deficits in early skills caused by inattention. However, the findings did not bear out this prediction. Although tutoring led to significant improvements in reading skills for poor early readers without attention problems, its positive effects were severely mitigated for children with pre-existing reading and attention problems. For children who entered first grade with poor early reading skills and normal attention, end-of-year reading scores rose to the normal range in response to tutoring. For poor readers with attention problems, post-test reading scores remained over a half a standard deviation below the sample mean.

These results are in accordance with the findings of Torgesen et al. (1999, 2001), who also looked at the effects of a remedial intervention on first and second grade children who were already experiencing reading problems. They found that without the proper attentional and behavioral restraint, children in that study could not benefit from additional instruction targeted at improving reading skills, especially when that instruction was delivered in a large classroom context. These findings, taken together, indicate that of the various symptoms of behavior problems, inattention may be the most salient predictor of later academic underachievement, especially when it is present early in the child’s academic career. Furthermore, traditional methods of remediation may not sufficiently address the needs of these children.

Another arena of research that may shed light on the contention that behavior problems cause learning problems is the literature on stimulant medication outcomes for individuals with ADHD. Theoretically, if stimulant medication targeting the symptoms of ADHD causes academic improvement, there might be additional support for an argument positing behavioral and attentional difficulties as the antecedents of learning problems. Thus far, the results of medication outcome studies have not provided a clear answer to this question. While stimulants have been shown to enhance academic functioning (Carlson, Pelham, Milich, & Dixon, 1992), they do not normalize academic performance, and researchers have argued that they have little
effect on cognitive skills that are associated with academic achievement (McGee & Share, 1988; Hechtman et al., 2004; Hoffman & DuPaul, 2000). Stimulants may increase on-task behavior, decrease disruptive behavior, and even increase the amount of classwork completed, but they do not appear to have a significant effect on the accuracy of that work (Pelham et al., 1993).

**Model#3: Behavior and reading problems share a common cause**

The relationship between ADHD and underachievement is often predicated by correlated behavioral and cognitive precursors (e.g., Hinshaw, 1992). This had led to a search for common factors that might underlie both problem areas. As Hinshaw (1992) points out, when shared early variables are controlled, support for unidirectional causation between behavior and learning or learning and behavior is diminished. Hinshaw reviewed a number of studies in an effort to identify antecedent variables that might explain the association between behavior and learning problems. He highlights multiple variables of interest, including mild to moderate language deficits, poor verbal skills, familial distress or discord, and neurodevelopmental delay.

Of the variables reviewed by Hinshaw (1992), language deficits have received perhaps the most attention as a common cause of both learning disabilities (LD) and ADHD. Cantwell and Baker (1991) cite the increased prevalence of ADHD and LD among children with early speech/language impairments. In addition, Pisecco et al. (2001) found that children with reading disabilities and ADHD at age 11 had experienced significant receptive language impairment at ages 3 and 5. For this reason, McGee et al. (1991) controlled for early language development by including a developmental control group matched on language scores to the group of hyperactive children whom they followed from age 3 through age 15. They found that the hyperactive group did not significantly differ from the developmental control group on achievement measures in elementary school; thus, they concluded that poor achievement in these hyperactive children was probably due to lower preschool language skills rather than initial difficulties with behavior. However, McGee et al. did find that by age 15, the hyperactive children were more likely to have a reading disability than the developmental controls; thus, continuing behavior problems might have contributed somewhat to reading problems, controlling for language deficits.

Pennington et al. (1993) examined the differences between the children in their sample with RD alone and the children with RD and ADHD on a number of variables, in an attempt to determine of why RD is comorbid with ADHD in certain cases. They found that children with RD who also had ADHD had lower maternal educational level, more familial stress (e.g., more single mother households), more family members with drug/alcohol abuse and mental health treatment, fewer children receiving therapy, more children in special classes at school, and higher delinquent scale scores than children with RD only. Thus, they argued that multiple causal factors might have led to or exacerbated existing symptoms of both RD and ADHD in this vulnerable population.

Finally, the possibility of common genetic influences on both RD and ADHD has been explored in genetic studies of the two disorders. An extensive review of the literature on genetic influences for RD and ADHD is beyond the scope of this paper. However, behavioral genetic analyses have found significant bivariate heritability for RD and ADHD, suggesting that common genetic influences may predispose individuals to both reading problems and behavioral symptoms of ADHD (Willcutt, Pennington, & DeFries, 2000). Interestingly, Willcutt et al. (2000) found that comorbidity between RD and inattention was more strongly attributable to common genetic influences than comorbidity between RD and hyperactivity/impulsivity. A more recent study by Willcutt and colleagues (2002) indicates that the comorbidity between RD and ADHD may be due, at least in part, to pleiotropic effects of a quantitative trait locus on chromosome 6p (Willcutt et al., 2002). To date, the physiological mechanisms by which these common genetic influences operate are unknown; no studies have isolated a neurocognitive deficit or physiological marker that is a consistent risk factor for both RD and ADHD.

**Model#4: Bi-directional influences between reading and behavior problems**

The studies reviewed above present conflicting opinions about the primacy of reading difficulties versus behavior problems in the context of the comorbidity between the two disorders. In light of this confusion, a model that posits bi-directional or reciprocal influences between reading and behavior problems is intuitively appealing. Rowe and Rowe (1992b) tested a complex model of the relationship between inattentiveness and reading achievement using structural equation modeling (SEM) with a sample of 5,000 5–14-year-old children. Their findings indicate that inattentiveness has strong negative effects on reading achievement, as well as on attitudes towards reading and reading activity at home. Furthermore, poor reading achievement – mediated by attitudes and reading activity at home – leads to increased inattentiveness in the classroom. Although no causal attributions can be made from this cross-sectional model, the results support a bi-directional model of influence for the relationship between reading and behavior problems.

McGee, Prior, Williams, Smart, and Sanson (2002) posit a similarly reciprocal model, which they refer to
as a dual-developmental pathway model. Based on two longitudinal studies following children with symptoms of early hyperactivity through adolescence, the authors assert that there are two main pathways from early hyperactivity to later academic outcomes. First, early hyperactivity is associated with continued attentional problems, which negatively impact academic performance; second, early hyperactivity is related to continued poor reading, which diminishes academic outcomes. At the same time, early literacy problems, which are associated with hyperactivity from a young age, are related to later reading problems and attentional difficulties. Based on these findings, McGee et al. (2002) suggest that remediation of both symptoms of inattention and overactivity and reading problems must be addressed in order to effect significant change in academic achievement.

Methodological issues

The review of the literature on the nature of the relationship between behavior problems and achievement yields only one unqualified conclusion: there is a strong need for additional, more precise research on this question. Part of the reason for the hazy understanding of the relationship between these two domains is the lack of methodological rigor in studies of the topic. Rowe and Rowe (1992a) devote an entire article to the methodological issues in current research on inattentiveness and learning disabilities. They list a number of problems that warrant attention, including: (a) utilization of diagnostic instruments with a focus only on negative, and not positive, behaviors; (b) the use of rating inventories alone to establish a diagnosis, with an arbitrary choice of cutoff points to determine pathology; (c) inappropriate measurement of potential third variables; (d) inappropriate analytical methods (i.e., examination of bivariate relationships as opposed to the use of exploratory modeling techniques).

Hinshaw (1992) discusses the different types of studies that must be conducted in order to achieve clarity on the nature of the relationship between behavior and learning. He asserts that in order to yield data that would truly address causal mechanisms, studies would have to include: (a) assessments of both achievement-related and behavioral variables at initial as well as follow-up periods; (b) measures of relevant antecedent or third variables; (c) statistical analyses that allow for causal inferences. To date, most of the studies conducted in this field are lacking one of more of these requirements. Hinshaw (1992) proposes an experimental design that would properly address the problem area under review. This design would require: (a) clinical samples of either children with achievement or behavior problems (or with clear risk factors for either); (b) randomly assigned treatment conditions directed toward either academic achievement or behavior; and (c) systematic assessment of both achievement-related and behavioral outcomes over an extended time period. Future research must be devoted to the methodologically rigorous testing of the various hypotheses proposed in the preceding pages so that interventions may be guided by a clear empirical understanding.

Conclusions and implications for future research

The review of the extant literature on preschool problems of inattention, hyperactivity, and impulsivity allows for a number of important conclusions. First, self-regulatory abilities and attentional focus develop at a rapid rate between the ages of 3 and 6. During these years, children become increasingly able to voluntarily direct attention to less interesting stimuli and to inhibit responses to salient but irrelevant aspects. They also begin to develop a more coherent pattern of behavior across situations; thus, problematic behavior begins to emerge, not just as isolated behaviors, but as a constellation of symptoms.

The second major issue reviewed in this paper is the stability of ADHD symptoms that are diagnosed in the preschool years. Longitudinal studies have found that children with I/H/I in preschool are more likely than other children to experience continuous problems through elementary school and into adolescence. Furthermore, a significant percentage of these children are eventually diagnosed with ADHD. However, the general consensus from the studies conducted thus far is that children with preschool I/H/I are at risk for the development of a range of disorders, ADHD being only one possible diagnosis. In addition, studies have cast doubt on the stability of behavioral classifications over time; children who are above a clinically significant cutoff in preschool are not necessarily above that same cutoff a few years later. The fact that many children with behavior problems in preschool do not experience clinically significant behavior problems later in life has led researchers to an examination of factors that are associated with more stable behavior problems. These factors include poor cognitive and language skills, adaptive disability, comorbid conduct problems, family stress, and maternal depression. Given the etiological importance of genetic factors for the development of ADHD, family background is another likely predictor for the stability of early inattentive/hyperactive or impulsive symptoms (Rietveld, Hudziak, Bartels, van Beijsterveldt, & Boomsma, 2004).

One of the significant correlates of preschool ADHD, according to the literature, is academic underachievement. Children with symptoms of inattention, hyperactivity, and impulsivity in preschool are more likely than those without such symptoms to
experience learning problems in elementary school. The reasons for this relationship are still unclear; the debate over the direction of causation has not been resolved. In addition to the models proposed to explain the link between behavior and learning in the general age population, one model that specifically relates to the preschool years proposes that inattention and hyperactivity affect later learning through their negative impact on emergent literacy.

Implications

The available literature on preschool ADHD answers the questions posed in this paper only up to a certain point. For example, it is quite clear that problems of I/H/I experienced in preschool are correlated with a host of achievement problems in elementary school. It is also clear that preschool children with these problem behaviors are likely to acquire emergent literacy skills at a lower rate than their peers. However, the available research has yet to clarify the mechanisms by which these inattentive, hyperactive, and/or impulsive preschool children become academic underachievers years later.

Studies that have attempted to identify pathways between behavior and learning suggest that there are multiple pathways leading to the development of related learning and behavioral problems. A unidirectional path most probably does not capture the nature of this relationship, as compartment and achievement are intrinsically connected, especially as children advance in their schooling. However, it has yet to be determined whether symptoms of ADHD and symptoms of learning problems emerge concurrently, are products of a common cause, or whether symptoms of one emerge before the other. This question is not simply an interesting theoretical one; it also has serious implications for early intervention planning. Researchers must attempt to pinpoint the crucial first links that begin the cycle of complementary learning and behavioral problems, thus informing appropriate preventive and intervention efforts.

In order for these research efforts to succeed, gaps between clinical and educational research must be bridged. While a good deal of clinical and epidemiological research now exists on the nature of behavior problems in preschoolers, little research exists linking those problems to emergent literacy skills. The absence of research on this link may be due to the fact that learning problems in the preschool years are less readily apparent than those in the elementary years. Furthermore, the assumption that poor attentional or behavioral control might hinder learning during those early years is less intuitive, as most people believe that few academic demands are placed upon children when they are young. However, should the curious individual wander into a typical kindergarten classroom in a public school, s/he would probably observe students sitting at desks, watching a teacher write letters and words on a blackboard. Furthermore, children are encouraged to expand their repertoire of receptive and expressive language at a dramatic pace during the early years of life. Thus, it is quite pertinent to ask whether early problems of inattention, hyperactivity, or impulsivity might hinder learning in such a classroom, setting the stage for future struggles with school.

A wealth of research in the past two decades has shed increasingly precise light on the nature of ADHD in elementary school-aged children. However, the lack of a consistent, thorough research base on problems associated with ADHD in preschool children hinders true progress in this area. Given that clinically significant deficits in inattention, hyperactivity, and impulsivity exist in the preschool population, it is important that those deficits be better understood, in terms of etiology, phenomenology, and implications for immediate and long-term development. Without a more complete understanding, little progress will be made in efforts to effectively prevent the development of significant behavioral and academic problems later on.

Author note

Elana Greenfield Spira, Department of Psychology, State University of New York at Stony Brook; Janet E. Fischel, Departments of Pediatrics and Psychology, State University of New York at Stony Brook.

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Correspondence to

Elana Greenfield Spira, Department of Psychology, State University of New York at Stony Brook, Stony Brook, New York 11794-2500, USA; Tel: (631) 632-7870; Fax: (631) 632-7871; Email: espira@ic.sunysb.edu

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