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Verbal Self-regulation over Time in Preschool Children at Risk for Attention and Behavior Problems

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This study is a prospective, longitudinal attempt to explore behavioral self-regulation, private speech, and speech-action coordination in a sample of behaviorally at-risk preschool children. Preschoolers ($N = 72$) were classified at age 3 years into a behaviorally at-risk group or a comparison group on the basis of preschool teacher behavioral ratings. Children were videotaped on four different occasions across the span of almost 2 years as they completed problem-solving tasks, and private speech, task performance, executive functioning, and speech-action coordination were analyzed. Children identified 2 years earlier as being hard to manage were at risk for continued behavior problems at elementary school entry. Behaviorally at-risk children consistently used more spontaneous private speech than comparison children across all observations. Both groups of children demonstrated a pattern of increasing silence with task success over time. No group differences were observed in children's speech-action coordination at age 5 years. Intraindividual developmental changes in private speech for both groups were associated with task performance, speech-action coordination, and executive functioning at age 5, but not with teacher- and parent-reported problem behavior.

Keywords: ADD/ADHD, behavior problems, emotion regulation, language, speech.

Abbreviations: ADHD: attention deficit hyperactivity disorder; CBCL: Child Behavior Checklist; SA: selective attention; TMT: Trail-Making Task; TRF: Teachers Report Form.

Preschool children identified by teachers or parents as being overactive, impulsive, inattentive, or generally "difficult to manage" are known to be at significant risk for continuing behavior problems and diagnoses of attention deficit hyperactivity disorder (ADHD) and other disruptive behavior disorders during the elementary school years (Campbell, Pierce, March, Ewing, & Szumowski, 1994; Egeland, Kalkoske, Gottesman, & Erickson, 1990). Understanding the developmental processes and mediational mechanisms involved in this progression from behavior patterns that are largely normative during the toddler and early preschool years to serious behavioral dysfunction and psychopathology in later years is a central goal of developmental psychopathology (Cicchetti, 1984). Language competence is widely believed to be an important mediator of both normal and atypical behavioral development (Nelson, 1996; Piacentini, 1987; Westby & Cutler, 1994), as language difficulties are common features of children with externalizing behavior problems (Gualtieri, Koriath, Van Bourgondien, & Saleeby, 1983; Love & Thompson, 1988) and preschool children with language disorders are at significant risk for later behavior problems (Baker & Cantwell, 1987; Benasich, Curtiss, & Tallal, 1993). The present report describes a 2-year, prospective longitudinal study that explored the role of language, in the form of private or self-directed speech, in the development of self-regulation with a sample of behaviorally at-risk (and comparison) preschoolers.

Significant developments take place during the preschool years in children's capacity for behavioral self-regulation, that is, in their ability to monitor, plan, guide, and control their own attention and behavior to attain challenging personal or situational goals (Diaz, Neal, & Amaya-Williams, 1990; Kochanska, 1993; Kopp, 1982). Various components of children's self-regulation have now been studied, including compliance (Kochanska, Aksan, & Koenig, 1995), internalization (Kochanska, Murray, Jacques, Koenig, & Vandergeest, 1996), conscience (Kochanska, 1993), impulsivity (Olson, Bates, & Bayles, 1990; Silverman & Ragusa, 1992), inhibitory

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control (Schachar & Logan, 1990), and delay of gratification (Shoda, Mischel, & Peake, 1990). Most theoretical perspectives on the development of self-regulation, including socialization, psychodynamic, attachment/organizational, and Vygotskian/sociocultural theory, emphasize as a primary mechanism for developmental change, the process of internalization (Berk & Winsler, 1995; Grusec & Goodnow, 1994; Kochanska, 1993; Kopp, 1982; Maccoby & Martin, 1983; Sroufe, 1996; Vygotsky, 1930–1935/1978). That is, during the toddler and preschool years there is a gradual shift from external, other-control to internal, self-control of the child's behavior. Further, depending on the history of parent–child interactions, the quality of parental control and discipline, the attachment relationship, and the personality of the child, the child identifies with or internalizes the behavioral expectations, rules, and behavioral control strategies of the parents and uses them to guide his or her own behavior. What, exactly, is being internalized, however, is often unclear. Vygotskian theory specifies that it is language that is internalized and is the primary mediating link in the transition from other- to self-regulation.

Vygotskian sociocultural theory (Vygotsky, 1934/1987; Vygotsky & Luria, 1993) draws attention to an important development that takes place during the preschool years, namely, the merging of language with thought and the resulting shift from language being used by the child for communication with others to language being used to regulate the child's behavior. Evidence of this process of language internalization often comes from children's private speech, or overt speech directed to the self, a phenomenon that peaks during early childhood. Private speech is seen as an important intermediate link in the internalization process from the child's behavior first being regulated by the speech of caregivers, then by the child's overt private speech, and finally by the child's inner verbal thought (Berk & Winsler, 1995; Diaz & Berk, 1992).

Children's private speech within normative samples has been found to follow a predictable developmental course over the early years from overt task-irrelevant speech, to overt relevant and clearly self-regulatory forms of private speech, to partially internalized manifestations of inner speech, such as whispers and inaudible muttering (see Berk, 1992). Also, preschool children preferentially use private speech in settings in which there are increased demands for behavioral self-regulation (Winsler & Diaz, 1995). Further, children's private speech is related to their concurrent and future task performance (Winsler, Diaz, & Montero, 1997). Finally, the quantity and quality of children's private speech is related to children's previous social interactions with adults (Behrend, Rosengren, & Perlmutter, 1992; Berk & Spuhl, 1995; Diaz, Neal, & Vachio, 1991; Winsler, Diaz, McCarthy, Atencio, & Adams Chabay, 1999).

Given that many investigators from a variety of theoretical perspectives agree that language takes on an important role in regulating children's behavior during the toddler and preschool years (Berk & Winsler, 1995; Campbell, 1997; Kopp, 1982; Luria, 1961; Rothbart & Bates, 1998), it is surprising that relatively little is still known about young children's private speech and its relation with behavioral control over time. Longitudinal study of children's private speech is quite rare and has focused on older (elementary school-age), normally developing children (Bivens & Berk, 1990). The functional utility of private speech in young children with self-regulatory difficulties has not been the topic of much research. If, indeed, private speech plays an important role in the development of self-regulation in normally developing children, then interesting questions emerge about such speech use among preschoolers with self-regulatory difficulties. To what extent do preschool children with behavior problems use private speech during goal-directed activity and is their private speech qualitatively different from that of children without behavior problems? Is the process of speech internalization delayed in behaviorally at-risk children? Is the connection between speech and action weaker in behaviorally at-risk children compared to controls? The goal of this investigation was to shed some light on these questions.

Attention deficit hyperactivity disorder (ADHD) is one of the developmental outcomes for which preschool children with behavior problems are known to be at risk (Campbell, Ewing, Breaux, & Szumowski, 1986; Campbell et al., 1994; Egeland et al., 1990). Recent perspectives on ADHD emphasize the centrality of the self-regulatory deficits in the disorder, that is, that problems with the inhibition, organization, regulation, and delay of children's goal-directed behavior via verbal plans and rules are definitional to the disorder (Barkley, 1997). Cross-sectional research on the private speech of 6–12-year-old boys with ADHD finds greater usage of both task-irrelevant and task-relevant private speech accompanied by less use of partially internalized forms of speech for these children relative to controls (Berk & Potts, 1991; Winsler, 1998). These authors interpret the results as suggesting that children diagnosed with ADHD are delayed in the process of internalizing speech, and call for longitudinal research to be conducted on the private speech of younger behaviorally at-risk preschool children.

A few other studies have investigated the private speech of subclinical groups of preschool children who are identified as "impulsive," "hyperactive," or having behavior problems, typically by either teacher report or laboratory measures (Copeland, 1979; Diaz, Winsler, Atencio, & Harbers, 1992; Meichenbaum & Goodman, 1971; Zentall, Gohs, & Culatta, 1983). These studies are consistent in showing that behaviorally at-risk preschool children do not have a deficit in the production of private speech during problem solving—in fact they often use more private speech than their normally behaving classmates. However, these studies are inconsistent in terms of their descriptions of the maturity or self-regulatory quality of impulsive children's private speech, with some arguing that their speech is less mature or regulatory in nature and others showing no group differences. Unfortunately, due to the cross-sectional nature of the research to date in this area, little information has been gained to inform the hypothesis of a possible speech internalization delay for behavior problem children. Another possibility, given that behavior problem preschoolers actually rely more on private speech than problem-free controls but yet continue to evidence problems of behavior regulation, is that the self-speech of behaviorally at-risk children is less coordinated or connected with their ongoing behavior than that of comparison preschoolers. That is, speech-action coordination could be disrupted among preschoolers with behavioral disturbances. The present study directly addresses these questions.

Overview of the Present Study

In this longitudinal study, children identified by their preschool teacher as demonstrating behavior problems and comparison children were observed four times (T1–T4) between $3\frac{1}{2}$ and $5\frac{1}{2}$ years of age. Measures of children's private speech during problem-solving activities were collected from videotaped observations at each wave of data collection and children's speech-action coordination, executive functioning, and both parent- and teacher-reported behavior problems were assessed at T4. The following four research questions were addressed: (1) To what extent do children identified by their preschool teachers at age 3 as having behavior problems continue to demonstrate problematic behavior at age 5? (2) To what extent do behaviorally at-risk children, relative to comparison children, show different patterns of private speech use and speech-performance relations at age 3, 4, and 5, and are there group differences in change in private speech over time? (3) To what extent are changes in private speech over time associated with T4 behavioral outcomes, both in general and within groups? and (4) To what extent are concurrent speech variables and background characteristics associated with parent- and teacher-reported behavior problems at age 5? We expected that the at-risk group would show stability of problem behavior over time, and that they would show increased usage of private speech and less internalization of speech over time relative to the comparison children. Further, we expected that internalization of private speech over time would be positively associated with behavioral control for both groups, and that the private speech of the behaviorally at-risk group would be less related to performance than the speech of comparison youngsters.

Method

Participants

The original T1 sample consisted of 82 children aged 3–4 years (80% male; age $M = 46.4$ mths, SD 5.05) who formed two groups—a behavior problems group ($N = 39$) and a control group ($N = 43$). The behavior problems group included those children who, during a screening of 566 children attending 11 preschools in a large metropolitan area of California, scored among the top 10% of this large sample ($M = 3.17$) on a preschool teacher rating scale of impulsivity/behavior problems. The teacher rating scale was based on DSM-III-R (American Psychiatric Association, 1987) diagnostic criteria for ADHD. Items from the scale include: "Child has difficulty following verbal directions," "Child interrupts or disrupts activities of peers," "Child shifts activities quickly before completion," "Child fidgets and appears restless," "Child is disruptive during organized group activities," and "Child has difficulty playing alone." This six-item, 5-point Likert scale has been reported in previous work to have a correlation across preschool teachers of .64 (Diaz et al., 1992). The control group consisted of a randomly selected subsample (matched on gender and school) of the other children who participated in the screening but who received teacher behavior problem ratings within the normal range.

In response to a 20% participant attrition rate from T1 to T2, 12 additional children (6 at risk, 6 control) were added to the study at T2 as a second cohort (according to the same procedures as above). The overall attrition rate for the entire span of the longitudinal study was 23%. Attrition was significantly associated with T1 teacher behavior ratings, with dropping out of the study occurring significantly more often among the behavior problem group (37%) than among the control group (10%). Also, those who left the study were more likely to rent (rather than own) their homes compared to those who remained participants. Those who left the study did not differ from those who remained in terms of any of the other demographic variables.

The final longitudinal sample consisted of 72 children (age $M = 65.6$ mths, SD 5.57). The behavior problem group included 29 children (83% male) and the control group 43 children (77% male). The ethnic breakdown of the final sample according to parental report was 63% White, 6% Hispanic/Latino, 2% African-American, 8% Asian-American, 0% Native-American, and 21% Other/Mixed. A full range of socioeconomic levels was present in the sample. By design, participating preschools were quite diverse in terms of the socioeconomic levels of the families served and type of child-care center. Corporate-sponsored, university-affiliated, and for-profit child-care centers of varying quality were included. Eighty per cent of the families owned their own home. Parental age of the sample was typically 35 to 36 (maternal age $M = 35.1$, SD 5.58, paternal age $M = 36.4$, SD 5.79) and parental education ranged from less than a high school diploma to post-doctoral work, with the average for mothers being at least some college and for fathers the completion of a bachelor's degree. The average number of siblings in the families was 1.12 (SD 0.97) and children's mean raw T1 PPVT-R (Dunn & Dunn, 1981) vocabulary score was 43.6 (SD 14.7) (standard score $M = 102.5$, SD 16.4). At T4, 68% of the sample was enrolled in kindergarten. There were no significant group differences on any of the demographic variables at T1 but children in the behaviorally at-risk group at T4 were more likely to be in a single-parent household (21% as opposed to 5% for the control group).

Procedures

Overview/Setting. Observational data collection occurred over the course of 20 months at four separate time intervals typically about 6 months apart. Time 1 (T1) data collection occurred in the spring semester of an academic year. Children's mean age at T1 was 46.4 mths (SD 5.05). At T2, in the fall of the same year, children were observed again (age $M = 52.1$, SD 5.16). Approximately 6 months later in spring, T3 data collection took place (age $M = 57.5$, SD 5.07). Final (T4) data collection began about 8 months later in the fall (age $M = 65.6$, SD 5.57). On each occasion, children were videotaped as they completed one or more cognitive problem-solving tasks (described below). As is typical for private speech research, the individual problem-solving tasks typically followed a brief adult-child collaborative introduction to the task. A high-quality, flat, table microphone was used on each recording occasion to increase the quality of the audio. For most children, data collection at each session took place in either a separate corner of their preschool classroom or in an extra room at their preschool. However, a small number of sessions ($\approx 15\%$) at T4 necessarily took place in the children's homes as a result of either scheduling difficulties, child preschool attendance problems, or terminated enrollment in the participating school. In both settings, children were similarly seated at a table with the experimenter for the data collection activities and typically other visual and aural distractions were present. Preliminary analyses revealed no significant differences on the outcome variables for children who were videotaped at the preschool vs. at home.

Tasks. Table 1 gives an overview of the tasks/assessments administered at each of the four waves of data collection and the major dependent variables collected.

(1) *T1.* Children individually completed a magnet board puzzle task which consisted of an 8.5″ by 11″ metal frame, 50 pieces of colored magnetic geometric shapes, and an 8.5″ by 11″ laminated color picture (the model) of a clown face that was completed with 24 of the pieces. After being exposed to the task in the context of a brief adult-child collaboration session (see

Table 1
Overview of Data Collection

Task	Measure
T1	
Problem-solving task	Task performance
(Magnet board puzzle)	Private speech
	# Irrelevant utterances/minute
	# Relevant utterances/minute
	# Partially internalized utterances/minute
	# Overall utterances/minute
PPVT-R	Receptive vocabulary
T2 & T3	
Problem-solving task	Task performance
(Selective attention)	Private speech
	# Successful items w/silence
	# Failed items w/silence
	# Successful items w/relevant speech
	# Failed items w/relevant speech
	# Successful items w/irrelevant speech
	# Failed items w/irrelevant speech
T4	
Problem-solving task	Task performance
(Selective attention)	Private speech
	# Partially internalized utterances/minute
	# Overall utterances/minute
''Hammer'' task	Speech-action coordination
	# Items w/correct motor performance
	% of items w/speech-action coordination
Trail-making task	Executive functioning
	# Overall private speech utterances/minute
CBCL	Child behavior at home
TRF	Child behavior at school

Winsler et al., 1999), the child was asked to do their best to make a copy of the clown by putting the geometric figures in the appropriate places on the magnet frame. The experimenter (and sometimes the child's mother) was in another part of the room occupied with forms. The magnet board task was chosen after pilot testing determined it was effective in eliciting children's private speech and interesting to, and at an appropriate level of difficulty for, this age group. Children were also individually administered the PPVT-R at T1.

(2) *T2 & T3*. In order to assess private speech-performance relations over time, children completed a selective attention (SA) task at T2 and T3. In this task, children first determine which dimension (either form or color) is shared by two pictures on a card and then attach a third picture that represents the dimension shared by the two. For example, a card might have a picture of a green flower and a red flower. Here, the correct response would be for the child to select and attach the card that is the colorless flower. The correct form varied randomly across the 12 items. Included in the answer card box to increase difficulty were six additional cards, one extra card for each of the six possible answers. This task has been shown in previous research to be interesting, of appropriate difficulty, and effective for eliciting private speech for this age group (Diaz et al., 1992; Winsler et al., 1997). The experimenter introduced the task, assisted the child with 2 example items, asked the child to try to finish the remaining 12 items individually, and increased the seating distance between the experimenter and child for the remainder of the items. As done in previous research (Winsler et al., 1997), the experimenter gave assistance to the children only if they failed an item on their own (i.e., put an incorrect answer on the card and appeared to be done, or did not answer the card). In these cases, the experimenter would ask leading questions to help the child get the correct response on the item, and withdraw assistance again as children started on the next item.

(3) *T4*. At the final data collection session, children were administered three tasks in a predetermined random order. The first task was the now familiar SA task (described above), made appropriately more complex for this older age group. On the basis of previous work (Winsler, 1998) and pilot testing, the number of items was increased to 15, the number of pictures on the items was increased from 2 to 3, and the number of dimensions that could be shared by the pictures similarly increased to 3 (the addition of number to shape and color).

The second task completed by children at T4 was the speech-action coordination or ''hammer'' task. This motor task, adapted from Balamore and Wozniak (1984) and originally based on Luria's (1961) work, involves a series of requests for the child to tap (with a toy plastic hammer) a sequence of colored pegs (red, green, orange, yellow, blue) placed on an 8.5″ by 11″ white, rectangular, plastic pegboard. One peg was placed toward each corner of the pegboard and the remaining peg was situated in the center. In this task, the experimenter asked the child to tap a progressively longer sequence of colored pegs (2, 3, 4, then 5 colors), with two trails present within each sequence length. Children went on to the next higher sequence of colors if they correctly hit the colors in order on both trials. This pattern was then repeated four times.

The final task administered to children at T4 was an adapted version of the Trial-Making Task (TMT; Reitan, 1971) which was given to assess children's executive functioning. The TMT is a widely used tool for assessing executive and other prefrontal functions (Sellers & Nadler, 1992) in adults and has also been used with children of varying ages (Davis, Adams, Gates, & Cheramie, 1989). The task consists of three trials (numbers, letters, and a combination of numbers and letters) of connecting a series of dots in ascending order with a pencil. Children were to make a line or ''connect the dots'' (without lifting the pencil from the paper) going in either ascending numerical order, alphabetical order, or alternating numerical and alphabetical order for the three trials, respectively. After making sure the children knew the numbers and letters, and after doing one or two practice trials, children completed trial 1 which contained 10 numbers, trial 2 which consisted of 10 letters, and then trial

3 which consisted of 10 numbers alternating with 10 letters (A-1-B-2-C-3 …).

Measures

Private speech (*T1–T4*). Child speech during the T1 magnet board task, the T4 TMT, and all administrations of the SA task, was carefully transcribed from the videos, and transcripts were later independently verified/corrected by another person. As is typical in private speech research, the unit of analysis was the utterance, defined as either a complete sentence, a sentence fragment or clause with intentional markers of termination, a conversational turn, or any string of speech which is temporally separated from another by at least 3 seconds (Diaz et al., 1990; Feigenbaum, 1992). Child speech utterances were classified as either social or private, with private speech being defined as any verbalization by the child which was not explicitly addressed to another person, as indicated by either a pronoun reference, a gaze to another person, or other signals of social intent, such as physical contact, argumentation, or conversational turn taking (Diaz, 1992; Winsler, 1998).

Private speech utterances during the T1 task were classified according to Laura Berk's (1986) coding system, which categorizes children's private speech utterances on the basis of their overtness (volume) and task-relevance. It consists of three broad categories. Level I, task-irrelevant private speech, includes word play, affect expressions, comments to imaginary others, and other utterances which appear unrelated to the task at hand. Level II, overt (regular volume) task-relevant private speech, includes statements about the task or the child's ongoing or future task-related activity. Level III, partially internalized private speech, includes inaudible muttering, whispers, and silent, verbal lip movements. To control for differences in the amount of time children took to complete the task, number of utterances per minute was calculated for each of the private speech categories and total private speech. Overall number of social speech utterances per minute was also calculated. Inter-rater reliability was estimated by having two research assistants naive to group membership and the research questions independently code a randomly selected subset of the transcripts. Percentage agreements for the distinction between social and private speech (on a subsample of 17% of the transcripts) was 89%, and for the private speech coding system (on a 20% subsample), 89%[1].

For the T2 and T3 SA task, individual items were coded rather than speech utterances as suggested by Diaz (1992) and Winsler et al. (1997). These authors argue that speech-performance relations are best studied microanalytically by exploring item-by-item speech/performance co-occurrences during a task to avoid problems with global utterance count-performance correlations, such as (a) the assumption that more utterances is better for performance than fewer utterances, (b) typical large individual differences in overall amount of private speech emitted by children, and (c) the third variable confound of task difficulty (both private speech and task failure are more likely to occur with increased task difficulty). Thus, each of the 12 SA items was coded twice—once for performance and once for type of speech. Performance on the items was simply coded as either success/failure. If the child independently placed the correct card on the item, the item was coded as a success. If the child placed an incorrect answer card and appeared to be finished, or did not complete the item, the item was coded as a failure. Children's private speech during the period while they were working independently on the task items (i.e., before the experimenter intervened in the case of a failure) was coded as either item-relevant or item-irrelevant. Items were classified as having item-relevant private speech if, at any time while the child was working independently on the item, the correct dimension that was shared by the two pictures (either the specific exemplar—"They're both blue"—or the general concept—"Same color") was mentioned. Items were classified as containing item-irrelevant private speech if speech was used by the child during that item but the correct perceptual dimension was never mentioned. If the child produced no private speech while independently working on the item, the item was coded as silent.

Thus, six different types of speech-performance relations were possible for each item: (1) Silence/Fail, (2) Irrelevant Private Speech/Fail, (3) Relevant Private Speech/Fail, (4) Silence/Success, (5) Irrelevant Private Speech/Success, and (6) Relevant Private Speech/Success. The total number of items in each of these categories was recorded, as was the total number of correct items (regardless of speech) and the total number of items with each type of speech (regardless of performance). Change scores[2] (T3 minus T2) were also calculated for each of these measures. Inter-rater reliability for the item coding system, which was assessed by having two naive assistants independently code a random subsample (14%) of the videos, was 92%.

Private speech measures during the T4 SA task consisted of overall private speech utterances per minute and the number of partially internalized (whispers and muttering) private speech utterances per minute. Total number of private speech utterances per minute was also calculated for speech during the TMT. An aggregate measure of overall T4 private speech utterances per minute was calculated by averaging the similar measures from the T4 SA task and the T4 TMT. Finally, change scores (T4 minus T1) were calculated for children's overall and partially internalized private speech utterances per minute.

Speech-action coordination (*T4*). Variables derived from the hammer task included overall motor performance (number of trials in which the child hit the color sequence correctly) and speech-action coordination (percentage of trials in which the child's speech [if any] and motor actions were coordinated [action matched the speech] as opposed to dyscoordinated [child said one thing, did another]).

Executive functioning (*T4*). Performance on the TMT was calculated as the total number of correct connections the child made between consecutive points on trial three of the task.

Selective attention (*T4*). Performance on the SA task was calculated as the number of items the children completed successfully without assistance.

Problem behavior at home and school (*T4*). Parents completed the attention problems and aggressive behavior subscales of the Child Behavior Checklist (CBCL; Achenbach, 1991a) and children's teachers filled out the same two scales of the Teachers Report Form (TRF; Achenbach, 1991b).

[1] Kappa coefficients, a superior estimate of chance-corrected inter-rater reliability for categorical coding systems, were unfortunately not able to be calculated in this study because the original reliability data tables were lost in a flood. Overall percentage agreements were calculated earlier and recorded in a different location, but we were not able to go back to calculate the kappas. It is our experience with these coding systems that kappas are typically 3–8 points lower than percentage agreements.

[2] Change scores, once thought by many to be avoided as unreliable indices of change, are now understood to be excellent, natural measures of individual change over time (Rogosa, 1995), and they are central to currently popular individual growth curve modeling procedures (Bergman & Magnusson, 1997; McArdle & Epstein, 1987; Willett, Singer, & Martin, 1998). Previous thinking about change scores was based on a model that assumed (a) equal growth across all individuals over time, (b) unchanging "true" scores for individuals, (c) equal variances across waves, and (d) a necessarily negative correlation between change and initial status. None of this is the case here.

Results

Preliminary Analyses

Preliminary analyses consisted of testing for gender differences on the main dependent measures and exploring within-wave associations between age of child and variables of interest. The only variable that differed by gender was teacher-reported attention problems, Welch $t(1, 47.8) = 3.48$, $p < .001$, with the boys ($N = 57$) seen by teachers as having more problems of attention ($M = 6.28$, SD 6.29) than the girls ($N = 15$) ($M = 2.15$, SD 2.67). Both genders were grouped together in the analyses that follow except for those involving teacher ratings. Also, gender did not interact with other independent variables in the analyses reported below.

Stability of Behavior Problems

The first research question was whether children identified at age 3 as difficult to manage by preschool teachers would continue to show behavior problems 2 years later. Table 2 shows the group averages on parent and teacher CBCL/TRF scores and other T4 outcome measures. The at-risk group was reported by parents to have more attention problems, $t(47) = 3.24$, $p < .01$, and aggression, $t(47) = 3.82$, $p < .001$, than the comparison group 2 years later when children were entering elementary school. Given that (1) 32% of the sample had not yet entered kindergarten and were still attending a preschool/child care setting, and (2) teachers' behavioral expectations in kindergarten are likely to be far greater than those in preschool and thus it becomes clearer (with raised expectations in a new context) who is able to behave well and who isn't, teacher-reported behavior problems were analyzed separately for those still in preschool and those in formal kindergarten. Medians were chosen as the preferred measure of central tendency for the teacher rating date due to fairly skewed cell distributions. Although there were no group differences in median teacher-reported attention and aggression problems for children still in preschool, significant group differences did appear on both attention, Median test $\chi^2(40) = 5.38$, $p < 0.5$, and aggression, $\chi^2(40) = 3.58$, $p < 0.5$, for those youngsters in kindergarten. These patterns in teacher ratings were the same for both genders.

At T4, 29% of the at-risk group had received at least one behavior rating from teacher or parent in the clinical range (greater than 2 SDs above the mean relative to the standardization sample on either the attention or aggression scale), compared to 11.9% for the comparison children, a difference that approached standard statistical significance, $\chi^2(66) = 3.06$, $p = .08$. These findings, together with the fact that attrition in this study was more likely to occur among children with the most severe teacher ratings at T1, suggest that children seen by preschool teachers as having behavior problems at age 3 are indeed at risk for continuing behavioral difficulties several years later.

Group Differences in Private Speech at T1

Means (and standard deviations) for the speech variables at T1 are given in Table 3. The three different categories of private speech (irrelevant, relevant, partially internalized) at T1 were entered as dependent measures in a MANOVA with group as the between-subjects variable. A significant multivariate group effect emerged, $F(1.5, 36.5) = 2.84$, $p < .05$, and follow-up univariate tests revealed that the only group difference at T1 was that the at-risk group used significantly more overt, task-relevant private speech during problem solving than the comparison group, $F(1, 77) = 7.94$, $p < .01$. Total private

Table 2
Group Differences at Age 5 (T4)

Problem behavior	At risk	Control
Parent CBCL—Attention problems*		
Mean	5.81	2.70
(*SD*)	(4.38)	(2.38)
Parent CBCL—Aggression*		
Mean	16.19	8.03
(*SD*)	(7.61)	(6.69)
Teacher TRF—Attention problems		
Preschool median	2	3.5
Kindergarten median*	6.5	2
Teacher TRF—Aggression		
Preschool median	2	6
Kindergarten median*	9.5	2
Private speech (PS)		
Total PS utterances per minute		
Mean	11.00	6.85
(*SD*)	(5.45)	(6.12)
Partially internalized PS per minute		
Mean	0.95	0.95
(*SD*)	(1.21)	(1.09)
Other		
Executive functioning		
Mean	7.65	9.19
(*SD*)	(6.10)	(5.58)
Selective attention		
Mean	10.04	11.63
(*SD*)	(3.96)	(3.54)

*$p < .05$.

Table 3
Group Differences in Children's Speech at T1

	At risk	Control
Level I—Overt, task-irrelevant private speech per minute		
Mean	0.64	0.42
(*SD*)	(1.29)	(1.00)
Level II—Overt, task-relevant private speech per minute*		
Mean	1.52	0.63
(*SD*)	(1.67)	(1.13)
Level III—Partially internalized private speech per minute		
Mean	0.53	0.42
(*SD*)	(0.87)	(0.57)
Overall private speech per minute*		
Mean	2.70	1.47
(*SD*)	(2.21)	(1.84)
Social speech per minute*		
Median	3.60	0.72

*$p < .05$.

speech utterances per minute also showed significant group differences, $t(77) = 2.68$, $p < .01$, favoring the at-risk group. The at-risk group was also found to use significantly more social speech per minute than the comparison group during the individual session, Median test (highly skewed distributions), $\chi^2(79) = 12.19$, $p < .001$[3].

Group Differences in Private Speech at T4 and Global Change from T1 to T4

The two comparable private speech measures available at both T1 and T4 were total number of private speech utterances per minute and the number of partially internalized (whispers and inaudible muttering) utterances per minute. Each of these was entered into a 2×2 mixed ANOVA with time (T1, T4) as the repeated measure and group (at risk, comparison) as the between-subjects variable. For overall private speech, there was a significant group effect, $F(1, 58) = 8.49$, $p < .01$, a significant time effect, $F(1, 58) = 79.71$, $p < .001$, and a significant interaction, $F(1, 58) = 4.43$, $p < .05$. Behaviorally at-risk youngsters continued to use more overall private speech ($M = 11.00$, SD 5.45) than comparison children ($M = 6.85$, SD 6.12) at T4. Both groups' private speech increased in frequency over time, and this increase over time in the number of utterances per minute during problem-solving tasks was significantly more pronounced for the at-risk children than for comparison children. For partially internalized speech, only a significant time effect emerged, $F(1, 58) = 7.79$, $p < .01$, indicating that this type of speech also increased for both groups of children from ages 3 to 5.

Change in Private Speech and Task Performance from T2 to T3

Table 4 gives the means (and *SD*s) for the number of SA task items completed with different combinations of speech/performance co-occurrences over time, by group. Overall, relevant private speech on the task was associated with task success for both groups. Paired *t*-tests for the entire sample revealed, for example, that relevant private speech was much more likely to accompany success than failure at both T2, $t(76) = 7.16$, $p < .001$, and T3, $t(71) = 7.07$, $p < .001$. Also, inspection of Table 4 reveals that speech/performance discontinuities (i.e., relevant speech with failure, and irrelevant speech with success) were relatively rare. A series of mixed ANOVAs with group (at risk, control) as a between-subjects factor and time (T2, T3) as a repeated measure on each speech/performance variable was conducted. Overall performance on the SA task increased for both groups from T2 to T3, $F(1, 69) = 38.52$, $p < .001$. The at-risk group was more likely to complete items with relevant private speech than the controls at both time periods, $F(1, 69) = 15.23$, $p < .001$, whereas the control children successfully completed more items with silence than the at-risk group at both time periods, $F(1, 69) = 18.51$, $p < .001$. Both groups showed an increase over time in the number of successful items completed in silence, $F(1, 69) = 6.55$, $p < .01$. The only significant group $\times$ time interaction was in the number of failed items that contained irrelevant private speech, $F(1, 69) = 4.01$, $p < .05$, indicating that although this speech/performance co-occurrence was more common among at-risk children than comparison children at T2, the two groups were indistinguishable at T3, with both groups showing a significant reduction in this speech/performance co-occurrence over time, $F(1, 69) = 16.02$, $p < .001$.

Thus, these results suggest that (1) relevant private speech is associated with task success for both groups of children over the course of their fourth year, (2) behaviorally at-risk children, compared to controls, are more likely to accompany failure with irrelevant private speech at the beginning of the year but then catch up with their normally behaving counterparts by the end of the year, (3) at-risk children continue to accompany their problem-solving with overt task-relevant speech more often than controls throughout age 4, (4) control children are more likely than at-risk youngsters to show a pattern of task success with silence, and (5) both groups of children are showing the expected developmental trend of increasing success with silence over time.

[3] At the suggestion of an anonymous reviewer, analyses of group differences in private speech at all time points were run again with children's PPVT score as a covariate. In each case the results were the same.

Table 4
Change in Private Speech (PS) and Task Performance Over Time, T2 and T3, by Group

	At risk		Control	
	T2	T3	T2	T3
Successful items with relevant PS[a]				
Mean	4.03	4.31	2.21	1.74
(*SD*)	(3.59)	(3.31)	(2.78)	(2.78)
Successful items with irrelevant PS				
Mean	1.66	1.76	1.29	1.40
(*SD*)	(1.91)	(1.90)	(1.82)	(2.47)
Successful items with no PS[ab]				
Mean	3.24	4.48	6.24	7.95
(*SD*)	(2.96)	(3.53)	(4.12)	(4.51)
Failed items with relevant PS				
Mean	0.17	0.31	0.29	0.10
(*SD*)	(0.38)	(0.71)	(0.80)	(0.37)
Failed items with irrelevant PS[bc]				
Mean	1.41	0.41	0.74	0.40
(*SD*)	(1.92)	(0.78)	(1.33)	(0.83)
Failed items with no PS[b]				
Mean	1.17	0.69	1.19	0.41
(*SD*)	(1.49)	(1.26)	(1.40)	(0.88)
Total # of successful items[b]				
Mean	8.93	10.55	9.74	11.09
(*SD*)	(2.63)	(1.54)	(1.96)	(1.54)
Total # of items with relevant PS[a]				
Mean	4.21	4.66	2.50	1.67
(*SD*)	(3.57)	(3.61)	(2.99)	(2.67)
Total # of items with irrelevant PS				
Mean	3.07	2.14	2.02	1.91
(*SD*)	(2.96)	(2.03)	(2.45)	(2.98)

[a] Significant group effect.
[b] Significant time effect.
[c] Significant group by time interaction, $p < .05$.

Speech-Action Coordination at T4

No significant group differences at T4 emerged for either motor performance or speech-action coordination according to two independent sample *t*-tests. The mean number of trials correctly hit was 13.14 (*SD* 3.97) for the at-risk children and 14.3 (*SD* 4.43) for the controls, and the proportion of items in which speech-action coordination was demonstrated was .85 (*SD* .12) for the at-risk group and .90 (*SD* .12) for the control group.

Associations between Change in Private Speech and Behavior

To explore the degree to which change in private speech over time is associated with children's behavioral outcomes at age 5, correlations were calculated between the private speech change score variables (change from T1 to T4 in overall and partially internalized PS per minute, and change from T2 to T3 for the six SA speech/performance co-occurrences) and the T4 behavior and task performance variables. Although none of the private speech change scores were significantly associated with parent- or teacher-reported externalizing behavior problems, many of them were associated with children's performance on the laboratory measures. Increases from T2 to T3 in the number of SA task items completed with relevant private speech were negatively associated with motor performance on the hammer task ($r = -.40$, $p < .05$), executive functioning ($r = -.37$, $p < .05$), and performance on the selective attention task ($r = -.37$, $p < .05$), at T4. Correspondingly, increases from T2 to T3 in the number of SA items completed successfully with silence was positively associated with performance on the hammer task ($r = .37$, $p < .05$), and executive functioning ($r = .28$, $p < .05$), at T4.

To check whether these relations between change in private speech over time and behavior differed by group, the same correlations above were calculated separately by group. Similar patterns were found as above for both groups with the following interesting exception. Among the at-risk group, increases from T2 to T3 in the number of items with irrelevant private speech during the SA task was strongly associated with parent-reported attention ($r = .71$, $p < .05$) and aggression ($r = .55$, $p < .10$) problems a year later, but this was not so for the comparison children ($rs = -.33, -.26$, respectively—statistically significant differences between the correlations, $Z = 3.06$, $p < .001$, $Z = 2.21$, $p < .05$, respectively).

Contemporaneous Correlates of Parent- and Teacher-reported Behavior Problems at T4

Finally, to examine the extent to which concurrent speech variables and background characteristics were associated with parent- and teacher-reported behavior problems at age 5, correlations were calculated between T1 child PPVT score, demographic variables (maternal and parental age and education, marital and employment status, ethnicity), and parent and teacher reports on the CBCL/TRF, and between the T4 speech/task performance variables (speech-action coordination, selective at-

tention, executive functioning, and private speech) and the T4 adult reports. None of the background variables were significantly associated with parent and teacher reports of child behavior problems at age 5. Teacher-reported behavior problems (aggression and attention scales combined) at age 5, however, were negatively associated with children's executive functioning in the laboratory ($r = -.27$, $p < .05$) and positively associated with frequency of private speech utterances per minute ($r = .32$, $p < .05$) at T4. Thus, children who are having behavioral difficulties in the classroom continue to use more private speech and demonstrate poorer executive functioning in the laboratory than children without such difficulties.

Discussion

The goal of this investigation was to explore longitudinal relations between private speech, speech-action coordination, and behavioral self-regulation in a sample of preschool children with and without behavior problems at age 3. This study represents the first attempt to explore such issues in this age group with a longitudinal design. Results from this study provide preliminary information about the longitudinal course of private speech and behavior problems in preschool children and give a number of methodological suggestions and cautions for future work in this area.

First of all, the present study replicates other investigations showing that children identified at age 3 as being hard to manage in the preschool classroom are at risk for continued behavior problems years later upon entrance to elementary school (Campbell et al., 1994; Egeland et al. 1990). Children who scored in the top decile at age 3 on the behavioral screening instrument completed by preschool teachers were reported by their parents to have more problems of attention and aggression in the home 2 years later. Further, teacher reports of children's externalizing behavior problems in the kindergarten year were significantly higher for children identified 2 years earlier as being difficult by preschool teachers, than for children not so identified. These findings attest to the importance of early identification and intervention with this easily identifiable population of children.

A central goal of this study was to explore the developmental course and functional quality of private speech among preschool children with behavioral difficulties. Multiple aspects of children's private speech were investigated, including the overall quantity of children's spontaneous private speech, relations between private speech and performance, speech-action coordination, and change over time in private speech, which provide us with data on the functioning of the verbal self-regulatory system in such children. First, it is clear that behaviorally at-risk children are not deficient in the spontaneous production of self-talk. A consistent and robust finding was that the behaviorally at-risk preschool children were more likely to talk to themselves in task-relevant ways than children without behavioral difficulties across all ages and task settings. Behaviorally at-risk children were no different from controls in frequency of irrelevant private speech at T1, nor of partially internalized speech (whispers and inaudible muttering) at T1 and T4. Thus, at least in terms of these broad categories of private speech, it does not appear to be the case that behavior problem preschoolers use qualitatively different types of private speech to comparison children. Detailed content analysis of children's private speech, however, was not conducted in this study and such analyses may be an appropriate avenue for future research. A further question explored in this study was whether behaviorally at-risk children show a disconnection between their private speech and their actions. The answer to this appears to be negative. No group differences were found for children's speech-action coordination nor for their motor performance during the hammer task. The self-speech of the behavior problem preschoolers was just as likely to be in sync with their motor behavior as that of comparison children.

The present study also provided longitudinal data on change over time in children's private speech, which informs the question of whether children with behavioral regulation problems show a developmental delay in the internalization of private speech relative to control children. Clear evidence of a developmental delay in speech internalization among the at-risk group would have emerged if the observed pattern had been overt private speech decreasing over time and partially internalized private speech increasing over time for the comparison group only. Instead, partially internalized private speech was found to increase from ages 3 to 5 for both groups of children. Further, both groups of youngsters demonstrated the expected developmental pattern of success on the SA task increasingly covarying with silence over the course of their fourth year. Nonetheless, the findings that (1) frequency of overt private speech increased from T1 to T4 significantly more for the at-risk group than for the comparison group, (2) at-risk children demonstrated increased failure and use of irrelevant private speech relative to controls during the selective attention task at T2, a pattern which normalized by T3, and (3) control children were more likely to complete tasks with silence, whereas behaviorally at-risk youngsters typically accompanied task completion with the aid of private speech, suggest that some type of non-normative developmental rate or trajectory for private speech internalization may be operating for behaviorally at-risk children.

Also explored in this study were relations between change in private speech over time and children's behavioral outcomes and task performance at age 5. Although intraindividual developments in children's private speech between the ages of 3 and 5 were not generally correlated with parent- or teacher-reported externalizing behavior problems, several were associated with children's performance on the laboratory measures. Increases from T2 to T3 in the frequency of relevant private speech usage was negatively associated with T4 motor sequencing, executive functioning, and selective attention. Relatedly, increases from T2 to T3 in the successful completion of task items with silence was positively associated with motor sequencing and executive functioning at T4. Finally, among the behaviorally at-risk group, increases in irrelevant private speech during the SA task at age 4 were positively predictive of parent-reported attention and aggression problems a year later. Such associations were not found for the comparison group. Thus, the positive developmental trajectory for private speech between the ages of $3\frac{1}{2}$ and $5\frac{1}{2}$ appears to be one of decreasing private speech overall (task-relevant and task-irrelevant) accompanied by increasing task success with silence.

This investigation represents the first of its kind to explore private speech longitudinally among behaviorally

at-risk children. Future research in this area would do well to overcome the numerous methodological limitations of the present investigation. First, it is important to point out that the global T1 to T4 developmental trends in private speech discussed in this report need to be interpreted with some caution because the tasks completed by the children were unfortunately different across these two time points (this was not a concern for T2 to T3 developmental changes as the same task was used). Quantity of children's private speech has been found to be sensitive to such variables as type of task (Frauenglass & Diaz, 1985) and task difficulty (Behrend et al., 1992). Future longitudinal research should take extra care to administer isomorphic tasks of age-appropriate and approximately equivalent difficulty levels over time. Also, special attention to subject retention procedures is clearly needed in longitudinal investigations involving behaviorally at-risk preschool children to avoid the systematic attrition of the children with the most severe behavioral profiles, which occurred here. Finally, increased sample size and a more balanced distribution of girls to boys is suggested for future research.

Another methodological concern of the present study includes the relatively limited measures of executive functioning and children's behavioral self-regulation that were used. Excellent progress has only recently been made in the development of instruments and batteries for assessing young children's inhibitory control (Kochanska et al., 1996), internalization (Kochanska, Murray, & Coy, 1997), emotion regulation (Eisenberg et al., 1995; Shields & Cicchetti, 1995), and executive functioning (Hughes, 1998). Future research exploring associations between children's private speech and behavioral control should target these more specific components of children's behavioral self-regulation.

Finally, the results of this study offer a few implications for intervention with preschool children with behavioral difficulties. First, it is clear that preschool children identified by their teachers as having behavior problems in the classroom at age 3 are at risk for later behavioral disturbances at elementary school entry. The behavior of such children appears to become particularly problematic during the kindergarten year. Early identification, prevention, and intervention for this behaviorally at-risk group of young children appears warranted. Also, given that task-irrelevant private speech within the at-risk group was particularly predictive of later behavior problems, such speech might be useful as a behavioral indicator during early screening and assessment. Further, this study demonstrates that young children with behavior problems do spontaneously use relevant private speech for self-regulation, which suggests that interventions capitalizing on children's self-instructions can focus on other goals besides getting these children to talk to themselves. Diaz and Berk (1995), for example, argue that self-instructional training interventions for children with behavior problems should be based on giving scaffolded opportunities for such children to talk to themselves spontaneously during challenging tasks rather than introducing particular self-instructional scripts or strategies for children to follow.

The developmental pattern associated with the greatest success in this study was increasing success with silence, decreasing irrelevant speech, and increasing partially internalized speech over time. Although further empirical support is needed, some have suggested that the way to facilitate children's eventual reduction and internalization of private speech is to actually maximize opportunities for children to talk to themselves, with the idea being that with sufficient experience guiding behavior with speech, children's overt private speech will naturally and eventually internalize (Berk & Winsler, 1995; Diaz & Berk, 1995; Winsler et al., 1997, 1999). If this is indeed the case, then children's private speech in educational, clinical, and home contexts should be allowed, if not encouraged, by early childhood educators and other adults, especially for children with behavioral difficulties.

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