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The Role of Private Speech in the Transition From Collaborative to Independent Task Performance in Young Children

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This study was designed to examine the following central Vygotskian hypotheses about the functions of preschool children's private speech: (1) that private speech facilitates the transition from collaborative to independent task performance, and (2) that children's use of private speech is conducive to task success. Age-related changes in children's use of private speech were also examined. Forty preschoolers, ranging in age from three to five, completed a selective attention task with scaffolded assistance given from an experimenter when needed. In an effort to overcome several methodological limitations found in previous research, a new microgenetic method of analyzing speech-performance relations based on assigning task items to discrete categories reflecting six possible co-occurrences between private speech (item-relevant speech, item-irrelevant speech, silence) and performance (success, failure) was introduced. Results were that (1) item-relevant speech was used more often during successful than during failed items while the opposite was true for item-irrelevant speech; (2) children were more likely to use private speech on successful items after scaffolding than they were on similar items not following scaffolding; (3) after scaffolding, children were more likely to succeed on the next item if they talked to themselves than if they were silent; and (4) hypothesized curvilinear, age-related patterns in children's item-relevant private speech and silence were found, however, only when analyzing speech during successful items. Implications of this research for preschool teachers and parents are discussed.

One of Vygotsky's (1934/1962, 1930–1935/1978, 1960/1981) most intriguing observations was that young children use language not only for social communication but also to plan, guide, and monitor their behavior in a self-regulatory manner. The use of language for self-regulation is labeled private speech, underscoring the fact that it is different from social speech in both audience (self, rather than others) and function (self-regulation, rather than social communica-

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tion). Rejecting Piaget's interpretation of private speech as simply a sign of egocentrism, Vygotsky (1930–1935/1978) theorized that children's use of language as a tool of thought during the preschool period signaled a "most important moment in the course of intellectual development," (p. 24) a species-specific interaction between thought and language that transforms the course of cognitive development. He further believed that children's use of private speech assists them not only in gaining mastery over the environment, but also in gaining executive control over their own actions and operations (Berk & Winsler, 1995; Diaz, Neal, & Amaya-Williams, 1990).

The functional significance of private speech in children's cognitive activity constitutes a central underlying assumption of Vygotsky's theory of cognitive development (Berk, 1992). Specifically, two major functions of private speech appear in Vygotsky's writing on the topic. First, through private speech children can transfer to the personal (intrapsychological) plane, abilities that were achieved first in interpersonal (inter-psychological) collaboration. This functional aspect of private speech reflects children's gradual takeover of the regulatory role provided by adults within the Zone of Proximal Development (ZPD), a zone of interpersonal functioning in which children collaborate on tasks with more expert members of their culture (Berk & Winsler, 1995; Rogoff & Wertsch, 1984). Through private speech, children begin to do for themselves what caregivers do for them during collaborative problem solving, such as focus attention, divide tasks into chunks, and praise successful performance (Diaz et al., 1990; McCarthy, 1992).

Second, through private speech children exercise executive or self-regulatory control over cognitive processes in meeting the demands of difficult tasks. This second function underscores Vygotsky's notion that with the aid of private speech children can create their own ZPD as they self-scaffold to achieve higher levels of competence in a given task (Bickhard, 1992). With development, children improve not only in their ability to solve problems but also in their ability to structure their own environments, to create new challenges for themselves, and to regulate their own learning through self-monitoring, self-regulating, and self-reinforcing strategies (Schunk & Zimmerman, 1994). Children's use of self-directed speech in this connection is seen as a potentially necessary precursor to the development and use of such self-regulatory strategies as well as to children's eventual independent and automated task performance (Berk & Winsler, 1995; Gallimore & Tharp, 1990).

Thus, the classic Vygotskian developmental model for the microgenetic emergence of task competence within a particular activity can be stated as follows: (1) children first accomplish tasks collaboratively with the assistance and scaffolding of caregivers; (2) children then begin to use a cultural mediator or sign system (like private speech) to appropriate regulatory responsibility of the task from caregivers; (3) during early stages of individual task completion, children continue to use the cultural tool or symbolic mediator (i.e., private speech) to assist with their problem solving; and (4) children are eventually able to perform the task easily and automatically without the use of overt symbolic tools or strategies (Berk & Winsler, 1995). The present study examines these functional aspects of speech as preschool

children move from collaborative to individual competence in a task of voluntary selective attention.

FROM SOCIAL INTERACTION TO SELF-REGULATION: THE ROLE OF PRIVATE SPEECH

A central hypothesis in Vygotsky's theory of development is that higher psychological functions, such as planning, voluntary attention, and strategic memory, have social origins. In response to both nativist and naive environmentalist theories, Vygotsky proposed that higher cognitive functions are neither innate nor simply learned from the caregiving environment. Rather, he believed that children gradually construct in collaboration with adults or more capable peers, functional levels of organization that will appear later in individual functioning and cognitive development. Thus, a major task for Vygotskian researchers is to specify and document how the transfer or appropriation from interpersonal collaboration to intrapersonal functioning occurs. We hypothesize that private speech plays a major role in the transfer/construction of cognitive functions from the social to the psychological domain.

Caregivers enhance and regulate children's participation in cultural activities through different scaffolding strategies, such as structuring the immediate environment, offering leading questions, posing new challenges with appropriate levels of difficulty, and providing positive feedback and motivational incentives (Rogoff, 1990). Sensitive scaffolding of young children's problem-solving by teachers and parents has repeatedly been associated with gains in children's task performance, task improvement over time, cognitive development, active engagement in problem-solving activities, and use of private speech (Berk & Winsler, 1995; Baker, Sonnenschein, & Gilat, 1996). Our hypothesis is that caregiver scaffolding produces its positive effects on children's cognitive development, at least in part, because of scaffolding's facilitative effect on children's private speech.

Two recent studies support the notion that children's private speech mediates the impact of adult scaffolding on children's task performance. Behrend, Rosengren, and Perlmutter (1992) examined the correlations between measures of maternal scaffolding, children's private speech, and task performance at two points in time during interactive and individual puzzle-solving conditions. As expected, maternal scaffolding was positively related to children's task performance as well as to children's use of private speech during the collaborative puzzle-solving situation. However, when the independent effects of maternal scaffolding and private speech on children's subsequent independent performance (Time 2) were examined, only children's private speech at Time 1 predicted significant portions of the task performance variance. The findings encouraged the investigators to propose a theoretical model whereby children's private speech mediates the effects of maternal scaffolding on task improvement over time. More recently, Berk and Spuhl (1995) found that their large and significant correlations between maternal scaf-

folding and preschool children's performance on a Lego-building task declined substantially when children's private speech during the task was partialled out.

Understanding both the process by which children learn from adult assistance during joint activity and the role that private speech plays in child development is of critical importance for early childhood educators. Given that it is during the toddler and preschool years that children are in the process of using and internalizing private speech for self-regulation, it is essential that preschool teachers, at a minimum, be aware of this important developmental phenomenon. However, if the impact of adult assistance on children's subsequent cognitive development is indeed mediated by children's use of private speech, then early childhood educators have at their disposal an invaluable assessment tool. As has been suggested elsewhere (Berk & Winsler, 1995; Winsler & Diaz, 1995), teachers can use children's private speech not only as a useful window for observing what is going on inside the child's developing mind, but also as a valuable indicator of (a) the extent to which adult intervention or scaffolding is successful in producing cognitive change and internalization of strategies, (b) the degree to which classroom tasks and activities are appropriately challenging for children, and (c) the extent to which the early childhood classroom environment provides opportunities for verbal self-regulation.

PRIVATE SPEECH AND COGNITIVE PERFORMANCE

During the last 20 years, empirical research has given substantial support to most of Vygotsky's hypotheses concerning private speech (see Berk, 1992, for a comprehensive review). As Vygotsky predicted, children's private speech is closely related to ongoing activity (Diaz, 1986; Winsler & Diaz, 1995), frequency of private speech increases with task difficulty (Behrend, Rosengren, & Perlmutter, 1989), and with increasing age or task mastery overt private speech is replaced with inaudible muttering and whispers, indicating progressive internalization (Berk & Garvin, 1984, Bivens & Berk, 1990; Frauenglass & Diaz, 1985). Also, mixed support has been given to Vygotsky's hypothesis of an inverted-U, curvilinear relationship between age and children's use of private speech, in that some have reported that the frequency of children's private speech peaks between the ages of three and four and then declines at the beginning of elementary school (see Berk, 1992; Kohlberg, Yaeger, & Hjertholm, 1968).

The search for a systematic relation between children's private speech and cognitive performance, however, has been difficult and plagued by a host of methodological problems (Diaz, 1992). Studies that examine the relation between private speech and concurrent task performance have produced equivocal results at best. Researchers have reported positive correlations (Azmitia, 1992; Beaudichon, 1973; Bivens & Berk, 1990; Gaskill & Diaz, 1991; Goodman, 1981), negative correlations (Frauenglass & Diaz, 1985; Zivin, 1972), and nonsignificant, close to zero correlations (Goudena, 1987; Pellegrini & DeStefano, 1979). As such, the available data can support all three simple alternative hypotheses

regarding the relation between private speech and cognitive task performance; namely that, (1) private speech has a positive, facilitating effect, (2) it has a negative, interfering effect, or (3) it is epiphenomenal with no effect on children's ongoing activity. This confusing pattern of results, however, can be understood if one posits, as Vygotsky did, a complex, dynamic relationship between private speech and task performance.

Studies that have examined the relation between private speech and performance at one point in time miss the fact that Vygotsky (1934/1962, 1930–1935/1978) postulated a changing, dynamic relationship between thought and language in development. In fact, Vygotsky explicitly and strongly criticized existing theories that portrayed static relations between thought and language in human cognition. As discussed by Diaz (1992), the specific relationship between private speech and cognitive performance is likely to differ depending on the child's current level of functioning with respect to the task demands at any given moment. That is, concurrent relationships between speech and performance will vary depending on where the child is currently located on an imaginary continuum representing the microgenetic development of competence on a single task. If a task is extremely easy for a child, such that it can be performed automatically with little or no cognitive effort, then private speech will likely not be necessary. As a task becomes more difficult, however, challenging the child's current level of unmediated competence, private speech will begin to be used in the child's attempt to gain mastery over the task, and this speech will be intimately related to the child's performance. As the child gains higher levels of competence on the task, task difficulty decreases and private speech will again be less frequent, less necessary, and less related to performance. Private speech is thus gradually incorporated into the child's ongoing activity as it is needed to meet cognitive demands. Once speech and action are effectively coordinated in verbally-mediated action and higher levels of cognitive functioning are achieved, private speech should become subvocal and eventually disappear. Once higher levels of competence are achieved and cognitive functions become routinized and well integrated in the child's current functioning, the need for executive strategies and active verbal mediation will diminish. The fate of effective private speech is to be eventually replaced by competent, automated, and silent performance.

Interestingly, all three of the simple alternative hypotheses noted above about the relation between task performance and private speech would be predicted given this analysis, depending on when observations are made in the path toward task competence. If a child is just beginning to work and is struggling with a difficult task, a negative relation between private speech and performance should be expected because private speech most likely will co-occur with failure in these early stages of competence. On the other hand, at medium levels of difficulty, speech and action will be most effectively coordinated and used as a tool of verbal mediation and, at this point, the relation between private speech and performance should be positive. Silence, however, would be expected at both ends of the competence continuum. Young novices, who might not even attempt to work on the task, and highly competent or expert children, would not need to use overt speech

as a problem-solving tool. Therefore, private speech emitted at the very beginning or toward the end of the competence continuum would be most likely epiphenomenal in nature, showing no relation to task performance.

What the above analysis reveals is that the relationship between children's private speech and task performance is too dynamic and complex to be captured by a single correlation between quantity of children's private speech and concurrent task performance. Unfortunately, this has been the strategy used in the majority of the studies in this area. There are other inherent difficulties in studying speech-performance relations with concurrent correlations. Correlational analyses rest on the implicit assumption that higher amounts or frequencies of private speech are more conducive to improvement in task performance. It is possible, however, that the number of private speech utterances emitted during a task reflects individual differences in children's verbal fluency or verbosity, differences that may have little functional significance for the ongoing cognitive activity. A verbalized strategy could have a similar impact on cognitive performance whether it is uttered just once or at several times within the same problem-solving session. If this is the case, an analysis based on the number of utterances emitted during children's task performance could underestimate the impact of private speech on children's ongoing activity. Another problem which emerges with frequency of private speech measures is that a rather homogenous group of children typically shows enormous individual variability in the quantity of private speech emitted during a given task. The field currently has little understanding of the meaning of such individual variation in frequency of private speech, and this variation often creates large standard deviations which seriously complicate standard between-group comparisons (Berk, 1992; Diaz, 1992). Thus, studies that rely on quantity of private speech could be masking other unknown variables that confound speech-performance relations.

At present, there appear to be two methodological ways of avoiding the above noted difficulties in studying the relationship between children's private speech and cognitive performance: (1) longitudinal studies which explore the relationship between speech at one time and performance at a later time, and (2) microgenetic analyses of the moment-to-moment relation between speech and performance during the construction of competence in a single task. Short term longitudinal studies that have examined the effects of private speech on task improvement over time, rather than on concurrent task performance, have documented Vygotsky's hypothesized positive relation between private speech and performance. Children who emit more private speech during a given task at Time 1 show greater improvement in cognitive performance over time compared to those who use little speech (Azmitia, 1992; Behrend et al., 1989; Bivens & Berk, 1990; Gaskill & Diaz, 1991).

This study uses a novel microgenetic strategy for exploring, item by item, the relation between adult–child scaffolding, children's private speech, and task performance with a sample of preschool children as the children complete an appropriately-challenging selective attention task. A trained experimenter carefully scaffolded children's problem solving by assisting the child immediately after she or he failed a given item and by withdrawing completely from the inter-

action at other times. The method used in this study to analyze speech-performance relations takes into account the pitfalls of correlational analyses and is largely independent of the frequency or amount of private speech emitted by children. Task items were assigned to one of the six categories created by the interaction of speech (item-relevant speech, item-irrelevant speech, silence) and performance (success, failure). Analyzing items according to this category system allowed us to investigate the presence of six possible relations between speech and performance while avoiding correlational analyses and the artificial theoretical separation between speech and activity which results from such analyses. Such a division is unfortunately present in most of the previous work in the area and is in stark contrast to the spirit of Vygotsky's theory.

This study tested two functional aspects of private speech, namely, that private speech mediates or facilitates the transition from collaborative to independent problem solving, and that private speech facilitates task performance and cognitive growth. In addition, we examined age trends in the production and internalization of private speech as well as age trends in the relationship between private speech and performance. We hypothesized that (1) adult scaffolding will facilitate children's use of private speech; that is, (a) children will more often use private speech on items after adult scaffolding than on items which did not follow scaffolding, and (b) during successful items after scaffolding, children will use item-relevant private speech more often than they will be silent; (2) private speech will facilitate task performance; that is, after scaffolding, children will be more likely to succeed on the next item if they talk to themselves than if they are silent; (3) children's speech will follow curvilinear age patterns as predicted by Vygotsky; that is, item-relevant speech will show an inverted u-shaped, curvilinear relationship with age, and silence on items will show a u-shaped, curvilinear relationship with age; and (4) item-relevant speech will be associated with task success whereas irrelevant speech will be associated with failure, that is, item-relevant private speech will occur more often during successful rather than failed items, while item-irrelevant speech will occur more often during failed items.

METHOD

Subjects

A total of 40 children (20 boys, 20 girls), all of whom attended a university-affiliated preschool in the San Francisco Bay area, participated in this study. The overall sample, which ranged in age from 36 to 60 months, was divided into four different age groups (n = 10) according to sample age quartiles. The resulting groups were: age 3 (M = 38.7 months.), age 3.5 (M = 44.8 mos.), age 4 (M = 50.3 months.), and age 4.5 (M = 55.1 months.). The ethnic composition of the sample was 89% Caucasian, 5% Asian American, 3% African American, and 3% Latino. All children were from middle- to upper middle-class families.

Procedure

In a separate room of the preschool, children were videotaped while they worked on a selective attention task. This task requires children to determine which of two perceptual dimensions (shape or color) is shared by two pictures, and then to select, from a group of alternatives, an answer card that represents the shared dimension. Each of the 24 items consisted of a 4-inch by 8-inch card with two pictures on it and a place for setting the answer card with Velcro® fastener. Subjects were given an open box which contained the answer cards plus a few distracter cards. The task requires children to selectively attend to the common perceptual dimension in the two pictures (either shape or color) and inhibit responding to the other. For example, one item's pictures might include a yellow house and a yellow dog. The correct card to be searched for would be a card with a yellow spot. The correct dimension varied randomly throughout the items.

A female investigator explained the task to the child while the two together completed six practice items. The first two practice items (one for each type of dimension) were completed by the experimenter while she explained what she was doing. The next two practice items were completed collaboratively and the last two were completed by the child. Then the child was instructed to try to do the rest of the cards individually while the experimenter increased her distance from the child yet remained seated nearby. Each time a child failed an item (i.e., put an incorrect answer on the card and appeared to be done, or did not answer the card), the experimenter helped the child get the correct response on the failed item. Thus, scaffolding or adult assistance occurred each time the child failed to complete an item individually. Ultimately, therefore, with the help of the experimenter, all 24 items were finished correctly.

The scaffolding children received from the experimenter consisted mostly of leading questions designed to help children discover their own mistake and think of the correct answer themselves. Adult verbalizations were intended to help children focus their attention on the correct perceptual dimension shared by the two item pictures. The experimenter was instructed to avoid giving the answers to children, yet to ask relevant leading questions, to give praise and competence attributions appropriately, and to restate/clarify what the child has done and/or what the goal/rule of the activity was. For example, the following exchange was typical:

Ch: (Child has placed a "blue" when the correct answer is "flower" and she is about to go on to the next item)

Exp: Hmm. Let's see. How are these two pictures the same?

Ch: This is blue an' this is yellow.

Exp: Mmhm. Are they both the same color?

Ch: No.

Exp: No. OK. So we don't put a color. Are they both the same picture?

Ch: Mmhm. Flower

Exp: Ah! They're both flowers. What do you have here? (Exp. points to child's answer [blue])

Ch: (Child takes off blue answer and gets a flower)

Exp: Yes. They're both flowers so you put a flower. Good. Remember. The idea is to make all three pictures the same. (Child goes on to next item)

The scaffolding protocol used in this study necessarily deviated somewhat from what might be described as an optimal or natural script for scaffolded instruction (Berk & Winsler, 1995) due to the need for item performance coding to keep the period in which the child independently worked on an item separate from the period of experimenter assistance. Thus, in this study the adult completely withdrew her assistance at the beginning of each item and entered the interaction only after the child was clearly unable to get the item answered correctly on his or her own. Under more natural circumstances, interaction between a scaffolder and child would likely be more fluid and global, with adult assistance being offered across a number of the early items and adult withdrawal taking place gradually across several items as the child's competence increases.

Measures

All experimenter and child speech during the task was transcribed from the videotapes. Each of the 24 items of the selective attention task was coded twice: once for performance and once for type of speech. Performance on the items was simply coded as either success or failure. 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, and the experimenter would then intervene with further questions/instruction as previously described. Children's speech while they were working independently on the task items (i.e., before the experimenter intervened in the case of an item failure) was coded as either (a) item-relevant, (b) item-irrelevant, or (c) silence (no speech). Items were classified as having item-relevant speech if, at any time while the child was working independently on the item, the correct dimension that was shared by the two pictures (shape or color) was mentioned. Speech was classified as item-relevant if either the specific exemplar ("They're both blue") or the general concept ("Same color") was mentioned.

Examples of children's item-relevant speech (with the characteristic mentioned referring to the correct dimension) included: "These are both blue ... so I get a blue," "House," "I want to do the orange," " Where's a dog?" "This is yellow," "Blue flower," and "Same color." Items were classified as containing item-irrelevant speech if there were speech used by the child during that item but the correct perceptual dimension was never mentioned. Examples of item-irrelevant speech included utterances which were unrelated to the task altogether ("That sure is loud thunder," "I cut up the moon," "One, two, buckle my shoe," and "What is that noise?") as well as speech related to either the task in general or the child's actions but that didn't include mention of the correct dimension ("Pick this one," "I'm doing it," "I need another card," "Blue and red," "OK," "Yellow" [correct answer

is 'house'], and "One, two, three, four left"). If the child was completely silent during an item, the item was coded as having no speech.

In coding children's speech from the videotapes, no distinction was made between children's social and private speech. This decision was made for both theoretical and practical reasons. Typically, research in the area defines private speech as any speech which is not explicitly addressed to another person as indicated by such things as eye gazes or the use of either others' names or pronouns (see Diaz, 1992). In joint collaboration or scaffolded task situations such as that in the present study, however, the distinction between social and private speech is less meaningful. We reasoned that from the Vygotskian microgenetic perspective which sees private speech as a tool for children to transfer the regulatory role from the adult to the child during joint activity, the exact point at which children's speech changes from being social to being private or from being private to being social was irrelevant. All task-directed speech during problem solving can be seen as serving some self-regulatory function regardless of whether the speech is explicitly private or social (Diaz, 1992).

From a practical standpoint, several methodological features of this study's design also made the social–private distinction less necessary. First, is the fact that task items were coded in this study rather than individual speech utterances. Thus, the determination of whether each of the speech utterances used during an item was explicitly social or private was not as important, as the focus was on whether or not the child mentioned the item-relevant dimension at least once while working on the item. Second, is the nature of the item/scaffolding contingencies in this study. Before the experimenter intervened on any given item, children were given the opportunity and/or encouraged to complete the item individually. Only speech was coded and analyzed during these periods in which the child was working individually on the task. All other speech used by the children during periods while they were working individually on the task was gently ignored by the experimenter. Occasional attempts by the children during these periods to explicitly engage the experimenter in social interaction were followed by a simple verbal prompt by the experimenter such as "[T]ry to do the card by yourself." If children continued to attempt to engage the experimenter in conversation and experimenter prompting for the child to work individually on an item was unsuccessful after three prompts, then the experimenter intervened, scaffolding began, and the individual item/speech coding and data collection stopped for that item. Thus, there were few opportunities during the time when items were being coded for the children to engage in interactive social speech. Child speech utterances during the experimenter–child scaffolding phases were not analyzed in this study.

The two coding systems discussed above (speech type and performance) were then crossed to obtain the following six different types of speech–action relations and the total number of each was recorded for each subject:

1) Silent / Fail
2) Irrelevant Speech / Fail
3) Relevant Speech / Fail
4) Silent / Success
5) Irrelevant Speech / Success
6) Relevant Speech / Success

The total number of correct items (regardless of the type of speech that occurred) and the total number of items with each type of speech (regardless of whether or not the item was correct) were also calculated.

In order to assess the effect of scaffolding on subsequent private speech and performance, the total pool of item events (24 items by 40 subjects) was divided into those which occurred after a successful item (without adult collaboration) and those which occurred after adult collaboration. Each of the above six types of speech–action events was then totaled again for the entire group (ignoring subject), but separately for those items which were after scaffolding and those which were not.

In a different session, prior to completing the selective attention task, children were administered the Peabody Picture Vocabulary Test - Revised (PPVT-R; Dunn & Dunn, 1981) by the same experimenter. The PPVT-R was given to obtain a measure of vocabulary or verbal intelligence, a variable which has been found to be related to the amount of private speech used by young children (Berk & Garvin, 1984; Kohlberg et al., 1968).

RESULTS

No gender differences were found in children's use of private speech or in their task performance. Similarly, PPVT vocabulary scores were not correlated significantly with any of the performance or private speech measures. For this reason, gender and PPVT scores were not included in subsequent analyses.

Scaffolding and Private Speech

To test our first hypothesis, that children would be more likely to use private speech after scaffolding, the percentage of items after scaffolding and not after scaffolding which included relevant private speech, irrelevant private speech, and no speech was calculated. The top portion of Table 1 shows these percentages. Overall, there was no difference in the percentage of items which contained private speech after a success compared to after a failure—private speech occurred on 74.5% of the items following scaffolding and on 70.2% of the items not following scaffolding. Thus, at this global level, hypothesis one was not supported.

However, a different picture emerged after subdividing the subsequent items into successes and failures, which is shown in the lower half of Table 1. When children received scaffolding and then went on to succeed on the subsequent item, they used relevant private speech 74.3% of the time. Yet when children succeeded independently on one item and then succeeded on another, they used relevant private speech on the second item only 64.7% of the time. These differences were statistically significant (Z-test for the difference between two proportions, $Z = 2.22$, $p < .05$). Thus, when scaffolding was successful, in that it allowed the child to understand the task better and to get the next item correct, children consistently used private speech and more so than if they simply com-

Table 1. Percentage of Items Which Contained Item-Relevant Speech, Item-Irrelevant Speech, and no Speech After Succesful Items and Failed Items: Both Overall and by Subsequent Performance.

Overall	After Success (No Scaffolding) (714 items)		After Failure (Scaffolding) (196 items)	
	(%)		(%)	
Item-Relevant Private Speech	60.5		63.3	
Item-Irrelevant Private Speech	9.7		11.2	
Silence	29.8		25.5	
Subsequent Performance	**Success (569 items)**	**Failure (145 items)**	**Success (144 items)**	**Failure (52 items)**
	(%)	(%)	(%)	(%)
Item-Relevant Private Speech	64.7	44.1	74.3	32.7
Item-Irrelevant Private Speech	4.4	30.3	4.2	30.8
Silence	30.9	25.6	21.5	36.5

pleted several items correctly without the scaffolding intervention. When scaffolding was not effective in bringing the child to task competence in the next item, the three types of speech were equally distributed across the categories; 32.7% relevant speech, 30.8% irrelevant speech, and 36.5% silence.

Also evident from Table 1 are the situations in which silence was most common. As would be predicted by Vygotskian theory, children were most silent when they were either getting multiple items correct (30.9%) or when they were failing repeatedly (36.5%) as compared to when they were alternating between correct and incorrect answers (21.5% and 25.6%). When task competence has been achieved by the child, as indicated by successive correct items, private speech does seem to diminish while silence increases, and when the task is too difficult for the child, or outside the child's ZPD, as indicated by multiple failed items, silence becomes more common and private speech less prominent. This is clear evidence for a dynamic relationship between private speech and performance.

Part two of hypothesis one stated that during a successful item after scaffolding, children will be more likely to use private speech than to be silent. This was supported as can be seen in the lower right-hand corner of Table 1. After scaffolding, when children got the next item correct, they used item-relevant speech much more often (74.3% of the time) than when they were silent (21.5%), $Z = 8.97$, $p < .001$. The same pattern did not emerge after scaffolding when children failed on the subsequent item, as there was no difference between frequency of item-relevant speech and silence (32.7% and 36.5%, respectively).

The idea that private speech mediates the relationship between scaffolding and successful individual functioning also received support from the data. Hypothesis two predicted that children, after scaffolding, will be more likely to succeed on the next item if they talk to themselves than if they don't. This, in fact, turned out to be the case. Limiting the pool of item events to those which occurred after failure/scaffolding (196 items), 86.3% of the items which contained relevant private speech were successful, compared to 62% of the items with silence. Another way to state this is the following: If children talk to themselves after scaffolding, the probability of succeeding on the next item is .86, whereas if children do not talk to themselves, the probability of success is .62. This difference is significant ($Z = 3.55$, $p < .001$). After successful items (no scaffolding), the same relationship does not hold, as the probability of success when children talked to themselves (.85) was the same as that when they were silent (.83).

Age Trends in Private Speech and Performance. Table 2 shows the overall age trends (regardless of performance) for the number of silent items, number of items completed with relevant private speech, and the number of items completed with irrelevant private speech. These data were submitted to a one-way ANOVA with the number of items containing relevant speech as the dependent variable and the four age categories as the independent variable. As seen in Figure 1, the number of items in which children used relevant private speech differed systematically by age, $F(3, 36) = 2.7$, $p < .06$, and the pattern revealed an inverted U-shape over time, as would be expected from Vygotskian theory (quadratic trend $t(36) = -2.29$, $p < .05$). Thus, as predicted from hypothesis three, children's use of item-relevant private speech on this task peaks at ages 3.5 and 4 and is reduced for the youngest and oldest age groups.

Correspondingly, as can also be seen in Figure 1, the number of items in which children were silent differed by age, $F(3, 36) = 2.82$, $p < .05$, and the means form somewhat the opposite of the above trend—a U-shaped distribution with peaks at the outside ages. A quadratic fit to these means was only marginally significant, however, $t(36) = 1.95$, $p < .06$, giving only partial support to our second hypothesis. Also shown in Table 2 and Figure 1 is how the number of items in which children used irrelevant speech differed with age, $F(3, 36) = 2.78$, $p < .05$, but as

Table 2. Means (and Standard Deviations) of the Number of Items (Regardless of Performance) That Contained Item Relevant Speech, Item-Irrelevant Speech, and no Speech, by Age

	3 Year-Olds	3.5 Year-Olds	4 Year-Olds	4.5 Year-Olds
Item-Relevant Private Speech	13.6 (6.5)	19.3 (5.2)	15.0 (7.3)	10.4 (8.9)
Item-Irrelevant Private Speech	4.2 (3.1)	1.3 (3.4)	2.7 (1.9)	1.3 (1.5)
Silence	6.0 (7.0)	3.2 (4.3)	6.2 (7.0)	12.3 (9.6)

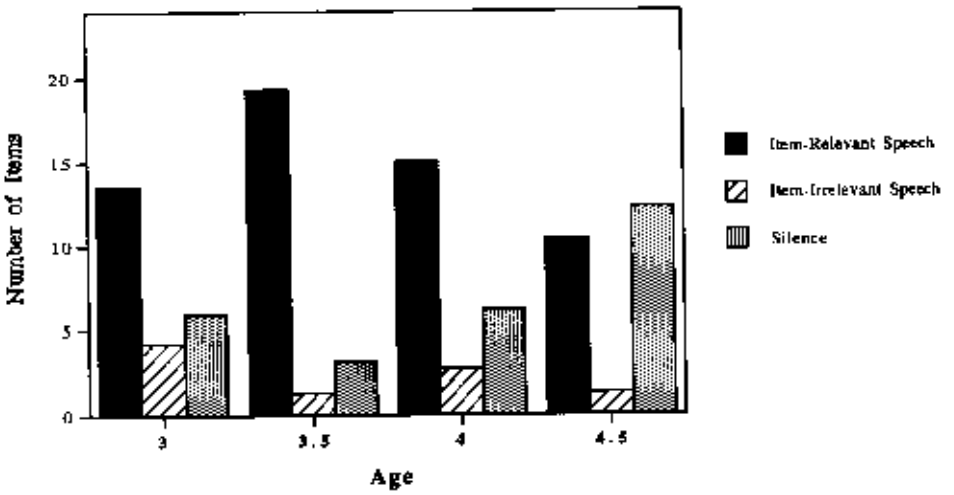

Figure 1. Total number of items with item-relevant speech, item-irrelevant speech, and silence, as a function of age.

can be seen in the figure, no particular linear or quadratic shape is evident. Fisher LSD post-hoc comparisons showed that the three-year-olds used more item-irrelevant speech than both the 3.5 and 4.5 year-olds.

Performance on the task improved with age, according to a one-way ANOVA with the number of successful items as the dependent variable and the four age categories as the independent variable, $F(3, 36) = 3.51$, $p < .05$. Means (and standard deviations) for the four age groups were as follows: (M age 3 = 16.1 (3.1), (M age 3.5 = 19.8 (4.2), (M age 4 = 18.1 (4.0), M age 4.5 = 20.9 (2.6). Fisher LSD post-hoc comparisons revealed that the three-year-olds were significantly different from both the 3.5-year-olds and the 4.5-year-olds. The Pearson correlation between age in months (as a continuous variable) and task performance was .43, $p < .01$. Looking microgenetically from the beginning of the task to the end, it was expected that children's performance on the task would increase toward the end of the items, possibly as a result of the scaffolding. A paired t-test of the number of correct items in the first half of the task (i.e., the first 12 items) and in the last half revealed that this was in fact the case (M First Half = 9.1 (2.0), (M Second Half = 9.7 (2.2), $t(39) = -2.25$, $p < .05$).

Private Speech and Task Performance. Overall, children used item-relevant private speech on more items than they did item-irrelevant speech. The mean number of items which contained relevant speech was 14.6 compared to 2.4 for items which contained only irrelevant speech (Paired t-test, $t(39) = 9.21$, $p < .0001$). Consistent with hypothesis four, relevant private speech occurred more often with successful items than with failed items. On average, 66% of subjects' successful items contained item-relevant private speech compared to 46% of failed items (Paired t-test – $t(39) = 3.47$, $p < .001$). Likewise, item-irrelevant speech co-

Table 3. Means (and Standard Deviations) of the Number of *Successful* Items That Contained Item Relevant Speech, Item-Irrelevant Speech, and no Speech, by Age

	3 Year-Olds	3.5 Year-Olds	4 Year-Olds	4.5 Year-Olds
Item-Relevant Private Speech	10.1 (5.1)	16.8 (6.1)	3.5 (3.9)	9.3 (8.1)
Item-Irrelevant Private Speech	1.5 (1.4)	.9 (2.5)	.8 (.8)	.3 (.5)
Silence	4.5 (6.2)	2.1 (2.5)	3.8 (4.5)	11.3 (9.3)

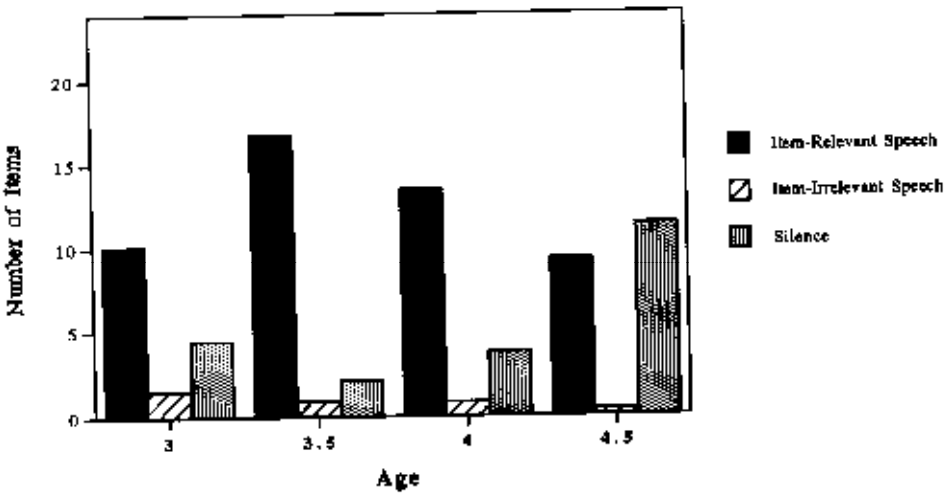

Figure 2. Number of successful items with item-relevant speech, item-irrelevant speech, and silence, as a function of age.

occurred with failure more often than success as 23% of subjects' failed items contained irrelevant speech compared to 1% of successful items (Paired t-test – t (39) = 4.81, $p < .001$). Silence was equally likely to occur in both failed (24%) and successful (29%) items.

As was the case with the relationship between scaffolding, private speech, and performance, a more interesting picture emerged when analyses were done separately for subsequently failed versus successful items. To see how the relationship between private speech and performance changes as a function of age, two, two-way repeated-measures ANOVAs were conducted, one for successful items and one for failed items. Age (4 levels - 3, 3.5, 4, 4.5) served as the independent variable in both models, with the repeated measure being the number of items which contained the three types of speech (relevant, irrelevant, no speech). Table 3 shows the means (and standard deviations) of the number of successful items which were accompanied by each of the three types of speech, for each of the four age groups. These data are also

Table 4. Means (and Standard Deviations) of the Number of *Failed* Items which Contained Item Relevant Speech, Item-Irrelevant Speech, and no Speech, by Age

	3 Year-Olds	3.5 Year-Olds	4 Year-Olds	4.5 Year-Olds
Item-Relevant Private Speech	3.5 (3.1)	2.5 (2.5)	1.5 (1.3)	1.1 (1.6)
Item-Irrelevant Private Speech	2.7 (2.2)	.4 (1.0)	1.9 (1.9)	1.0 (1.8)
Silence	1.5 (2.1)	1.1 (2.8)	2.4 (3.3)	1.0 (1.6)

visually represented in Figure 2. The key to this analysis was the significant interaction between age and the three types of speech/success events, F (6, 36) = 3.38, $p < .01$, which revealed that different developmental patterns exist for the three types of speech. Item-relevant private speech followed the predicted curvilinear pattern with such speech peaking at age 3.5 and becoming more internalized at the later ages (quadratic trend - t (36) = 2.60, $p < .01$), while silence with success followed the opposite course (quadratic trend - t (36) = 2.54, $p < .05$). The pattern for irrelevant private speech co-occurring with success was unremarkable in that it suggested a slight decrease with age but the trend was nonsignificant ($p < .09$).

Table 4 shows the same means (and standard deviations) as the previous table but this time for failed items. The overall repeated-measures ANOVA for failed items revealed that no particular age trends exist for private speech during failed items. Both the main effect for type of speech and the interaction between speech-type and age were nonsignificant. Thus the dynamic relationship between speech and performance is seen in this study only during items on which the child was successful.

DISCUSSION

This study examined the role of private speech in the development of task competence in young children. In particular, we hypothesized that private speech would serve as an important mediating tool in the transition from collaborative to independent problem solving. Also, we hypothesized that children's private speech would be related to task success. Substantial evidence was found in this investigation to support both of these hypothesized functions of speech. Support was also found for the age-related patterns of private speech use as suggested by Vygotsky. This study, with its novel methodology designed to overcome some of the problems of previous research, replicates and extends previous work in the area.

Evidence for the notion that the effect of adult scaffolding on children's cognitive performance is mediated by children's use of private speech was given by the finding that children were more likely to use private speech after scaffolding, and that children were more successful after scaffolding if they used relevant private

speech. These findings suggest that the movement from interpersonal collaboration to independent problem-solving involves children's active participation in taking over the regulating role of the adult collaborator. The suggestion here is that, in the development of cognitive functions, children use private speech to collaborate with themselves in much the same way that adults collaborate with children during joint problem solving. The fact that children were more likely to be successful after scaffolding if they used speech suggests that the path to individual task competence requires not only adult sensitive and contingent regulation, but also children's active participation, effort, and verbal self-regulation.

We also found evidence for the hypothesis that private speech is dynamically related to children's cognitive performance. Successful items were more often accompanied by task-relevant speech and least often accompanied by item-irrelevant speech. Also, the proportion of successful items accompanied by private speech was significantly higher than the proportion of failed items accompanied by such speech. These findings replicate a number of recent studies that document the positive effects of private speech on cognitive performance (Azmitia, 1992; Bivens & Berk, 1990; Gaskill & Diaz, 1991). However, the fact that we found such a positive relation independent of speech frequency and correlational analyses constitutes an important source of replication. This study, in conjunction with others over the last ten years, shows that private speech is intimately and dynamically related to preschool children's task performance and that speech may constitute an effective cognitive tool for the development of task competence.

The selective attention task used in this study showed promise for studying both private speech and the relationship between speech and performance. This task required children to selectively restructure their perceptual field by focusing on a given relevant dimension while actively inhibiting attention to the other. The fact that 95% of the children emitted some form of private speech during the task and that speech appeared on 71% of the items suggests that speech spontaneously emerged as a natural cognitive problem-solving tool for the children in this study. Previous work has shown that private speech usage in young children varies as a function of both type of task and task difficulty (Behrend et al., 1989; Frauenglass & Diaz, 1985), in that private speech is maximized when children are engaged in cognitive problem-solving or goal-directed activities which are of intermediate levels of difficulty. The selective attention task used in the present study proved to be of this type, that is, within the children's zone of proximal development by being appropriately challenging and showing no signs of floor or ceiling effects.

One of this study's contributions is the fact that it introduced a number of novel methodological strategies for investigating private speech and performance, including (1) analyzing speech-item correspondence rather than frequency of private speech and global task performance, (2) conducting item-level rather than subject-level analyses, (3) exploring developmental trends separately both for type of speech (item-relevant speech, item-irrelevant speech, and silence) and performance outcome (successful vs. unsuccessful items), and (4) examining changes in speech-performance relations microgenetically, item by item, as children work on one task. It is too early to tell, with just this one study, the extent to which these

methodological innovations will advance research in this area. However, the results from this investigation are encouraging and, at a minimum, suggest that more empirical work is needed along these lines. For example, the microgenetic approach taken in this investigation was somewhat limited in that it only explored performance on one item relative to performance on the immediately preceding item. Subsequent investigators may wish to look at the relationship between private speech and performance throughout an entire multiple-item task, with analyses exploring more than a one-item time lag. In concert with more detailed microgenetic analyses, longitudinal studies are also needed in order to further test the hypotheses advanced here that private speech serves as an important mediating variable or mechanism through which adult teaching, collaboration, and scaffolding have their effect on children's learning and development.

Some of the more provocative findings of the study were those concerning developmental trends in private speech use and how these varied by type of speech and item outcome. Item-relevant private speech during successful items followed the expected curvilinear pattern with age, with such speech increasing and peaking at about age 3.5 and then decreasing. Silence during successful items also showed the expected U-shaped curvilinear relationship with age, peaking at the two ends of the age spectrum. Interestingly, the same age-based relationships did not hold for speech during unsuccessful items.

Although more research is clearly needed in order to provide a truly satisfactory interpretation of these findings and to make sure that they are not simply an artifact of study design, this pattern of results is likely related to the fact that children in this study were in a scaffolding situation. One possibility is that children need to be in their zone of proximal development, that is, succeeding on challenging tasks with the sensitive assistance of others, in order for Vygotsky's hypothesized developmental patterns of speech use to appear. Also, children who were still unsuccessful on task items in the context of scaffolding might have felt like they should be performing better and as a result negative motivational and arousal factors could have come into play to interrupt the relationship between speech and performance. Finally, a certain amount of task knowledge might be necessary in order for the dynamic interplay between speech and performance to occur. That is, in order to make effective use of self-regulatory strategies toward attaining a goal, one may have to be relatively certain of what the goal/task is and have a reasonable expectation of being able to achieve the goal (Ford, 1995).

Two important limitations of the present study should be addressed in future research. First is the fact that detailed content and process analysis of the quality of the experimenter–child scaffolding was not conducted. To fully understand the dynamic processes by which children appropriate intrapsychological tools from interpersonal collaboration, deeper analyses of the discourse processes and interpersonal dynamics which take place during naturally occurring adult–child scaffolding interactions will have to be explored. Berk and Spuhl (1995) have recently provided one example of how this might be done. The second limitation is the fairly restrictive manner in which private speech was coded in the present study (i.e., item-relevancy based only on mention of the perceptual dimension of the cor-

rect answer). Subsequent studies in the area may do well to explore more inclusive or exhaustive speech coding systems.

Implications of the present study for early childhood educators and parents are numerous. First, it is clear that preschool children do use private speech for self-regulation during problem-solving activities and that this self speech plays an important role in children's cognitive and behavioral development, their learning from instruction, and their mastery of cognitive tasks. Adults who work with children of this age should understand that private speech serves an important self-guiding function, that it represents a way for young children to appropriate task responsibility from adults during teaching/collaborative interactions, and that such speech helps children learn, construct, and internalize verbal problem-solving strategies. For these reasons, private speech use by young children in the classroom and at home at a minimum should not be suppressed, and at a maximum, should be actively encouraged by adults (Berk & Winsler, 1995). Over time, through repeated, successful use of language for problem-solving, children's overt private speech will be internalized and, as a result, children will be better able to regulate their own learning, thinking, and behavior both inside and outside of the classroom.

Second, children's private speech offers early childhood professionals an excellent window for observing and understanding the developing mind of the young child. Parents and preschool teachers can listen to the private speech of their children not only to learn how children are thinking about and solving problems but also to assess the effectiveness of adult teaching and the degree to which tasks and activities are appropriately challenging for children. One potentially useful rule of thumb to use would be: If a child is using task-relevant private speech while engaged in a goal-directed activity, then the child is functioning within his or her zone of proximal development, sufficiently challenged as to require the use of overt verbal self-regulation, yet not overly taxed as to lead to disengagement.

Finally, although not specifically addressed in the present study, adult–child teaching/interaction styles are known to vary in the degree to which they promote children's use of private speech (Behrend et al., 1989; Berk & Spuhl, 1995; Berk & Winsler, 1995; Winsler, 1995). Warm, nondirective, highly verbal, responsive scaffolding has at least four distinctive features: the adult (a) engages the child in joint collaborative goal-directed activity, (b) carefully modifies task demands and adult assistance to keep the child working at an appropriately challenging level, (c) contingently withdraws adult control/assistance as the child's independent problem-solving ability increases, and (d) uses leading, conceptual questions and verbal problem-solving strategies as the primary form of teaching. These adult strategies serve to maximize children's use of private speech both during collaborative, dyadic sessions and during subsequent individual problem-solving. The neo-Vygotskian construct of scaffolding (Berk & Winsler, 1995) can be used as a new, powerful, and developmentally appropriate model for the early childhood classroom.

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