The relation between private speech and cognitive performance

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Abstract

Studies of children's private speech have generally failed to find positive relations between children's spontaneous use of private speech ad their task success or performance. This pattern of negative findings has challenged and questioned the validity of Vygotsky's theory regarding the self-regulatory functions of language. In the present study we hypothesize that positive private speech-performance correlations can be found when such relations are: a) stated in terms of specific speech categories and specific performance variables, b) analyzed controlling for task difficulty, and c) assessed on task improvement over time. Thirty preschoolers, ages 3-5, were videotaped while performing classification, block design, and puzzles with distractor tasks at two points in time. Their spontaneous verbalizations during the tasks were transcribed and co-ded into different categories of self-regulatory private speech. The results show that, when the above methodological constraints are applied, the spontaneous verbalization of labels and des-criptions strongly predicts improvement in a classification task over a two-day period. The use of private speech, however, failed to predict other aspects of performance, such as time on task or speed of transition between items.

Keywords: *Private Speech.*

Relaciones entre habla privada y ejecución cognitiva

Resumen

En la mayoría de estudios que se han realizado hasta el presente, no se ha podido compro-bar con certeza la propuesta Vygotskiana sobre el efecto que tiene el habla privada en la rea-lización eficaz de diferentes tareas. En este estudio proponemos que tres problemas metodoló-gicos han impedido el estudiar los efectos del habla privada en la actividad cognoscitiva de los niños. Primero, la relación entre habla y tarea se ha buscado en una forma demasiado amplia y global, sin tomar en cuenta funciones específicas del habla privada con respecto a diferentes aspectos más específicos de las tareas. En segundo lugar, los estudios anteriores no han tomado en cuenta el efecto que tiene la dificultad de la tarea; tareas de mayor dificultad aumentan el uso del habla privada pero al mismo tiempo disminuyen la posibilidad de una ejecución eficaz. Finalmente, la mayoría de estudios no han examinado el efecto que tiene el habla privada en una ejecución futura o posterior de la tarea; posiblemente, el mayor efecto del habla privada se puede descubrir en una mejora gradual en la realización de diferentes tareas. El presente estudio demuestra que, cuando se toman en cuenta estos tres problemas metodológicos, se pue-de observar una relación positiva entre el uso del habla privada y la mejora en tareas de cla-sificación realizada por niños entre tres y cinco años de edad.

Palabras clave: *Habla privada.*

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INTRODUCTION

According to Soviet developmental theory (Luria, 1961, 1982; Vygotsky, 1962, 1978) young children use language not only to communicate, but also to guide, plan and monitor their own activity. The use of language as a tool of thought, the theory states, frees children from the salience of the inmediate context or concrete visual field, allowing a more purposeful, planned and reflective course of action. Furthermore, Vygotsky (1978) proposed that the use of language from self-regulatory purposes transforms the course of a child's cognitive development, giving «birth to the purely human forms of practical and abstract intelligence» (p. 24).

In recent years, Western investigators have tested different aspects of Soviet theory in both laboratory and classroom settings, confirming the fact that children do indeed use self-regulatory private speech in the context of goal-directed and problem-solving activity (see e. g., Berk & Garvin, 1984; Frauenglass & Díaz, 1985). Studies have also found that private speech is consistently related to the child's cognitive activity in both its content and timing, that is, the majority of children's private speech is *about* the task and is more likely to occur in moments of transition and special difficulty¯ (Goodman, 1981).

In a large number of studies, however, the spontaneous use of self-regulatory language is not clearly related to success in the cognitive tasks and, in some cases, the frequent use of private speech is negatively related to the outcome of a child's performance (Frauenglass & Díaz, 1985; Yaeger, 1968; Zivin, 1972). Needless to say, these negative findings have tempered the enthusiasm for Vygotsky's insights regarding the significance and function of private speech in a child's cognitive development. Studies that have shown positive effects of private speech on behavior have involved, for the most part, experimenter-given and induced speech in the form of self-instructional strategies, rather than children's spontaneous production of private speech (see e. g., Balamore & Wozniak, 1984). We believe that such evidence, although important, is not suffi-

cient to support Vygotsky's claims on the relation between children's spontaneous private speech and cognitive activity. The present study explores this issue in the empirical literature, proposing that, if certain methodological problems are taken into account, it is possible to find functional relations between the spontaneous use of private speech and cognitive performance.

PRIVATE SPEECH AND COGNITIVE PERFORMANCE

Even though not all students of Soviet theory expect a positive relation between the use of private speech and success in cognitive tasks (see e. g., Frawley & Lantolf, 1986), it is clear that Vygotsky hypothesized a functional relation between the child's speech and her ongoing activity (Díaz, 1986b). By *functional relation* we mean that, according to Vygotsky, the child's utterances during a given task are not merely an accompaniment or epiphenomenal to the task; rather, the utterances are seen to affect the course and eventual outcome of the child's activity. In fact, Vygotsky's most famous anecdotal example of a child's private speech illustrates how the child's words, *«it's broken»* (in response to a broken crayon), led the child to draw a *broken* car (1962, p. 17). In addition, Vygotsky clearly stated that the use of private speech «can be useful in the solution of the task» (1978, p. 26). We believe that, in order to support Vygotsky's propositions, investigators must show that the spontaneous use of private speech predicts differences in performance or different behavioral outcomes during a given task.

In the majority of cases, as pointed out in Fuson's (1979) comprehensive review, researchers have not shown the expected positive relation between the use of private speech and cognitive performance variables. Five studies reviewed by Fuson, where both spontaneous private speech and performance variables were measured, presented inconsistent, and at times puzzling, findings. Pechman (1978) found large (.62-.87) significant correlations between private speech emited in classroom

settings and achievement test scores, while Dickie (1973) and Beaudichon (1973) reported small and mostly nonsignificant positive correlations between private speech utterances and task performance. Zivin (1972) and Yaeger (1968), on the other hand, reported negative correlations. In Zivin's study, for example, silent children performed faster and more accurate in finger mazes than children who emitted any kind of private speech during the tasks. A most puzzling finding was reported by Beaudichon (1973): Children instructed to «think aloud» talked less and performed better than noninstructed children!

Unfortunately, more recent studies have continued to present an inconsistent set of findings regarding the effects of private speech on cognitive performance. For example, in Goodman's (1981) study, children's self-regulatory speech was positively related to faster puzzle solution times. In contrast, Frauenglass & Díaz (1985) reported higher performance acores on both semantic and perceptual tasks for children who talked less during the tasks. In short, it is clear that the present pattern of findings does not allow us to distinguish between three possible alternative hypotheses: a) the use of self-regulatory language, as predicted by Vygotsky, facilitates performance, b) self-regulatory speech has an interfering effect on the child's problem-solving activity, and c) self-verbalizations are epiphenomenal to the child's activity and do not affect the outcome of a child's performance. A first step in support of Vygotsky's theory would be to show, with some consistency, a set of positive correlations between the spontaneous use of private speech and behavior or performance variables. In the present study, we hypothesize that such pattern of findings in support of Vygotsky's theory can be obtained if, as discussed below, certain methodological constraints are put into effect.

METHODOLOGICAL ISSUES

A careful review of the private speech literature shows that the search for speech-performance correlations has been limited on three accounts: a) the majority of studies have sought speech-performance relations at a very gross and global level, b) most studies have not controlled for the effects of task difficulty in the analyses, and c) researchers have looked for inmediate effects of private speech on task performance at one point in time, rather than on task *improvement* over time. Let us discuss these problems with some detail.

Global versus specific relations. Systematic observations of the *content* of children's private speech suggest that such language could be used for multiple *functions* during task performance (see e.g., Díaz, 1986a; Díaz & Padilla, 1985). In these studies, content refers to what the utterance is about; function refers to the utterance's possible effect on the child's ongoing behavior or performance. Analyses of private speech content reveal that, during a given task, children label and describe materials, verbalize plans, goals and instructions, emit transitional statements at the end of discrete items or problem-solving steps, praise themselves for given accomplishments, and so forth. These different kinds of statements suggest different possible functions or effects on the ongoing activity. For example, labeling could facilitate selective attention to different features or dimensions of a task, transitional statements could lead to a more efficient pace and faster transitions from item to item, questions and answers about a task could facilitate sustained attention and engagement on the task, to name a few. In this context, postulating global relations between total amount of private speech and overall performance might be seriously misleading. In the present study, therefore, we hypothesized that speech-performance relations can be found when the relations are specified in terms of specific types of utterances and specific behavioral outcomes, where the content of an utterance and its hypothesized function are conceptually and meaningfully related.

The effects of task difficulty. A consistent finding in the private speech literature is that the frequency of private speech increases as a function of task difficulty (see reviews by Berk, 1985 and Fuson, 1979). In addition, and not surprisingly, task difficulty increases the likelihood of task failure or decreased performance sco-

res. As stated in Frauenglass and Díaz (1985), when these two facts are taken into account, the expectation is that private speech should more often co-occur with failure than with task sucess. In other words, speech-performance correlations are affected by task difficulty as a third-variable confound. By increasing both the amount of private speech and the likelihood of failure, task difficulty might mask the positive effects of such speech on task performance. In the present study, we hypothesized that speech-performance correlations could be found more reliably when a measure of task difficulty is partialed out from the analysis.

Improvement versus Performance. In line with Vygotsky's theoretical statements, we should expect that the transformation of preverbal problem-solving skills into verbal thinking with the use of private speech is a relatively slow and gradual process. The effects of using private speech during a cognitive task, therefore, might not be evident at the time that such speech is being used. Examining the relation between private speech and performance within the time period of a given task, may be analogous to measuring the performance of a child learning to walk. His playmate, who still enjoys crawling, will beat him to the cookie jar every time. But we do not conclude that crawling is better than walking, since we know that *attempting* to walk is positively related to *future* success. In the present study, therefore, we hypothesized that the effects of private speech can be found most reliably on a child's task improvement over time rather than on individual differences in performance at a given point in time.

THE PRESENT STUDY

In the present study we propose a simple regression equation to assess the effects of private speech on performance variables that takes into account the three methodological issues discussed above. First, the equation examines relations between utterances of a specific content and specific behavioral outcomes. Second, using *hierarchical* regression techniques, the proposed analyses partial out and control for the effects of task difficulty. Fi-

nally, by measuring both private speech and performance variables at two points in time within a two-day period, the equation assesses their relation across time, allowing for an analysis of private speech on task improvement over time.

More specifically, the following regression equation was used to analyze the effects of private speech on task improvement, controlling for task difficulty:

Performance Score = Performance Score + Private Speech
(at Time 2) (at Time 1) (at Time 1)

where «Performance Score at Time 1» is the measure of task difficulty and is entered first in the hierarchical equation. Performance scores at Time 1 were chosen as the best available measure of task difficulty for two major reasons: a) the difficulty of a task cannot be adequately defined or measured as an objective property, without taking into account the child's ability to perform the task, and b) the way the children performed the tasks the first time around was our best estimate of how difficult the task was for each child, relative to the other children in the sample. An important feature of the above equation is that, once the variance due to performance scores at Time 1 is taken out of the analyses, the leftover systematic variance in performance scores al Time 2 can be attributed to children's improvement on the task over the two day period. In other words, we claim that by examining the effects of private speech at Time 1 on task performance at Time 2, while partialing out performance scores at Time 1, we take care of two methodological constraints at once: 1) We control for the effects of task difficulty in the speech-performance relation, and 2) We examine the effect of private speech on task improvement across time.

Using this paradigm, three specific hypotheses were tested:

1. Children's spontaneous labels and verbal descriptions of the task materials will predict improvement in tasks requiring semantic classification of familiar objects. We postulated that, through labeling and descriptions, children will focus on the distinctive features and relations between the different objects to be classified. Labels and descriptions, therefore, should

predict a measurable improvement in classification skills.

2. Children's spontaneous use of questions and answers about the task should promote the development of sustained attention by helping the child focus on the task and inhibit possible sources of distraction. Our observations of private speech in the past (see e.g., Díaz, 1986) have shown that children use a question-answer dialogue form in their spontaneous verbalizations about the task: «Where does the cow go?... Oh, right here!» We believe that a possible function of this dialogue with the self is to keep the child actively engaged and focused on the task. We hypothesized, therefore, that the use of questions about the task in private speech should predict improvement in on-task-behavior (or time-on-task, sustained attention), especially in the presence of distractors.

3. Finally, we predicted that children's use of transitional statements (such as «o.k., I'm done, let's see what's next») would help children develop the ability to go from item to item efficiently and rapidly without adult intervention. We hypothesized, therefore, that the use of transitional statements predicts an improvement in inter-item latency time, that is, a decrease in the amount of time spent between the individual items of a given task.

In addition to the three hypotheses stated above, the study observed changes in private speech over the two-day period. As suggested by Vygotsky's theory, it was expected that the amount of private speech would decline with time, while the number of whispers would increase, indicating that private speech becomes internalized with increasing competence on a given task. Furthermore, since the theory states that private speech is used to meet the difficulty of a given task, it was hypothesized that children who improved the most on the tasks would show the greatest decline of private speech over the two-day period.

METHOD

Subjects

Thirty preschoolers, ages 3-5 and a mean mental age of 4.5 (range 2.5-8.1)

years as measured by the PPVT, were selected from several preschool daycare facilities in the Albuquerque area. The ethnic composition of the sample reflected New Mexico's population: 22 Anglo, 1 Black, 5 Hispanic and 2 Native American children; all children in the sample, however, were native speakers of English. The sample included 17 girls and 13 boys.

Procedure

Children in the sample were administered there different tasks designed to elicit private speech: A classification task, a block design task and a puzzle task with a distractor. Each child was randomly assigned to the six possible orders of task presentation, so that each possible sequence of task presentation was equally represented. After brief instructions (described below in the *Measures* section) and the completion of two sample items, children were instructed to work on their own and do as many items as they could for a period of five minutes, and also to stop working at the sound of a timer bell. Following Frauenglass & Díaz's (1985) recommendation, children were told that they could talk all they wanted during the tasks. These procedures were followed similarly for each of the tasks. All children were videotaped while working on the tasks, while the experimenter was sitting a few feet away with his back turned against the child. Children worked individually in a space created by a partition within the larger preschool room, where background noise of children at work and at play could be heard. Two days after the first administration of the tasks (Time 1), children were administered the tasks a second time (Time 2), following the same assigned order and procedures as in Time 1. A few days later, a separate session was arranged to administer the Peabody Picture Vocabulary Test (PPVT) to each child individually.

Measures

Classifications Skills. In order to measure children's classification ability, children were asked to classify cards into meaningfully related pairs. The task included

8 envelopes, each containing a set of five cards. Only four cards of each set could be classified into two meaninfully related pairs, the other card had to be set aside as nonrelevant. All the classifiable pairs in the task could be classified according to a relationship of the general form: agent X uses object Y. For example, a typical envelope contained five cards portraying: 1) a baseball player, 2) a mechanic, 3) a policeman, 4) a wrench, and 5) a baseball bat. For each correctly classified pair, children received 1 point for a possible maximum total score of 16.

Inter-Item Transition Time. In order to measure time spent between individual items, children were given a block design task containing 12 cards with pictured designs and a set of colored blocks to match the designs. Children had to work on their own, copying with colored blocks the pictured designs, moving on to the next card once a given design was finished. The amount of time spent between the items was measured with a stopwatch from the videotapes. Specifically, inter-item transition time was defined as the time between leaving a finished design aside and taking the card with the next design.

Sustained Attention. Sustained attention was defined as the total amount of time gazing at a puzzles task, within the five-minute allotted period. Children were given a set of puzzles of age-appropiate level of difficulty. Children were asked to do as many puzzles as they could and avoid looking at a distractor set of slides situated on the near left of the child at a 90 degree angle. They were told that they could see all the slides after they finished the puzzles. Such instructions were given in order to make clear that the task was to complete the puzzles, while the slides were indeed distractors that they should try to avoid attending to. Distractor slides portrayed different attractive animal and zoo scenes that were projected continuously with an audioviewer. With a stopwatch, the amount of time looking at distractor slides or away from the puzzles was measured from the videotapes. Sustained attention was computed as five minutes minus time spent looking away from the task.

Private Speech Categories. In order to

test the three specific hypotheses outlined above, children's speech emitted during the task was transcribed from the videotapes and categorized first as social or private speech. Social speech was defined as speech inmediately preceded, accompained or inmediately followed with a gaze towards the experimenter (see Frauenglass & Díaz, 1985, for further details on defining and categorizing private speech units). All other speech not obviously directed at the experimenter was classified as private. From the private speech protocols the number of items under the following categories were counted for each child: 1) *Labels and descriptions of materials* (e.g., «The man is going to work», «Mailman, letter»); 2) *Transitional statements,* (e.g., Another one», «O.K., I'm done... what's next?»), and 3) *Questions about the task,* (e.g., «Where does this one go?» «Is this the right one?»). In addition, for the sake of more global analyses, private speech was also classified as task-relevant, task-irrelevant and whispers.

RESULTS

Speech and Performance Changes over Time

Table I shows means and standard deviations for all speech and performance measures in the study at both points in time. As expected, children in the sample showed some improvement in all performance measures over the two day period. However, only the improvement in classification scores was statiscically reliable [$t(28) = 2.44$, $p < .02$]. There was a decline over time in the amount of private speech emitted, except for whispers which showed a slight increase. Only questions about the task, however, showed a statistically significant decline over the two day period [$t(28) = 2.58$, $p < .01$].

Even though the overall decline in private speech and the increase in whispers were slight and nonsignificant, possibly due to the short period of time between testing sessions, the obtained pattern of changes over time suggests that private speech tends to diminish with increasing competence and mastery of a given task.

TABLE I

Means (and standard deviations) for speech and performance variables at both times of testing

Speech variables	Time 1	Time 2	t	p
Labels and description	3.96 (6.39)	2.86 (5.01)	1.04	n.s.
Transitional statements	.90 (1.72)	.45 (.83)	1.56	n.s.
Questions	.38 (.78)	.03 (.18)	2.58	<.01
Task relevant speech	6.21 (8.81)	4.11 (6.05)	1.45	n.s.
Whispers	6.83 (6.80)	7.96 (7.27)	.91	n.s.
Task-irrelevant speech	.86 (2.69)	1.76 (3.51)	1.43	n.s.
Performance variables	**Time 1**	**Time 2**	**t**	**p**
Classification	6.43 (4.38)	7.70 (4.99)	2.44	<.02
Inter-item transition Time (in seconds)	21.78 (22.78)	20.15 (19.93)	.94	n.s.
Time on task (in seconds)	275.10 (21.54)	280.93 (39.18)	.76	n.s.

In order to test this possibility, the sample was divided into high and low improvement groups with a median split, according to the amount of improvement observed in the different tasks. Improvement was defined as the difference between Time 2 and Time 1 scores in the tasks.

First, the effects of classification improvement on the decline of private speech over time was tested in a 2 × 2 ANOVA with factors IMPROVEMENT (high vs. low) and TIME (T1 vs. T2), where TIME was a repeated measures factor and the amount of private speech emitted the dependent variable. A significant effect of classification improvement was found [$F (1,27) = 6.95$, $p<.01$], indicating that children who improved the most in the classification task emitted more private speech overall. As hypothesized, there was an improvement by time interaction [$F (1,27) = 4.02$, $p<.05$] indicating that, for children whose classification scores improved the most, their private speech declined more sharply over the two day

period. The same pattern of decline was not found, however, when improvement score for time on task or transition time were used as independent variables. Considering that the hypothesized effect was found only for the classification task, and that the interval between times of testing was relatively brief, the decline of speech over time as a function of task improvement must be considered with caution and only as suggestive for further research on the changes of private speech over time.

Private Speech as Predictor of Task Performance and Task Improvement

Through the use of hierarchical multiple regression equations it was possible to investigate the effect of private speech on both performance at one point in time and on task improvement over the two day period. As stated earlier, the following equation was used to test the effects of private speech on improvement:

TABLE II

Effects of private speech on task performance (within time) and task improvement (across time)

1. **Label and descriptions on classification**
   A. (across time) $\Delta R^2 = .10$ $F = 11.36$, p<.001
   B. (within time) $\Delta R^2 = 0,07$ $F = 6.88$, p<.01

2. **Transitional statements on inter-item transition time**
   A. (across time) $\Delta R^2 = .003$ F<1, n.s.
   B. (within time) $\Delta R^2 = .001$ F<1, n.s.

3. **Questions on time on task**
   A. (across time) $\Delta R^2 = .006$ F<1, n.s.
   B. (within time) $\Delta R^2 = .002$ F<1, n.s.

A) Performance = Performance + Private Speech

(at Time 2)   (at Time 1)   (at Time 1)

In addition, by using Private Speech at Time 2 rather than Private Speech at Time 1 as the predictor, as in the following equation:

B) Performance = Performance + Private Speech

(at Time 2)   (at Time 1)   (at Time 2)

the effects of speech on performance at one point in time (i. e., at Time 2) could be also assessed. Note that in both equations A and B Performance at Time 1 is entered first in the equation as a measure of task difficulty. The effects of private speech can then be determined by examining the changes in R square produced by entering private speech as a predictor.

Table II shows the changes in R square for private speech as a predictor of task improvement (across time) and task performance (within time), testing the three hypothesized specific relations between private speech and performance. Neither transitional statements nor questions about the task predicted any significant portions of the corresponding performance variance. The failure to show significant effects could be due in part to the fact that neither transition time nor time on task showed significant improvement during the short duration of this study, and also

to the fact that the actual amount of private speech emitted under these categories of speech was considerably lower than speech emitted under the *labels and descriptions* category.

On the other hand, labels and descriptions of the task predicted significant portions of both the performance variance on classification within time (delta R square = .07, F = 6.88, p<.01) and the improvement variance across time (delta R square = .10, F = 11.36, p<.001). Note that, as hypothesized, the predictability of private speech on classification performance increases substantially when improvement, rather than performance at one point in time, is used as the criterion.

In order to further investigate the effects of private speech on performance and test the three main hypotheses of the study, children were divided into high and low private speech groups with a median split, according to the number of utterances emitted at Time 1 under the three different private speech categories. The effects of private speech on performance variables was tested in a 2 × 2 ANOVA design with factor PRIVATE SPEECH (high vs low) and Time (T1 vs T2), where TIME was a within-subject factor and performance measures the dependent variables. Three ANOVAS were done to asses separately the effects of private speech on classification scores, time on task, and transition time. Table III shows the means and standard deviations for the variables tested in these analyses.

TABLE III

Means (and standard deviations) of performance variables and both points in time for high and low speech groups

		Time 1	Time 2
1. *Dependent variable: classification scores*			
Labels and descriptions	High	7.71 (4.27)	10.36 (4.50)
	Low	5.67 (4.18)	5.73 (4.18)
2. *Dependent variable: inter-item transition time in seconds*			
Transitional statements	High	15.6 (6.85)	13.80 (6.80)
	Low	25.73 (26.85)	23.17 (18.90)
3. *Dependent variable: time on task in seconds*			
Questions	High	271.86 (22.51)	286.00 (10.86)
	Low	275.54 (22.01)	278.95 (45.51)

As in the multiple regression analyses, no significant effects were found for the transition time and time on task measures. However, a close inspection of the means reported in Table III indicates several trends in the predicted direction. For example, on the average, inter-item transition times were approximately 10 seconds faster for children who emitted a higher number of transitional statements. In addition, time on task increased approximately 15 seconds for children who emitted a higher number of questions about the task, while only about 3 seconds for children in the low questions group.

On the other hand, a very strong statistical relation between private speech and classification skills was found. A significant TIME main effect was found [$F_{(1,27)} = 7.30$, $p<.01$], indicating a significant increase in classification scores over time. Also, a significant Private Speech main effect was found [$F_{(1,27)} = 4.84$, $p<.05$], indicating that children who emitted more labels and descriptions obtained overall higher classifications scores. And, as hypothesized, a significant and strong PRIVATE SPEECH by TIME interaction was found

[$F_{(1,27)} = 7.05$, $p<.01$], indicating that children who emitted more labels and descriptions during the classification task at Time 1 improved the most on the task.

Increasing the Predictability of Private Speech

In the present study we hyothesized that by applying several methodological constraints, it was possible to show significant effects of private speech on children's task improvement over time. The constraints included: a) hypothesizing specific instead of global speech-performance relations, b) controlling of task difficulty in the analyses, and c) assessing the effects of private speech on inprovement over time. The results reported above, however, do not clearly specify the independent effects of each methodological constraint on the speech-performance relation. The question remains as to which paradigm or set of constraints maximizes the predictability of private speech on cognitive performance.

In order to answer this question, the effects of applying one constraint at a time was examined on the speech-performance

TABLE IV

Increasing predictability of private speech on classification skills as a function on methodological constraints

Hypothesized Relation

	Pearson r within time	Pearson r across time	Control for difficulty within time[a]	Control for difficulty across time[b]
GLOBAL (Total private speech as predictor)	Time 1: $r = -.07$, n.s. Time 2: $r = -.01$, n.s.	$r = .18$, n.s.	$\Delta R^2 = .003$ $F<1$	$\Delta R^2 = .06$ $F = 5.13$, p.<.05
SPECIFIC (Labels & descriptions as predictor)	Time 1: $r = -.08$, n.s. Time 2: $r = -.08$, n.s.	$r = .26$, n.s.	$\Delta R^2 = .07$ $F = 6.88$, p<.01	$\Delta R^2 = .10$ $F = 11.34$, p<.001

[a] equation used: performance T2 = Performance T1 + Private speech T2.
[b] equation used: Performance T2 = Performance T1 + Private speech T1.

correlation, using the classification task as an example. Table IV reports the results of these analyses. As can be seen in the table, the Pearson correlations between private speech and cognitive performance at both points in time are nonsignificant and in the negative direction, a finding that is common in the private speech literature. Interestingly, the correlation coefficient did not change dramatically or achieved significance when the specific and meaningfully related category of private speech was used. Relating private speech and performance across time augmented and changed the correlations to the positive direction. However, both specific and global relations across time failed to reach statistical significance with this manipulation.

When the measure of task difficulty is controlled for (using equation B, above) the relationship between speech and performance increases and achieves significance for the specific type of speech. This finding suggests that the positive effects of private speech on performance can be seen within time for specific relations, as long as the difficulty of the task is controlled for in the analyses. However, as evidenced by the changes in R square and the corresponding F values, the paradigm that maximizes the predictability of private speech on performance variable is one that simultaneously applies the three constraints mentioned above. A change in R square of .10 as a function of private speech is quite impressive, considering that the control variable (i.e., classification at Time 1) predicted on its own 65 % of the variance in the equation. Since only 35 % of the remaining variance in classification scores at Time 2 could be attributed to improvement, the above finding indicates that private speech accounted for almost one-third of the improvement variance in the classification task. Such impressive contribution of private speech to children's classification improvement, obtained with the proposed regression equation, is certainly not evident in the nonsignificant negative correlations that are usually reported in the current literature.

DISCUSSION

The present study investigated the relation between spontaneous private speech and cognitive performance, proposing and applying three important methodological constraints. It was hypothesized that, in order to assess private speech-performance correlations, investigators must: a) state relations between specific private speech categories and meaningfully-related specific behavioral outcomes, b) con-

trol for task difficulty in the analyses, and c) assess the effects of private speech on task improvement over time. When these methodological issues were taken into account, the present investigation revealed a strong relation between children's spontaneous labeling and descriptions and their semantic classification skills. Specifically, private speech was positively related to performance at one point in time when the relation was stated in terms of specific categories of private speech and performance, and when the task difficulty was controlled for in the analysis. However, the relation became even stronger when improvement over time, rather than performance at one point in time, was the predicted variable. Children's spontaneous verbalizations predicted close to one-third of the improvement variance in the classification task when the three methodological constraints were applied simultaneously.

Even though causality cannot be appropriately inferred from correlational data, these findings provide some support to Vygotsky's (1962, 1978) notion that private speech is not merely an accompaniment to the child's activity, but rather affects and transforms the outcome of such activity. Further support for Vygotsky's theory was found in the patterns of change observed over time: a) private speech declined, b) whispers increased, and c) the decline in private speech over time was more pronounced for children who improved the most on the task. Even though further research is needed to reliably verify these changes in private speech over time, the findings suggest that overt private speech might serve important functions in the early development of strategies and skills, and then becomes subvocal or disappears with increasing mastery.

Not all the hypothesized relations between private speech and behavioral outcomes were supported by the data. Specifically, even though the observed trends were in the right direction, no significant effects of private speech were found on inter-item transition times nor on the measure of sustained attention. Two alternatives should be considered when explaining these negative findings. First, the negative findings might be due to the follo-

wing two facts: a) children actually emmitted very few questions and transitional statements, and b) these two measures failed to show reliable improvement over the two-day period. A second possible explanation, however, is that private speech plays a major role only in tasks involving higher levels of semantic organization (Frauenglass & Díaz, 1985), while only minimally affects nonsemantic skills such as speed and distractability. This second possibility merits further investigation considering the fact that training self-verbalizations is frequently the treatment of choice for impulsive children (Kendall & Braswell, 1985).

It should be clear that to show a positive relation between private speech and cognitive performance represents only a first step in the understanding of the issues at hand. The question remains, for example, as to how or through which mechanisms the verbalizations during a given task predict sucess and improvement on the task. It is possible, as Vygotsky suggested, that private speech signals the beginning of a new and more advanced type of thinking, verbal thought, that facilitates accurate performance. On the other hand, it is possible that verbalizations during a given task represent children's actual effort and motivation to solve the task. By the same token, improvement in classification scores could index improvement on a number of performance variables. For example, did private speech facilitate recognition of the relations presented in the classification items? Or, did private speech simply speed-up the sorting of the items according to relations already recognized without the aid of speech? Obviously, further research is needed to fully validate the Vygotskian hypotheses on thought and language.

Most likely, we have oversimplified the true relation between language and cognitive performance. Our categories of private speech were devised primarily for experimental precision and not to describe exhaustively be multifunctional aspects of self-directed language. Moreover, a child's private speech utterances are usually nested within the social/parental context rather than being exclusively oriented toward individual achievement or failure. In the

present study we asked children to work on their own in order to reduce their attempts to engage the experimenter for help, and elicit the use of self-regulatory language in the relative absence of external social structure. Even though these procedures probably do not reflect the natural context of children's private speech nor maximize the absolute frequency of such speech (Goudena, 1983), the experimental manipulations did indeed elicit self-regulatory language and also facilitated a more precise classification of utterances into social and private speech categories.

The overwhelming majority of private speech used during the tasks was categorized under *labels and descriptions*. This finding is not only consistent with the existing private speech literature, but also provides some support to Vygotsky's claims regarding the social origins of private speech. Maternal teaching strategies are characterized by a high frequency of questions about the task (Laosa, 1980) and, in adult-child teaching situations, children's verbal participation consists mostly of brief responses about the task, usually names, labels, and other descrip-

tions of the materials at hand. (Mother: «what goes here?» Child: «the cow...» Mother: «And, what color is this one?» Child: «a red one...»). It is interesting to note that, when the child is asked to work alone, the child brings to the task not the exact question-and-answer teaching format but, as Vygotsky would predict, a more simplified or predicated form of social interaction. Also, the use of labels and the verbal description of materials reflect the child's connection to the conceptual world of the adult culture. Labels and descriptions are precisely the conceptual tools and symbols that the child has received from his social-cultural context while dealing with and adapting to a changing environment (Vygotsky, 1978; Werstch, 1985). Labeling, therefore, is probably a more socially integrative form of speech than other types of speech, such as transitional statements or questions and answers about the task. As such, the present study offers some support to Vygotsky's claim that higher levels of conscious, goal-directed activity originate in social interactions and come to be mediated by the semiotic functions of language.

References

BALAMORE, U. & WOZNIAK, R. H. (1984). Speech-action coordination in young children. *Developmental Psychology, 20*, 850-858.

BEAUDICHON, J. (1973). Nature and instrumental function of private speech in problem solving situations. *Merrill-Palmer Quarterly, 19*, 117-135.

BERK, L. E. (1985). Why children talk to themselves. *Young Children*, July, 46-52.

BERK, L. E. & GARVIN, R. A. (1984). Development of private speech among low-income Appalachian children. *Developmental Psychology, 20*, 271-286.

DÍAZ, R. M. (1986a). The union of thought and language in children's private speech. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 8*, 90-97.

DÍAZ, R. M. (1986b). Issues in the empirical study of private speech: A response to Frawley & Lantolf's commentary. *Developmental Psychology, 22*, 709-711.

DÍAZ, R. M. & PADILLA, K. A. (1986). Teoría e investigaciones empíricas sobre el lenguaje privado. *Anuario de Psicología, 33*-1985(2).

DICKIE, J. R. (1973). Private speech: The effect of presence of others, task and intrapersonal variables. *Dissertation Abstracts International, 34* (3-B), 1292.

FRAUENGLASS, M. H. & DÍAZ, R. M. (1985). Self-regulatory functions of children's private speech: A critical analysis of recent challenges to Vygotsky's theory. *Developmental Psychology, 21*, 357-364.

FRAWLEY, W. & LANTOLF, J. P. (1986). Private speech and self-regulation. A commentary on Frauenglass and Díaz. *Developmental Psychology, 5*, 706-708.

FUSON, K. C. (1979). The development of self-regulation aspects of speech: A review. In G. Zivin (ed.) *The development of self-regulation through private speech*. New York: John Wiley & Sons, pp. 135-217.

GOODMAN, S. H. (1981). The integration of verbal and motor behavior in preschool children. *Child Development, 52*, 280-289.

GOUDENA, P. P. (1983). Private speech: An analysis of its social and self-regulatory functions. Unpublished Doctoral Dissertation, Sociale Wetenschappen aan de Rijksunivessiteit te Utrecht, Holland.

KENDALL, P. C. & BRASWELL, L. (1985). *Cognitive-behavior therapy for impulsive children*. New York: Guilford Press.
LAOSA, L. (1980). Maternal teaching strategies in Chicano and Anglo-American families: The influence of culture and education on maternal behavior. *Child Development, 51*, 759-765.
LURIA, A. R. (1961). *The role of speech in the regulation of normal and abnormal behavior*. Oxford: Pergamon Press.
LURIA, A. R. (1982). *Language and cognition*. New York: John Wiley & Sons.
PECHMAN, E. M. (1978). Spontaneous verbalization and motor accompaniment to children's task orientation in elementary classrooms. Unpublished doctoral dissertation, University of Michigan.
SUGARMAN, S. (1983). *Children's early thought: Developments in classifcation*. Cambridge: Cambridge University Press.
VYGOTSKY, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.
VYGOTSKY, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
WERTSCH, J. V. (ed.) (1985). *Culture, Communication and Cognition: Vygotskian Perspectives*. Cambridge: Cambridge University Press.
YAEGER, J. A. (1968). Self-directing speech and puzzle-solving in children. Unpublished doctoral dissertation, University of Chicago.
ZIVIN, G. L. (1972). Functions of private speech during problem-solving in preschool children. *Dissertation Abstracts International, 33*, (4-B), 1834; Ann Arbor, Michigan.: University Microfilms. N.ᵒˢ 72-26,224.

Resumen Extenso

Uno de los temas centrales en la teoría de Vygotski es que, a una temprana edad, los niños comienzan a usar el lenguaje no sólo para comunicarse sino también para planificar, guiar y evaluar la propia actividad. Este uso del lenguaje, llamado «habla privada», representa el origen de las funciones autorreguladoras que tipifican la inteligencia humana. En su mayoría, las investigaciones hechas en Europa y América han apoyado y dado validez a las principales tesis Vygotskianas sobre el habla privada. Sin embargo, en el trabajo de investigación empírica sobre el tema existe un punto controvertido de gran importancia, ya que muchas investigaciones no han podido documentar una relación positiva entre el uso del habla privada y la ejecución eficaz de las tareas.

En el presente estudio se propone que la ausencia de una relación positiva entre habla privada y ejecución de tareas se debe, principalmente, a varios problemas metodológicos. Específicamente, los autores proponen que una relación positiva entre habla privada y realización de tareas se puede encontrar si se toman en cuenta las tres siguientes sugerencias metodológicas:

Primero, la relación se debe buscar en términos específicos y no globales. Es decir, se deben buscar relaciones entre un tipo determinado de verbalización privada y un aspecto específico de la actividad del niño. Los estudios deben buscar el documentar relaciones, por ejemplo, entre el uso de descripciones de materiales y la atención selectiva, ya que, al describir diferentes aspectos de la tarea, el niño puede enfocar su atención selectivamente. La observación de relaciones específicas, en vez de relaciones globales, puede manifestar con mayor claridad las relaciones habla-actividad que realmente existen en la ejecución de diferentes tareas.

En segundo lugar, las investigaciones deben controlar los efectos de la dificultad de la tarea en el habla privada. Se sabe que la dificultad de una tarea influye en la cantidad de habla privada que un niño emite; tareas que son más difíciles evocan una mayor cantidad de habla privada. También se sabe que, por supuesto, mientras más difícil es una tarea para un niño más pobre será la realización de la tarea para ese niño. Dado que la dificultad de una tarea simultáneamente aumenta el habla privada y disminuye la eficacia de la ejecución, no nos debe sorprender que las relaciones positivas entre habla y ejecución son muy difíciles, si no imposibles, de encontrar. El presente estudio pro-

pone un método donde se puede controlar estadísticamente la dificultad de una tarea en el análisis de relaciones habla-actividad.

Finalmente, el estudio propone que los efectos del habla privada en la actividad del niño se deben buscar no en un momento dado, sino en la mejoría que se observa gradualmente en la ejecución de diferentes tareas. El habla privada emitida durante una tarea quizá no mejora tanto la ejecución de esa tarea específica en el momento presente, ya que el habla privada se emite al encontrar obstáculos y dificultades en la tarea. Sin embargo, el habla privada debe conducir a una mejor ejecución de la tarea la próxima vez que se realiza, ya que a través del habla privada el niño desarrolla los recursos y estrategias necesarios para una ejecución más eficaz de esa tarea.

El presente estudio investiga la relación entre habla privada y ejecución de tareas tomando en cuenta los tres puntos metodológicos mencionados. La investigación analiza tres relaciones específicas: 1) el uso de etiquetas (labels) y descripciones en relación con una tarea de clasificación que requiere atención selectiva, 2) el uso de preguntas y respuestas en relación con el tiempo que el niño pasa actualmente trabajando en la tarea, ya que el uso de preguntas y respuestas llevan a una mayor motivación e implicación en la tarea, y 3) el uso de transiciones verbales en la eficacia de moverse de un ítem a otro, ya que la transición eficaz entre ítems se puede ayudar verbalmente con palabras como: «bueno ya hice ésta... a ver cuál otra debo hacer».

Los resultados del estudio indican que el habla privada tiene un impacto significativo en la ejecución de tareas de clasificación. Sobre todo, el habla privada predice una mejor ejecución de la tarea, la segunda vez que se intenta.