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Mediation of Self-regulation through the Use of Private Speech

ABSTRACT

On the basis of teachers' ratings of impulsivity, 18 preschoolers were assigned to either an impulsive (high scores) or a control (low scores) group. Children with high impulsivity scores participated in fifteen, 15-minute training sessions over a six-week period. The individual training sessions, conducted in a corner of the preschool classroom, were designed to mediate children's spontaneous use of private speech for self-direction. Guided by Soviet self-regulation theory and current developmental research on private speech, the effective use of private speech was mediated through sensitive and gradual increases of task difficulty and contingent withdrawal of trainer control. Children's degree of impulsivity, selective attention, sustained attention, and private speech were assessed before and after the training sessions. Before training, children with high impulsivity ratings emitted a higher frequency of private speech, especially self-verbalizations that are typically considered as low-level or immature. Training was effective in reducing both teachers' ratings of impulsivity and children's reliance on low level private speech.

One of Vygotsky's (1934/1962, 1930-1935/1978) most interesting observations about the preschool years is that young children use language not only for communication, but also to plan, guide, and monitor their behavior in a self-regulatory manner. This use of language for the self, now labeled *private*

speech, marks an important moment in the child's cognitive development. Perceptual, attentional and motor functions that are controlled at an earlier age by the immediate external environment become increasingly self-regulated through children's use of private speech. Thus, the theory states, private speech plays a crucial role in the decline of impulsivity, the development of selective and sustained attention, and the emergence of a more systematic and flexible approach to problem-solving activity during the preschool years. Central to Vygotsky's hypothesis is the notion that, through private speech, children take over and internalize adults' regulatory functions, facilitating the progression from socially-mediated learning interactions to autonomous and self-regulated cognitive functioning (Diaz, Neal, & Amaya-Williams, 1990).

During the past twenty years, a moderate number of research studies done in the West have given substantial support to Vygotsky's theory of private speech (see Berk, 1992, for the most recent and comprehensive review on the topic). Namely, research has shown that private speech appears reliably during the preschool years, that its frequency increases in moments of increased cognitive difficulty, and that its use predicts improvement of attentional, motor, and cognitive performance. Because private speech is indeed a tool for self-regulation, it emerges spontaneously when a given task demands the use of executive rather than highly routinized or automatized operations, and also when the sources of social and external regulation decline, creating a demand for children's self-direction (see Diaz, 1992).

Inspired by the seminal work of Meichenbaum and Goodman (1971), and considering the crucial role of private speech for self-regulation, a substantial number of researchers and clinicians have trained the use of self-regulatory verbalizations in children who exhibit a wide range of learning and behavior problems. The rationale for self-instructional training can be stated simply as follows: if in normal development children rely on private speech to plan, guide, and monitor their own activity in a self-regulated manner, children who exhibit problems in self-control, such as impulsivity, distractibility, and hyperactivity, could benefit from training in the use of self-instructions. Unfortunately, for a number of reasons, some of which are discussed below, self-instructional training has not proven effective in helping decline children's impulsivity or in increasing their self-regulatory skills and behavior (see reviews by Abikoff, 1985; Diaz et al., 1990; Dush, Hirt, & Schroeder, 1989).

A Critique of Self-instructional Training

For the most part, self-instructional training has been modeled on procedures developed by Meichenbaum and colleagues in the early 1970s (see e.g., Meichenbaum & Goodman, 1971; Meichenbaum, 1971, 1975). As recently summarized by Diaz and Berk (1991), the typical self-instructional treatment regimen consists of the following five steps:

1. The experimenter acts as a model, talking aloud while performing the task.
2. The child performs the same task while the experimenter provides verbal instructions.
3. The child is asked to perform the task again while instructing him- or herself aloud, using statements similar to those modeled by the experimenter.
4. Next, fading of self-instructions occurs; the child is asked to perform the task while whispering to him- or herself, using no sound but only lip movements.
5. Finally, the child is asked to perform the task while verbalizing covertly, without lip movements. (pp 6-7)

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In our view, three major problems or misguided assumptions, see Diaz & Berk (1991) have contributed to the failure of self-instructional training programs. First, self-instructional training procedures have assumed that children with self-control problems have a lack or a deficient/immature use of private speech. However, current research has shown that impulsive, inattentive and hyperactive children emit *more* private speech than their normal counterparts, and also that their private speech is task-relevant and increases normally on difficult tasks (Berk & Potts, in press; Diaz & Lowe, 1987). Moreover, as explained in more detail below, the (so-called) low-level or immature speech emitted by impulsive children can perform important attention-focusing functions.

Second, self-instructional training procedures have assumed that *modeling* the use of self-verbalizations in an experimental setting will increase children's spontaneous use of private speech across different settings. However, research on mother-child teaching interactions has shown that the spontaneous use of private speech emerges not through modelling or imitating adults' self-verbalizations, but rather it appears in situations where difficult tasks challenge children's automatized performance and there is a contingent decline in external sources of direction and regulation (Diaz, Neal & Amaya-Williams, 1990; Diaz, 1992).

Finally, by instructing children to use self-verbalizations while simultaneously working on any given task, training procedures have not taken into account the documented dynamic and complex relation between private speech and increasing competence on the task. Because private speech (and the need for executive self-direction) naturally declines with the increasing automatization of skills and cognitive processes, asking children to verbalize indiscriminately throughout a given task might interfere with the development of competence in the task.

Diaz (1992) has recently outlined the observed relation between private speech and task competence with the following four-step progression:

1. If a child is competent on a given task, very little or no use of private speech is necessary to meet the demands of the task. A task can be considered "easy" when the child can perform the task with highly practiced, routinized abilities and little executive effort.
2. As the task becomes more difficult and challenges the child's current level of ability and competence, private speech will be used in an attempt to gain new and higher levels of mastery on the task.
3. If the child's private speech is indeed efficient and successful, it will facilitate and create a higher level of competence on the task.
4. Increasing levels of competence on the task will reduce the need to use private speech, bringing the child back eventually to the situation described in step 1. (p. 76)

The use of private speech, as a tool to achieve the self-regulation of cognitive functions and operations, should diminish as the given function or operation becomes increasingly regulated. For example, the use of self-verbalizations to focus and guide attention selectively should diminish as children's capacity for selective attention increases. Similarly, the use of self-verbalizations to inhibit responding to distractors should diminish with the decline of children's impulsivity. Thus, private speech should emerge as a tool to achieve competent, self-regulated performance, and should decline or virtually disappear as higher levels of competence and regulation are actually achieved.

The Private Speech of Impulsive Children

Because of their severe problems in motor and attentional regulation, impulsive and hyperactive children experience great difficulty in those tasks that are relatively easy and highly automatized for their normal same-age peers. It follows that, in order to perform adequately on a given task, impulsive children need to exercise more executive effort than self-regulated

children in order to sustain attention or inhibit impulsively responding to distractors. Thus, it is not surprising that in tasks of similar difficulty impulsive children use more private speech than their normal counterparts. Interestingly, their increased use of private speech manifests both their weakness (i.e., their need for greater executive effort), as well as their strength (i.e., their increased attempts to achieve acceptable levels of performance).

Unfortunately, at this time we do not know enough about the private speech of impulsive or hyperactive children to understand why their increased use of private speech does not lead to greater self-regulatory development, as it does in normal children. One possible explanation is that, as suggested by other researchers (e.g., Copeland, 1979), the private speech of impulsive children tends to be "low-level" or immature, such as speech that *accompanies* (e.g., descriptions of own activity) rather than *precedes* the child's action (e.g., planning). Vygotsky (1934/1962) hypothesized that, in normal development, private speech will move from accompanying to preceding ongoing activity. By preceding children's actions, private speech can exert a greater guiding and regulatory effect on subsequent behavior.

A second possibility is that children's efforts at self-regulation through private speech fall short or below a certain threshold of effectiveness in order to guide and regulate their behavior appropriately. For example, the simultaneous demands for attentional, motor, and cognitive regulation in the context of a classroom activity might be so challenging for impulsive children that their genuine attempts at self-regulation through private speech might not be enough to achieve the desired performance outcome.

It is important to note that simultaneous descriptions of self could perform important attention-focusing functions, as well as regulate children's ongoing motor behavior. The use of self-descriptions to maintain attention on task could be a most adaptive strategy in the

face of distractible and impulsive behavior. Children with attentional problems and impulsivity, therefore, should be expected to rely more often on these "low-level" strategies in order to achieve acceptable levels of performance. If this is the case, the use of low level strategies should not be considered a sign of immaturity in the verbal self-regulatory system, but rather an appropriate use of verbal self-regulatory strategies in children who are, by one reason or another, inattentive and impulsive.

A New Training Procedure: Mediating the Spontaneous and Effective Use of Private Speech

The training procedures employed in this study were designed as an alternative to typical self-instructional training procedures used by investigators in the past. Guided by the developmental literature on children's spontaneous use of private speech for self-regulation, we designed a training based on the following two assumptions:

1. Impulsive children already possess a wide range of verbal strategies that have the *potential* to regulate their behavior. Training, therefore, should focus on providing repeated opportunities to use their spontaneous private speech effectively, rather than modeling strategies they already possess.
2. Training procedures should provide contexts and situations similar to those shown to elicit a maximum amount of private speech in natural settings.

Research to date shows that private speech can be elicited reliably using tasks of medium difficulty, that is, neither too easy nor beyond the child's actual capacity. As long as the task offers an age-appropriate demand for executive functioning, the use of private speech should be expected. Private speech production can also be increased by the presence of others, only if such presence is not controlling, a situation which would diminish a child's need for self-regulation. Thus, the presence of a scaffolding adult, where the adult dynamically and contingently brings a difficult task within range of the child's potential mastery, is

the most conducive social context to elicit children's use of self-regulatory language.

Our training procedures were designed, therefore, to provide a dynamic and contingent window of opportunity, a Zone of Executive Function (ZEF; Diaz, 1990), where children were given the opportunity to direct their own activity with self-verbalizations as they worked towards a pre-specified goal. The ZEF is created by gradual increases in task difficulty and contingent declines in adult control. The window of opportunity, or ZEF, was contingently and dynamically adjusted so that each child could have a maximum opportunity for verbal self-direction in the following way:

1. Trainers engaged children in goal-directed activity, using a variety of educational toys that involve the construction of three-dimensional arrays according to pictured models. The task and goal (model) were selected by the child from a set of possibilities tacitly structured by the trainers.
2. If children worked towards the goal steadily, easily, and without self-verbalizations, trainers were asked to increase the difficulty of the task.
3. If children were engaged in self-talk, directing their activity, trainers were asked to remain silent and not intervene.
4. Only if children were distracted or off-task, trainers were asked to help children return to the task in the least controlling way possible.

The trainers, therefore, were acting as mediators of children's self-regulation, a central aspect of a mediated learning experience (MLE), as defined by Feuerstein (1980). However, instead of providing children with metacognitive strategies, the trainers or adult mediators were manipulating the child's environment to elicit the spontaneous use of such strategies in their private speech.

In summary, our training/mediating procedures were different from the typical self-instructional training in the following three ways:

1. We did not assume an absence of private speech in impulsive children. Rather, we created a situation that elicited and

facilitate private speech. Trainers were seen to elicit private speech from the children.

2. Goals of the training were set by the children, not by the trainers. The trainers only provided support and encouragement when the children showed difficulty in controlling their behavior.

3. The training was designed to be non-structured and non-sequential. The trainers did not provide a fixed sequence of tasks. The training was designed to be flexible and to respond to the needs of the children as a result of their behavior.

It is our hypothesis that children who have had experience with self-regulation can benefit from this training, especially those who have had a history of failure in their schoolwork. The training requires the children to be present in the classroom and to be able to follow directions and test their own ideas.

Hypotheses

In an effort to test our hypotheses, as well as to evaluate the effectiveness of the training procedure, the following hypotheses were formulated for the study:

1. Before the training, the children will use *more* private speech in the presence of others than in the absence of others. This is especially true for the impulsive children who will use *more* private speech in the presence of others than the non-impulsive children. This is especially true for the children who will show a decline in private speech after the training.
2. After the training, the children will show a decline in private speech. This is especially true for the children who will show a decline in private speech after the training.
3. After the training, the children will show a decrease in private speech. This is especially true for the children who will show a decrease in private speech after the training.

METHOD

Subjects

15 children

facilitated children's spontaneous use of private speech to achieve task goals that were set in collaboration by the child and trainer.

2. Guided by research on the social origins of private speech, we did *not* model adult-given verbalizations. Rather, we promoted the spontaneous use of private speech by gradual increases in task difficulty and contingent declines in adult control.

3. Finally, we examined children's spontaneous use of private speech (on a non-trained task) before and after the training sessions, expecting a pre-post decline in private speech as children became more attentive and less impulsive as a result of the training.

It is our belief that adult mediation of self-regulation through successful experiences in the use of private speech can benefit children enormously, especially those children who, on account of their impulsivity and inattention, require greater self-regulatory effort. The present study was designed to investigate and test this possibility.

Hypotheses

In an effort to examine our assumptions, as well as the effectiveness of our new training/mediation procedures, the following three hypotheses were formulated and tested in the present study:

1. Before training, impulsive children will use *more* private speech overall than the non-impulsive children. Specifically, impulsive children will produce more "low-level" private speech than their non-impulsive peers.
2. After training, impulsive children would show a decline in private speech, especially a decline in the use of low-level private speech.
3. After training, with the expected decrease of private speech, impulsive children will show improvements in task performance, as well as in measures of sustained attention and impulsivity.

METHOD

Subjects

18 children (14 male, 4 female) from two

preschool classes in a corporate-sponsored child care center in the San Francisco Bay Area served as subjects for the study. The age range of the children was 36-61 months, with a mean age of 49.22 months.

The training group ($n=10$, mean age = 49.0 months), consisted of children who had the highest scores of inattention and impulsivity, as determined by a teacher rating scale described below. The non-trained/control ($n=8$, mean age = 49.5 months) group consisted of subjects randomly selected from the remaining children in the preschool classrooms.

At pretest, the *Training and Control* groups were, by design, widely different on the impulsivity dimension [19.30 vs 11.56, $F(1,16)=27.95, p < .01$], as measured by teachers' behavioural ratings. It is important to remember, however, that children in the training group are considered "impulsive" only relative to the control group. For the purpose of this study, impulsivity is considered as a continuous variable within the normal population. Our label of impulsivity should be understood as indicating a relatively high position in the impulsivity dimension within a normal group, rather than a statement about the severity or pathological nature of children's problems within the preschool environment.

Measures

The following measures were administered both before (pretest) and after (posttest) the training sessions:

Impulsivity. Children in the two preschool classrooms were each rated by two teachers on a six-item behavioral scale. The items assessed children's general level of inattention (e.g., child shifts activities without finishing them) and impulsivity (e.g., child acts without thinking); items were based on and adapted from the list of diagnostic criteria for ADHD, as stated in the DSMIII-R. Teachers rated the items using a Likert scale from *Rarely* (1) to *Quite Frequently* (5). Children were also administered two laboratory measures of impulsivity, the *Matching Familiar Figures Test* (MFFT)

and the *Draw-a-Line* (DAL) test, both adapted for preschool children.

The MFFT and the DAL test, however, did not correlate with one another nor with teachers' ratings of children's impulsivity; we decided, therefore, to omit these measures from subsequent analyses. Teachers' ratings were chosen as our measure of impulsivity, above the MFFT and DAL, on account of the following three reasons: 1.) Teachers' ratings had the greatest ecological and face validity in describing impulsive and inattentive behavior in the classroom; 2.) Because each child was independently rated by two teachers, we had an estimate of inter-rater agreement ($r = .64$) on this measure; and 3.) Reliability and validity data are scarce for the adaptations of the MFFT and DAL tests when used with preschool children.

Selective Attention. Children were administered a selective attention task that required the child to identify whether two pictures are alike by color or shape. Each item card had two pictures that shared similarity in either color or shape, and a remaining space for the child to place an answer card. After a child identifies the distinctive feature, he/she must choose an answer card with a third figure that portrays the correct dimension that relates the original pair. There were 12 cards in the set, six of which were the same by shape and six, by color; the 12 cards were distributed in random order. The answer cards had colored circles or white shapes, thereby enabling the child to match only by color or shape. Children's performance was determined by the number of answer cards correctly placed. At posttest, a similar but not identical set of cards were administered. Children's performance on the selective attention task was videotaped in order to get measures of sustained attention and private speech, as described below.

Sustained attention. Children's sustained attention was measured through time-sampled observations of the videotaped performance on the selective attention task. Fifteen ten-second intervals within a five-minute period were

rated as either *Sustained Attention* (3), *Moderate Attention* (2), or *Inattention* (1), based on the child's gaze on the task. If children's gaze was on the task during the 10-second interval, a score of 3 was given. If children's gaze was off the task for the duration of the 10 second interval, a score of 1 was given. If children's gaze was both on and off task during the 10-second interval, a score of 2 was given. Sustained attention scores were obtained by calculating the mean score for the 15 ten-second intervals rated.

Private speech. Children's verbalizations during the selective attention task, at both pretest and posttest, were transcribed from the videotapes. A complete sentence, or any segment of speech separated from other speech by three or more seconds, was considered a speech unit. Speech units were classified as being either social or private. Private speech was defined as any utterance emitted by the child which was not explicitly addressed to another person, as indicated by either a social gaze (during, or immediately before or after the utterance) or an explicit social reference ("which one, David?").

All instances of private speech were then coded into one of the following ten mutually-exclusive categories, based on the coding system used by Copeland (1979):

1. *Exclamations*: excitement words, e.g., "Oh!" - "Oops!" - "Ahh!"
2. *Nonwords*: humming, vocal sounds, often accompanying motion, e.g., "Hmmm" - "Blapptt!" - "nnnnn"
3. *Descriptions of Self*: descriptions of the child's own behavior, e.g., "I'm looking for blue" - "I found a fish"
4. *Descriptions of Environment*: descriptions of the child's surroundings, including the task, e.g., "No more orange" - "They are the same" - "Two cars"
5. *Self-reinforcement*: self-praising statements, positive feedback, e.g., "I got it!" - "I can do more than that!" - "Good"
6. *Planning*: verbalization of intentions or future oriented statement that precede the action, e.g., "I'll pick the car" - "I need a chicken"
7. *Commands*: instructions given to the

self in the form of "I'll pick them up!" - "I'll pick one more"

8. *Questions*: self-questions, e.g., "I wonder if I left unanswered" - "Where's the..."

9. *Inaudible*: speech that is accompanied by mouthing of words but is not heard and/or understood

10. *Other*: Any other speech not coded with the above categories - "O.K." - "There"

Consistent with the hierarchy proposed by Hjertholm, the categories of private speech were coded into two levels:

Low-level
Exclamations
Self-Descriptions
Self-Reinforcement
these categories are "stimulating" or "representing" speech use.

High-level
Plans, Commands
Inaudible Mumbled
Kohlberg's "moral" utterances are advanced, and older children are older children's age.

Procedure

On the basis of the measures of impulsivity, teachers' ratings of impulsivity, and self-regulation training, the preschool subjects were randomly assigned to two laboratory groups (DAL and MFFT) before performing the task. Both groups received the training and the impulsive group received a five-minute individualized training within a period of two weeks. They were randomly assigned to two trainers, each with two assistants. A

self in the form of imperatives, e.g., "Pick them up!" - "Don't put a blue spot" - "Get one more".

8. *Questions*: questions addressed to the self whether answered by themselves or left unanswered, e.g., "Which one?" - "Where's the blue?".

9. *Inaudible Mutterings*: vocal sounds accompanied by lip movements, clear mouthing of words which were too soft to hear and/or understand.

10. *Other*: Any speech that could not be coded with the above categories, e.g., "O.K." - "There" - "Yes".

Consistent with the developmental hierarchy proposed by Kohlberg, Yaeger, and Hjertholm (1968), the above categories of private speech were further coded into two levels of maturity:

Low-level private speech: included Exclamations, Nonwords, Descriptions of Self, Descriptions of Environment, and Self-Reinforcement; utterances under these categories are considered "self-stimulating" or "outward-directed," representing earlier modes of private speech use.

High-level private speech: included Plans, Commands, Questions, and Inaudible Mutterings; according to Kohlberg's hierarchy, these types of utterances are developmentally more advanced, and more frequently used by older children or children of higher mental age.

Procedure

On the basis of teachers' ratings of impulsivity, ten children with the highest impulsivity scores were selected for self-regulation training. Eight children were then randomly selected from the rest of the preschoolers to serve as control subjects. Both groups were administered two laboratory measures of impulsivity (DAL and MFFT) and a selective attention task before (pretest) and after (posttest) the training sessions. Children in the impulsive group received fifteen 15-minute individual training sessions within a period of six weeks. Children were randomly assigned to either one of two trainers, both male graduate research assistants. All testing and training

sessions occurred at the preschool, in a corner of the classroom designed for such purpose.

RESULTS AND DISCUSSION

Group Differences at Pretest

The selective attention task, administered before and after the training sessions, proved to be an excellent task to elicit children's spontaneous use of private speech. As predicted, before the training, children in the impulsive (training) group emitted more private speech than their more reflective (control) counterparts. As shown in Table 1, this difference is substantial (22.20 vs 9.88), indicating that children with high ratings of impulsivity emitted at pretest more than double the amount of private speech emitted by their less impulsive peers. This difference, however, failed to reach statistical significance ($F(1,16) = 2.58, ns$), possibly due to large standard deviations on this variable within groups. This substantial group difference on private speech replicates the findings of previous studies, some of them reviewed in the introduction, where impulsive and hyperactive children emitted a higher frequency of self-verbalizations than normal control subjects in a cognitively demanding task.

The higher frequency of private speech emitted by children rated high on impulsivity at pretest can be interpreted in the following way. Because of their higher attentional and motor impulsivity problems, as determined by their teachers, any cognitive task would be actually more difficult or demanding for these children than for their less impulsive peers. In response to the increased difficulty, these children should be expected to increase their use of private speech.

At pretest, the high-impulsivity group performed lower than the control (5.40 vs 7.25) on the selective attention task showing that, indeed, the task was more difficult for this group. Children with higher impulsivity scores also experienced more difficulty sustaining attention on the task (2.73 vs 2.84). These differences on selective and sustained attention, however, failed to reach the prespecified

Self-regulation

level of statistical significance. Nonetheless, the pretest data did show that children rated by teachers as more impulsive used overall more private speech than control children, most likely in response to the relatively greater demands of the task on their attentional and cognitively performance.

When children's private speech is examined in more detail, in terms of maturity levels, the picture is more complex and instructive. Between-group differences are highest for low-level private speech [14.60 vs 6.38; $F(1,16)=3.89, p < .07$], suggesting that the high-impulsivity group not only emitted more private speech across all categories, but emitted substantially (and marginally significant) more private speech that is considered "low level" or immature.

The higher incidence of "low-level" private speech in children rated by teachers as more impulsive could be interpreted in two different ways. A first interpretation, the one taken by some researchers in the field (e.g., Copeland, 1979; Meichenbaum, 1971), is that impulsive children have immature, delayed, or deficient verbal self-regulatory strategies. According to this interpretation, as some investigators have implied, the immature use of verbal self-regulatory strategies might be causally related to impulsivity.

This first interpretation is supported by the fact that the strongest group differences in private speech were found for the *Exclamations* category (see Table 2). Even though the use of exclamations could

potentially activity, transition emotions Copeland, agreed with exclamation

Table 2 Means Training and Ex

Table 1 Means (and Standard Deviations) of Measures at Pretest and Posttest, for Training and Control Groups

	Pretest		F ¹ Group	Posttest		F ¹ Group
	Training Group	Control Group		Training Group	Control Group	
Impulsivity	19.30 (3.35)	11.56 (2.71)	27.95*	14.65 (4.02)	9.13 (2.53)	11.40*
Selective Attention Performance	5.40 (2.68)	7.25 (2.38)	2.34	6.70 (3.16)	8.75 (1.58)	2.78
Sustained Attention ²	2.73 (0.25)	2.84 (0.14)	1.13	2.84 (0.15)	2.92 (0.12)	1.19
Total Private Speech	22.20 (20.18)	9.88 (8.66)	2.58	16.30 (11.72)	17.25 (20.70)	<1
Low-level Private Speech	14.60 (10.62)	6.38 (5.63)	3.89°	9.40 (6.82)	10.50 (14.08)	<1
High-level Private Speech	6.50 (10.22)	3.00 (3.16)	<1	5.20 (4.66)	5.88 (7.18)	<1

¹ One-way ANOVAs (n=18, df=1,16) comparing groups at pretest and at posttest
² (n=17)
[°] (p<.07)
^{*} (p<.01)

Exclamation
 Nonwords
 Descriptions
 Descriptions of environment
 Self Reinforc
 Plans
 Commands
 Questions
 Inaudible Mu
 Other

[°] One-way AN
[°] Correlated p
 within group
[°] (p<.07)
^{*} (p<.05)

of "low-level" children rated by some could be in ways. A first taken by some (e.g., Copeland, 1971), is that the immature, self-regulatory leading to this investigators have of verbal self-ht be causally

potentially regulate children's ongoing activity, such as marking important transition points during the task or regulate emotions, many investigators (e.g., Copeland, 1979; Meichenbaum, 1971) have agreed with Kohlberg et al. (1968) that exclamations are signs of self-stimulation

rather than self-regulation. Readers should be aware, however, that the functional significance of exclamations, as well as the potential regulatory functions of the (so-called) "low level" private speech, need to be examined with further research.

Children rated high on impulsivity

Table 2 Means (and Standard Deviations) of the Number of Private Speech Utterances by Category, at Pretest and Posttest, for Training and Control Groups

	Pretest		F ^a Group Pretest	Posttest		F ^a Group Posttest	Within-Group Change	
	Training Group	Control Group		Training Group	Control Group		t ^b Training Pre to post	t ^b Control Pre to post
Exclamations	1.20 (.92)	.38 (.52)	5.11*	.40 (.70)	.63 (1.19)	<1	2.45*	-.61
Nonwords	1.70 (2.31)	.88 (1.81)	<1	.70 (.95)	.50 (.76)	<1	1.15	.70
Descriptions of self	2.20 (2.20)	1.00 (1.07)	1.98	.80 (1.23)	1.38 (3.50)	<1	2.09*	-.39
Descriptions of environment	8.90 (7.84)	3.88 (4.32)	2.63	7.00 (6.50)	7.38 (9.77)	<1	.78	-1.46
Self Reinforcements	.60 (.70)	.25 (.46)	1.48	.50 (.71)	.63 (1.41)	<1	.32	-.89
Plans	4.30 (8.76)	.75 (1.77)	1.28	1.40 (1.32)	1.50 (.74)	<1	1.00	-1.53
Commands	.40 (.70)	.63 (1.77)	<1	.80 (1.32)	.38 (.74)	<1	-.77	.6*
Questions	1.00 (2.21)	.88 (1.46)	<1	1.50 (1.96)	1.75 (3.11)	<1	-1.34	-.84
Inaudible Mutterings	.80 (1.32)	.75 (1.17)	<1	1.50 (1.90)	2.25 (3.81)	<1	-1.25	-.96
Other	1.10 (1.20)	.50 (1.07)	1.22	1.70 (2.91)	.88 (1.13)	<1	-.57	-.66

^a One-way ANOVAs (n=18, df=1,16) comparing groups at pretest and at posttest

^b Correlated pairs t-tests comparing change in private speech from pretest to posttest, within group (df_{training}=9, df_{control}=7)

^c (p<.07)

^d (p<.05)

is supported by group differences found for the (Table 2). Even exclamations could

and Control

Group	F ^a Group
Control	11.40*
Training	2.78
	1.19
	<1
	<1
	<1

also emitted more descriptions of self and the environment than their lower rated counterparts. These two categories of speech, while considered "low level" in Kohlberg's coding system, could have important self-regulatory potential. Therefore, a second interpretation we would like to consider is that the (so-called) immature private speech could perform important regulatory functions for children who are inattentive and impulsive.

Descriptions of self or own activity and descriptions of the environment, for example, may play an important role in helping the child focus on his/her own activity in the task. If this is the case, distractible and impulsive children would rely, more often than not, on this verbal strategy in order to keep their attention on task and avoid responding impulsively to distracting stimuli. Thus, considering their actual need for strong attention-focusing strategies, the use of some categories of low-level private speech by impulsive children could be considered a strength, rather than part of the problem. In the words of Diaz & Berk (1991):

Descriptions of self can perform important regulatory functions, such as focusing the child's attention on the task or guiding and pacing motor activity. In fact, children who are impulsive or who show attentional regulation problems could be expected to use more descriptions of self in an adaptive attempt to regulate their attentional and motor behavior. From this perspective, a heavy reliance on this type of speech might be a sign of health rather than immaturity of the verbal self-regulatory system. (p. 12)

It is important to note that we obtained a large negative correlation ($r = -.80, p < .001$) between the measure of sustained attention and the use of low level private speech for the entire sample at pretest. That is, children who were most inattentive during the task used more low-level private speech. Unfortunately, however, this negative correlation between attention and low-level private speech could be used in support of either

of the two alternative interpretations mentioned above. Further research is needed to investigate and determine whether the use of low-level private speech indicates children's strong attempts to regulate inattentive behavior or just part of the dysfunction of inattentive, impulsive children.

Group Differences at Posttest

At posttest, the initial group differences in the quantity of private speech disappeared. As Table 1 indicates, children in the training group showed a substantial decline in their use of low level private speech, from a mean of 14.6 at pretest to a mean of 9.4 at posttest. An examination of the means for specific private speech categories emitted by the impulsive group, reported in Table 2, shows a substantial decline in the frequencies of *Exclamations* [from 1.20 to .40, $t(9) = 2.45, p < .05$] and *Descriptions of Self* (from 2.20 to .80, $t(9) = 2.09, p < .07$). For the control (non-trained) group, the means for all ten different speech categories remained relatively stable between both times of testing.

Both groups showed increases in their selective attention performance, as well as in the measures of sustained attention. However, at both pretest and posttest, the control group scored higher than the impulsive/training group on these measures, although not significantly so. Mean impulsivity scores, derived from teachers' ratings, declined substantially for the impulsive/training group (from 19.28 to 14.22, $t(9) = 5.43, p < .001$) and slightly but significantly for the control group (from 11.56 to 9.13, $t(7) = 2.99, p < .05$).

Assessing the Effects of Training

In order to assess the effects of training on selective attention, sustained attention, and private speech, these variables were analyzed as dependent variables in analyses of covariance. Specifically, the data were analyzed in two-way ANCOVAs with factors GROUP (Training vs Control) and TIME (Pretest

vs Posttest) as a within-subjects factor. The effects of TIME were examined using the following equation:

Because the analysis was based on the basis of the data from teachers' ratings, it is not clear whether the effects of training were significant at the beginning of the course or whether the effects were significant at the end of the course. For the purpose of this study, we used the following equation:

The analysis of the effect of TIME on the selective attention scores ($F(1,17) = 4.97, p < .05$) showed a significant effect ($p < .05$). These results, as shown above, indicate that the children became more focused on the task and, as a result, their task performance improved. The effects were significant.

The analysis of the marginally significant interaction between private speech and training ($F(1,17) = 3.12, p < .10$) showed that the impulsive group, but not the control group, showed a significant decline in the use of low level private speech ($F(1,17) = 4.97, p < .05$).

The two-way analysis of variance showed a significant effect of TIME on the ratings of impulsivity ($F(1,17) = 15.12, p < .001$). The fact that the children's impulsivity scores declined significantly ($p < .001$) during the course of the study indicates that the children's levels of impulsivity also a significant effect.

vs Posttest), where TIME was analyzed as a within-subject factor. In this design, the effects of training can be assessed by examining the significance of GROUP by TIME interactions.

Because the groups were selected on the basis of impulsivity scores derived from teachers' ratings, the groups could not be considered equivalent at the beginning of treatment. Therefore, as suggested by Campbell and Stanley (1963) for the analysis of non-equivalent treatment and control groups, ANCOVAs were conducted covarying initial teacher ratings of impulsivity. This was done for all the dependent variables except, of course, for the impulsivity variable itself, where a two-way ANOVA design was used.

The analyses of covariance showed an effect of TIME for the performance scores on the selective attention task [$F(1,17)=4.97, p < .05$] and the measure of sustained attention on the task [$F(1,17)=7.74, p < .05$]. These findings indicate, as mentioned above, that all children in the sample became more attentive with time on the task and, not surprisingly, increased their task performance. No significant group effects were found in the ANCOVAs.

The analyses of covariance showed a marginally significant Group by Time interaction for the measure of low-level private speech [$F(1,17)=3.97, p < .07$]. This finding indicates that the trained group, but not the control group, showed the predicted decline in their use of low level private speech. This effect was substantial, even after covarying for initial group differences in impulsivity ratings.

The two-way ANOVA done on the ratings of impulsivity showed, not surprisingly, a significant group effect [$F(1,17)=18.49, p < .001$], underscoring the fact that the groups were very different on their impulsivity scores, as they were intended to be. The analysis also showed a significant effect of time [$F(1,17)=40.33, p < .001$], indicating that both groups of children improved (i.e., declined) in their levels of impulsivity. The analysis yielded also a significant Group by Time

interaction [$F(1,17)=4.92, p < .05$] giving support to the hypothesized effects of treatment on children's impulsivity. This finding, though highly encouraging, should be taken with some degree of caution because in the chosen non-equivalent design, impulsivity scores could be subject to "regression to the mean" effects; the significant Group by Time interaction, therefore, could have been affected by this artifactual effect. In addition, because teachers were aware of training efforts, their ratings could have been biased in favor of the trained group of children.

In short, the training procedures employed in this study had two notable effects, namely, a decline in children's impulsivity and a decline in their use of low level private speech. No effects of training were observed, however, on children's task performance or on children's sustained attention on the task.

CONCLUSION

In the present study we have attempted to mediate self-regulation by providing preschool children with repeated opportunities for the use of their spontaneous private speech. Our training procedures were designed very differently from typical self-instructional procedures used by cognitive-behavioral researchers. Within this tradition, self-instructional researchers and clinicians have assumed a lack or deficient use of self-regulatory strategies in impulsive children; self-instructional training, therefore, has been designed to model and rehearse the (purportedly) absent strategies. Within the self-instructional paradigm, the expected outcome of treatment, besides the decline of impulsivity, is children's reliance on mature and efficient self-regulatory strategies.

Our training, on the other hand, assumed the presence of self-regulatory strategies in impulsive children. We also believe that "low-level" private speech, such as descriptions of self and the environment, can perform important attention-focusing functions in the regulation of impulsive behavior.

Therefore, instead of modelling experimenter-given self-verbalizations, we created opportunities for impulsive children to use these strategies effectively, within a controlled one-to-one situation. Based on our current knowledge regarding the complex interaction between private speech and cognitive activity, we expected the training to reduce children's use of private speech as they became more attentive and less impulsive.

It is clear, from the above discussion, that self-instructional training (SIT) and the mediation of self-regulation (MSR) procedures that we propose are very different in their assumptions regarding 1.) the nature of the self-regulatory deficit, 2.) the nature of the proposed treatment procedures, and 3.) the expected outcomes of treatment. The present study was a first attempt to examine the viability of MSR procedures and their underlying assumptions.

The findings give some support to the potential of MSR to reduce children's impulsivity and promote a consequent decline in their use of low-level private speech. However, considering the limitations of sample size, teachers' bias when rating trained children, and possible regression towards the mean in the measure of impulsivity, these findings should be considered tentative and in need of replication and further elaboration.

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