The Analysis of Verbal Behavior 2009, **25,** 51–66

The ''Silent Dog'' Method: Analyzing the Impact of Self-Generated Rules When Teaching Different Computer Chains to Boys with Autism

Erik Arntzen, Lill-Beathe Halstadtro, and Monica Halstadtro, Akershus University College, St. Olavs Hospital/Trondsletten Habilitation Services, and Byasen High School, Norway

The purpose of the study was to extend the literature on verbal self-regulation by using the ''silent dog'' method to evaluate the role of verbal regulation over nonverbal behavior in 2 individuals with autism. Participants were required to talk-aloud while performing functional computer tasks.Then the effects of distracters with increasing demands on target behavior were evaluated as well as whether self-talk emitted by Participant 1 could be used to alter Participant 2's performance. Results suggest that participants' tasks seemed to be under control of self-instructions, and the rules generated from Participants 1's self-talk were effective in teaching computer skills to Participant 2. The silent dog method was useful in evaluating the possible role of self-generated rules in teaching computer skills to participants with autism.

Key words: silent dog method, self-generated rules, computer tasks, rule following, verbal behavior

Verbal behavior has been defined as ''behavior reinforced through the mediation of other persons'' (Skinner, 1957, p. 2), and the important refinement to distinguish it from social behavior is ''that the 'listener' must be responding in ways which have been conditioned precisely in order to reinforce the behavior of the speaker'' (p. 225). In recent years, there have been an increasing number of publications that focus on the elementary verbal operants, such as the mand, the tact, and the intraverbal (Sautter & LeBlanc, 2006). Thus, it appears that most of the research on verbal behavior has focused on the behavior of the speaker rather than the behavior of the listener.

A special case of listener behavior has been described as rule-governed behavior. Skinner (1966, 1969) introduced the terms *contingency-specifying* and *rule-governed* behavior to describe a relation in which nonverbal behavior is controlled by verbal stimuli that describe environmental contingencies. Conceptual issues regarding this relation have been discussed by a number of behavior analysts (e.g., Agnew & Redmon, 1992; Hayes, 1989; Hayes & Hayes, 1992; Parrott, 1987; Ribes-Iñesta, 2000; Skinner, 1966, 1969). Blakely and Schlinger (1987), for instance, suggested that contingency-specifying stimuli may serve to alter either the discriminative or motivational function of other stimuli that in turn would directly evoke behavior. Furthermore, contingency-specifying stimuli may be used to either remediate performance or evoke novel behavior (Pelaez & Moreno, 1998).

Although rule following typically suggests the presence of both a speaker and listener as in any verbal episode, the same individual may serve as both the speaker and listener. In other words, the speaker may also act as his or her own listener. Typically this may occur covertly, as when the speaker talks to him- or herself or self-instructs (Greer & Speckman, in press; Keohane & Greer, 2005).

Self-instructions can be defined as verbal response products that control some other behavior in the listener (Vintere, Hemmes, Brown, & Poulson, 2004). A number of studies have shown that nonverbal behavior may be mediated by covert verbal behavior, often labeled as self-instructions (Horne, Lowe, & Randle, 2004; Lowenkron, 2004). One area of research has been particularly

The current study was presented as a poster at the ABAI conference in San Diego in 2007. We are very grateful to three anonymous reviewers.

Correspondence concerning this article should be addressed to Erik Arntzen, Akershus University College, P.O. Box 423, 2001 Lillestrom, Norway (e-mail: erik.arntzen@equivalence.net)

concerned with the relation between self-instructions and problem solving. Baer and colleagues (Duarte & Baer, 1994; Fjellstrom, Born, & Baer, 1988; Grote, 2003; Grote & Baer, 2000; Grote, Rosales, & Baer, 1996; Grote, Rosales, Morrison, Royer, & Baer, 1997; Jay, Grote, & Baer, 1999) conducted a number of studies on the role of self-instructions on sorting tasks with both typically developing children and adults with mental retardation. In all of these studies, the acquisition of in-common discriminations seemed to have been significantly facilitated by teaching participants the relevant verbal skills to self-instruct.

A second area of research has focused mainly on the role of self-instruction on on-task behavior (Bornstein & Quevillon, 1976; Friedling & O'Leary, 1979; Guevremont, Osnes, & Stokes, 1988; Higa, Tharp, & Calkins, 1978; Wacker et al., 1988) or combinations of independent variables (Roberts, Nelson, & Olson, 1987). Some of these studies have also included recordings of verbal behavior (Guevremont et al.). Although results from these studies are mostly mixed (Friedling & O'Leary), overall, they suggest positive effects of self-instructions in increasing on-task behavior.

A third area of research has been concerned with self-instruction and gross-motor chains (Kirby & Holborn, 1986; Vintere et al., 2004). Results from these studies suggest that self-instructions may be used to teach gross-motor chains, and that this method may be more effective than the use of modeling and praise alone (Vintere et al.)

Although these studies used self-instruction as their main independent variable, in most cases recordings of verbal behavior were not taken, making it unclear whether participants were actually self-instructing. Hayes, White, and Bissett (1998) suggested that one way to assess the control that rules may have on behavior is through a method called the *silent dog* strategy. In this method, the participant talks aloud while he or she performs nonverbal tasks. This method includes three controls for evaluating whether verbal behavior (i.e., self-generated rules) controls nonverbal behavior (i.e., on-task performance). In Control 1, it must be shown that on-task performance is not interrupted by talking aloud. In Control 2, it must be demonstrated that on-task performance is altered by the presentation of distracters. In Control 3, the verbal report generated in Control 1 must change the performance of another participant when used as an external rule. If all three control conditions are presented, producing the changes in behavior as described, then performance can be said to be governed by rules. These talk-aloud protocols may be considered functionally equivalent to self-rules.

Recently, Alvero and Austin (2006) used this method in the area of behavioral safety. Participants were instructed to perform an assembly task with and without a talk-aloud requirement after the participants had observed someone else performing safely. The dependent variable consisted of three different sitting topographies. Results showed that all three controls were fulfilled and suggested a functional relation between safety-related verbalizations and increases in safe performance.

Taylor and O'Reilly (1997) studied the link between covert verbal self-regulation and nonverbal behavior. Four participants with mild intellectual disabilities were trained to perform 21 steps of a shopping task with the use of overt and covert self-instructions. In a subsequent condition, self-instructions were blocked through the presentation of auditory stimuli (i.e., numbers) that participants were required to repeat. This resulted in a reversal to baseline levels of shopping skills. Furthermore, self-instructions were used as external directives for three other participants to show that these instructions could serve to control the target behavior. Taylor and O'Reilly labeled Controls 1, 2, and 3 as covert self-instruction, blocking, and self-instructions as external directives, respectively, to describe what takes place in these different conditions.

In a follow-up study by Faloon and Rehfeldt (2008), 3 adults with mild developmental disabilities were trained to perform a daily living skill with 18 steps. A combination of a multiple baseline design across participants and a multielement design (blocking vs. nonblocking) was used to assess the effect of self-instructions in training the chain and whether responding was under control of self-talk. In the blocking sessions, participants were instructed to

Table 1

Phase	Training and testing	Participant
Pretraining	Training seven behavioral chains with Microsoft Word and training to report the skills.	Simon
Phase 1	Training three different behavioral chains with Microsoft Word.	Simon
Phase 2	Testing for overt and covert self-instruction: Testing if concurrent talk-aloud procedures were functionally equivalent to performance without talk-aloud reports for the behavioral chains in Phase 1. No programmed consequences followed correct or incorrect responses.	Simon
Phases 3 and 4	Training and testing for blocking: Testing if the introduction of counting reduced correct responses for the behavior skills from Phase 1 to baseline levels. No programmed consequences followed correct or incorrect responses.	Simon
Phase 5	Testing for self-instructions as external directives: Testing if the verbal reports produced in Phase 2 and subsequently used as an external rule with another boy produced alteration in his task performance. No programmed consequences followed correct or incorrect responses.	Philip
Follow-up	Testing if the behavior skills from Phase 1 were maintained 8, 9, and 10 weeks after reaching criterion performance. No programmed consequences were delivered during the follow-up phase.	Simon

repeat numbers presented by the experimenter, whereas in the nonblocking sessions, there was no requirement of repetition. Results showed that self-talk became part of the controlling variables that were responsible for responding, even though differences in performance were not so pronounced.

Few studies have focused on the functional relations between covert self-rules and nonverbal behavior. In the previous studies, the silent dog method was used with participants who already engaged in self-talk. Therefore, we wanted to investigate the relation between covert verbal behavior and nonverbal behavior in participants who had not been observed to engage in self-talk prior to the beginning of the study. Thus, the purpose of the study was to extend the literature on verbal self-regulation while teaching functional computer skills to individuals with autism. In addition, the study aimed to assess whether these skills would be maintained during a follow-up test as well as to test the effects of different distracters during the blocking condition.

METHOD

General Overview

A general overview of the method is presented in Table 1. During pretraining, the 1st participant was required to engage in self-talk while performing seven word-processing tasks. Pretraining was followed by a baseline phase in which participants were presented with six unknown word-processing tasks. No programmed consequences followed correct or incorrect responses during baseline or during testing (described below). In Phase 1, training, three unknown word-processing skills (Set 1) were trained. Phase 2, testing for overt and covert self-instruction (Control 1), was implemented to test whether on-task performance with continuous, concurrent talk-aloud procedures was functionally equivalent to performance without self-talk. Phase 3, testing for blocking (Control 2), was implemented to test whether performance would decrease to baseline levels when different types of simple math tasks were presented. In Phase 4, a new training and subsequent test for blocking (Control 2) were introduced including both unknown behavior chains (Set 2) and other types of distracters, because we wanted to explore further the effects of distracters with increasing demands on target behavior. Phase 5, testing for self-instructions as external directives (Control 3), was implemented to see whether the self-talk emitted by Participant 1 could be used to alter another participant's performance. In a follow-up phase, performance was tested at 8, 9, and 10 weeks after training.

Participants

Two boys who had been diagnosed with autism participated in the current study. For Simon (14 years old), the Reynell language development scales (Hagtvet & Lillestolen, 1985) showed a receptive language score of 5 years old (Level 3; levels were from 1 through 9) and an expressive language score of 6 years old (Level 7). He could count from 1 to 100, 20 to 1, subtract numbers up to 10, and had correct performance for some numbers in the multiplication tables (i.e., the 2, the 3, the 5, and the 10 times tables). He did not engage in any self-talk prior to the beginning of the study. For Philip (7.5 years old), the Reynell language development scales showed a receptive language score of 6 years old (Level 1) and an expressive language score of 6 years old (Level 6). Both participants had some skills and showed interest in computer-based activities (i.e., turn on the computer, open Microsoft Word, write simple transcriptions, and do simple dictations). Philip was never observed to engage in self-talk prior the current study. For both participants, using a computer was seen as an important skill, because computers can be used to develop self-help skills, communication, writing e-mails, and so on. In addition, the use of instructions could be a part of their curriculum. None of the behavior chains used in the experiment were a part of the participants' repertoires prior to the beginning of the study. Simon participated in pretraining and Phases 1 through 4, and Philip participated in Phase 5. They were not trained or tested together. In other words, they did not observe each other in any of the training and testing phases.

Setting

Pretraining and Phases 1 through 4 took place in a separate room that was used only by Simon at his school, and Phase 5 took place in Philip's room at a different school. Both rooms had a table, laptop computer, three chairs, a bookshelf, and a video camera. An experimenter and an observer were present during sessions. Written instructions were printed (Font Size 20, Times New Roman) in lower case letters and written on paper (21 cm by 4 cm).

Target Behaviors and Recordings

A task analysis was completed for each behavior chain or computer task. There were no stimuli that signaled the beginning and the end of the steps in each chain. The chains in Set 1 were used in Phases 1, 2, 3 and 5. The first computer task consisted of making a front page with a triangle, a hexagon, and writing the word *mathematics* as a heading, using the function word art gallery and making a red background (Table 2). The computer task analysis yielded 21 responses or steps. For the second chain, the computer task analysis yielded 18 responses or steps (Table 3). The task was to paste in a calendar for August 2002 (the year of the study) and show the calendar on one page. The third computer task was to paste a picture of a water lily, reducing the size of the picture, and writing *water lily* under the picture with pink cursive font (Size 36). The computer task analysis showed that this chain was divided into 23 steps (Table 4). The chains in Set 2 were used in Phase 5. The first chain (to make a table of contents) consisted of 26 steps (Table 5). The second chain (to write a letter to his parents) consisted of 23 steps (Table 6). The last chain (to paste four figures in four boxes) consisted of 28 steps (Table 7).

A trial was defined as the completion of the whole chain. The number of correct responses in each chain was recorded and percentage correct was calculated. In the phases with a self-talk requirement, both the nonverbal responses and verbal (self-talk)

Table 2
Steps for the first chain task analysis

Step	Description
1	Click on auto shapes
2	Click on basic shapes
3	Click on triangle
4	Click on page
5	Click outside the triangle
6	Click on the auto shapes
7	Click on basic shapes
8	Click on hexagon
9	Click on page
10	Click outside the hexagon
11	Click on Word art gallery
12	Click on a Word art style
13	Click on OK
14	Click on ''insert text'' in text box, press backspace on the keyboard until the text appears
15	Write *mathematics* in text box
16	Click on OK
17	Click on the word *mathematics*, hold down mouse button, drag the heading above the shapes, and then release
18	Click outside the heading
19	Click on format
20	Click on background
21	Click on red

This chain was to make a front page with a triangle and a hexagon and write *mathematics* as the heading using the Word art gallery with a red background.

Table 3
Steps for the second chain task analysis

Step	Description
1	Click on file
2	Click on new
3	Click on new document
4	Click on calendar wizard
5	Click on OK
6	Click on next
7	Ensure that a dot is in the circle outside ''boxes and borders.'' If not, click in the circle
9	Click on next
10	Ensure that a dot is in the circle outside the box as a portrait. If not, click in the circle
11	Click on next
12	Ensure that August is in the text box ''start month.'' If not, click on arrow in the text box and click on August
13	Ensure that August is in text box ''end month.'' If not, click on arrow in text box and click on August
14	Ensure that 2002 is in text box ''start year.'' If not, click on the arrow until the number 2002 is presented
15	Ensure that 2002 is in text box ''end year.'' If not, click on the arrow until the number 2002 is presented
16	Click on continue
17	Click on view
18	Click on zoom
19	Click on a full page

This chain was to paste in a calendar for August 2002 as one page.

responses were recorded. Correct responses were recorded if there was correspondence between verbal and nonverbal responding. For instance, a response was scored correct if the participant said ''I'm clicking on the calendar wizard'' while he physically clicked on the calendar wizard. A response was scored incorrect if there was no match between verbal and nonverbal behaviors.

Pretraining

The purpose of this phase was to teach Simon to engage in self-talk while emitting on-task behavior. During this phase, he was trained to perform different unknown computer tasks that were organized in seven chains, with one to three responses in each chain. For example, one of the chains required him to make a table with six columns and 10 rows. All chains were trained using forward chaining. Each trial started with the presentation of two written instructions, one related to the nonverbal task (e.g., ''Make a table with six columns and 10 rows'') and one related to the verbal (self-talk) task (''Talk aloud about what you are doing''). These two written instructions were followed by the vocal instruction ''Start doing the task on the computer.'' Potential reinforcers (e.g., praise, cookies, or popcorn) were delivered contingent on a correct match between self-talk and on-task behavior. The first three trials in all three behavioral chains

Table 4
Steps for the third chain task analysis

Step	Description
1	Click on insert
2	Click on picture
3	Click on file
4	Click on example picture
5	Click on open
6	Click on water lily
7	Click on insert
8	Click on picture
9	Place the arrow in the corner at the top on the left of the picture
10	Click in the corner until a cross is presented, hold the mouse button down and draw the arrow down over the picture, then release
11	Click at the bottom in the right corner outside the picture
12	Click on enter
13	Write *water lily*
14	Click in front of the letter v, hold down the left mouse button and draw the pointing arrow over the text, then release
15	Click on format
16	Click on write
17	Click on italic in text box text style
18	Click on number 36 in text box script size
19	Click on OK
20	Click in front of the letter v, hold down the left mouse button and draw the pointing arrow over the text, then release
21	Click on change color
22	Click on the color pink
23	Click on OK

This chain was to paste a picture of water lily, reduce the size of the picture and write *water lily* under the picture with pink cursive font (Size 36).

Table 5
Steps for the first chain in Phase 4 task analysis

Step	Description
1	Write content and click enter
2	Write computer training and click enter
3	Write Microsoft Word and click enter
4	Write save front page and click enter
5	Write save calendar and click enter
6	Write insert picture
7	Mark computer training
8	Click normal until style is presented
9	Click on Heading 1
10	Click outside computer training
11	Mark Microsoft Word
12	Click on normal until style is visible
13	Click on Heading 2
14	Click outside Microsoft Word
15	Mark save front page, save calendar, and insert picture
16	Click on normal until the style is presented
17	Click on Heading 3
18	Click outside make front page, save calendar, and insert picture
19	Place marker after content
20	Click on insert
21	Click on index and tables
22	Click on content
23	Click on OK
24	Place marker in front of computer training
25	Hold down ctrl and press enter
26	Click on the symbol for preview

This chain was to make a table of contents.

were physically prompted to ensure correct performance of computer tasks. After the third trial, the trainer delivered prompts only if necessary and faded prompts according to a progressive prompt-delay procedure. This was done by introducing a 2-s delay before the prompt and increasing it by 1 s on subsequent trials. The trainer was situated behind Simon (the same for all phases). No feedback was provided if the response was incorrect or if no response occurred. Training continued until Simon could perform the whole chain and the criterion was met. Training criterion was set at three consecutive trials with 100% correct responding (i.e., completing the computer task while engaging in self-talk).

Experimental Design

In Phase 1 we used a multiple probe design across three chains including the test trials from Phases 2 and 3, and a pre- and posttest design was used in Phases 4 and 5. In Phase 4, we compared the performance during baseline, training, and a second condition with

Table 6
Steps for the second chain in Phase 4 task analysis

Step	Description
1	Click on file
2	Click on new
3	Click on letter and fax
4	Click on letter wizard
5	Click on OK
6	Click on send a letter
7	Click on OK
8	Write today's date in the column date line
9	Click at the top on the right in the column and choose page layout
10	Click on standard letter
11	Click on next
12	Write the name of your mother and father in the column recipient's name
13	Write the address of your mother and father in the column address
14	Click on at the top on the right in the column to ''person concerned''
15	Click on the text dear mother and father
16	Click on next
17	Click on next
18	Write your name in the column sender's name
19	Write the school's address in the column sender's address
20	Click on finish
21	Delete the text after the word *father* to the words *yours sincerely*
22	Click with left mouse button after the word *father* and click enter
23	Write ''I have learned to make a front page, a calendar and to insert a picture with Microsoft Word''

This chain was to write a letter to mother and father.

Table 7
Steps for the third chain in Phase 4 task analysis

Step	Description
1	Click on format
2	Click on frames
3	Click on new frame
4	Click on new frame on the right
5	Click in the corner of column frames
6	Click on auto shapes
7	Click on stars and banners
8	Click on a star
9	Insert the star in frame at the top on the left
10	Click on format
11	Click on frames
12	Click on new frame below
13	Click on auto shapes
14	Click on basic figures
15	Click on a heart
16	Insert heart in the frame at the bottom on the left
17	Click on the frame at the top on the right
18	Click on the circle on the toolbar
19	Insert the circle at the top on the right
20	Click on format
21	Click on frames
22	Click on new frame below
23	Click on toolbar
24	Insert rectangle in the frame at the bottom on the right
25	Click on view
26	Click on top text and bottom text
27	Write ''four figures in four frames'' in the frame top text
28	Click on close top text and bottom text

This chain was to paste four figures in four boxes.

distracters. In Phase 5, we compared the percentage of correct responses across three new skills before and after Philip was given the instructions generated by Simon's self-talk.

Interobserver Agreement

Two independent observers collected data for all baseline probes, 50% of sessions during the intervention in pretraining and Phase 1, and 100% of sessions for the tests in Phases 2 through 5. An agreement was defined as a match between two independent observers' scores. Interobserver agreement was calculated as the total number of agreements divided by the sum of agreements and disagreements multiplied by 100%. Agreements averaged 90% (range, 80% to 100%). Reliability data were collected for both computer performances and self-talk.

Baseline

During baseline, all chains were tested (i.e., the six chains later used in training and testing for Simon's performance, Phases 1 through 4, and the three chains later used in testing for Philip's performance, Phase 5). Similarly to pretraining, the experimenter presented the written instruction that specified what the participants were going to do, followed by a vocal instruction, ''Start doing the task on the computer,'' to ensure that the participant started to work on the computer. No programmed consequences followed correct or incorrect responses.

Procedure

Of note, all six behavior chains were chosen because they had been assessed as functional and useful for the children in their daily lives. Furthermore, engaging in self-talk was seen as an important part of the children's training program or curriculum in general.

Phase 1: Training. In Phase 1, Simon was trained to perform the three different tasks on the computer (Set 1). Each trial started with the presentation of the written instruction followed by the vocal instruction, as in baseline. For the first three trials every response was physically prompted to ensure that he correctly performed the computer tasks (see pretraining). If the percentage of correct responses was more than 90% correct by the completion of each chain, praise, cookies, or popcorn were presented. No feedback was provided if the response was incorrect or no response occurred. This phase lasted 5 days with 2.5 hr of training each day. Each session lasted 10 min, with a 5-min break between each. The criterion for termination of this phase was three consecutive trials with a minimum of 90% correct responding.

Phase 2: Testing for overt and covert self-instruction (Control 1). In Phase 2, Simon was required to talk aloud while he performed the tasks trained in Phase 1. This was done to make sure that talking aloud did not interrupt the task performance in the three chains trained in Phase 1. The trainer presented the same written instructions as in Phase 1 in addition to the written instruction ''Talk aloud about what you are performing.'' In this phase, three trials for each chain were tested across 9 consecutive days.

Phase 3: Testing for blocking (Control 2). The purpose of Phase 3 was to test whether self-talk influenced on-task behavior. Thus, we wanted to see whether performance trained in Phase 1 would be reduced to baseline levels when a distracter was presented. Distracters included asking the participant to ''count from 10 to 1'' or ''count from 1 to 10'' while he was performing the computer task. The trainer started the session by presenting the same written and vocal instructions as in Phase 2 in addition to the vocal instruction, ''Continue performing the tasks on the computer even if I start talking to you.'' In this phase, three trials for each chain were tested across 9 consecutive days.

Phase 4: Training and testing for blocking (Control 2). The purpose of this phase was to replicate Phase 3 and explore the effects of different distracters on chain performance. Thus, Simon was trained to perform three new chains (Set 2): ''Make a table of contents,'' ''Write a letter to your parents,'' and ''Paste four figures in four boxes.'' The different chains included approximately the same number of responses. The training lasted 5 days with 2.5 hr of training per day. Each session lasted 10 min, followed by a 5-min break. The chains were established as in Phase 1. The criterion for termination of this phase was three trials with a minimum of 90% correct responding. During the testing for blocking, the teacher presented distracters such as counting (the same as in the first test for blocking) and subtraction and multiplication (the 2, the 3, the 5, and the 10 times tables). In this phase, three trials for each chain were tested across three consecutive days.

Phase 5: Testing for self-Instructions as external directives (Control 3). In the current phase, we wanted to see whether Philip, who was unfamiliar with the tasks, could perform the tasks solely under control of instructions generated from Simon's verbal statements (self-instruction) during Phase 2. Thus, if Simon had said ''I am pointing to a water lily'' while performing one of the steps of the chain, the instruction generated was ''point to water lily.'' Each trial started with the presentation of the same written instructions

Table 8
The number of trials to criterion for the different chains in pretraining

Chain	Trials to criterion
1	9
2	9
3	10
4	14
5	12
6	12
7	21

as in Phase 1. The trainer successively presented the different instructions generated from Simon's self-talk (i.e., Instruction 1 [''click on file''], Philip clicked on file, then the trainer presented Instruction 2 [''click on new''], Philip clicked on new). In this phase, three trials for each chain were tested across 9 consecutive days.

RESULTS

Results obtained in pretraining showed that the seven chains were mastered after 9 to 21 trials, with a mean of 13.7 trials (see Table 8). During baseline, responding was 0% correct for all chains (Figure 1). After nine sessions, responding was 100% correct for the first behavior chain, after three sessions for the second chain, and after eight sessions for the third chain. For both the second and the third chains, responding was 0% correct during baseline probes immediately before the implementation of training. In Phase 2 (the test for Control 1), responding (match between what the participants was saying and doing), was 100% correct for all three behavior chains. Similarly, in Phase 3 (the test for Control 2), responding was 100% correct for all three behavior chains. In addition, the follow-up tests showed that all chains were maintained at 8, 9, and 10 weeks.

In Phase 4 (Control 2), Simon showed no correct responses in any of the new chains during baseline (Figure 2). After training, he demonstrated 100% correct responses in all chains. In the trials with distracters, the mean percentage of correct responses for all three chains was 89% (range, 83% to 100%) when the trainer presented counting tasks (Figure 2, top). The mean percentage was 31% (range, 0% to 90%) when the trainer presented subtraction tasks (Figure 2, middle) and 0% when the trainer presented multiplication tasks (Figure 2, bottom).

In Phase 5 (the test for Control 3), Philip had emitted no correct responses in any of the chains during baseline (see Figure 3). With the instructions generated from Simon's self-talk, Philip's correct responding increased to 87% for all three tests in the first chain. For the second chain, correct responding was 79% in the first and second trials and 100% in the third trial. For the third chain, correct responding was 44% for all trials.

DISCUSSION

The results showed the following: (a) Simon learned different computer tasks, (b) the tasks seemed to be under control of self-instructions, and (c) the rules generated from Simon's self-talk were effective in teaching computer skills to Philip. Furthermore, it was possible to use the silent dog method to evaluate the role of self-generated rules to teach computer skills to 2 participants with autism. Results from all three controls support this notion. First, the test for overt and covert self-instruction suggested that performance with ongoing talk-aloud reports was functionally equivalent to performance without talk-aloud reports for all three chains, because the requirement of self-talk did not reduce on-task behavior. The second control, testing for blocking, showed that performance on the computer chains was not reduced to baseline levels for any of the chains. In the second test for blocking, we used three distracters to study their effects. One of the distracters was the same as in the first test for blocking to replicate its effects with new chains. For the two new distracters, on-task performance was reduced to baseline levels. In the third control, the test for self-instructions as external directives showed that the verbal report produced by Simon produced changes in Philip's on-task performance when it was used as external rules for Philip. Results of follow-up tests showed that performance was maintained after 8 to 10 weeks. Few studies on self-instructions have

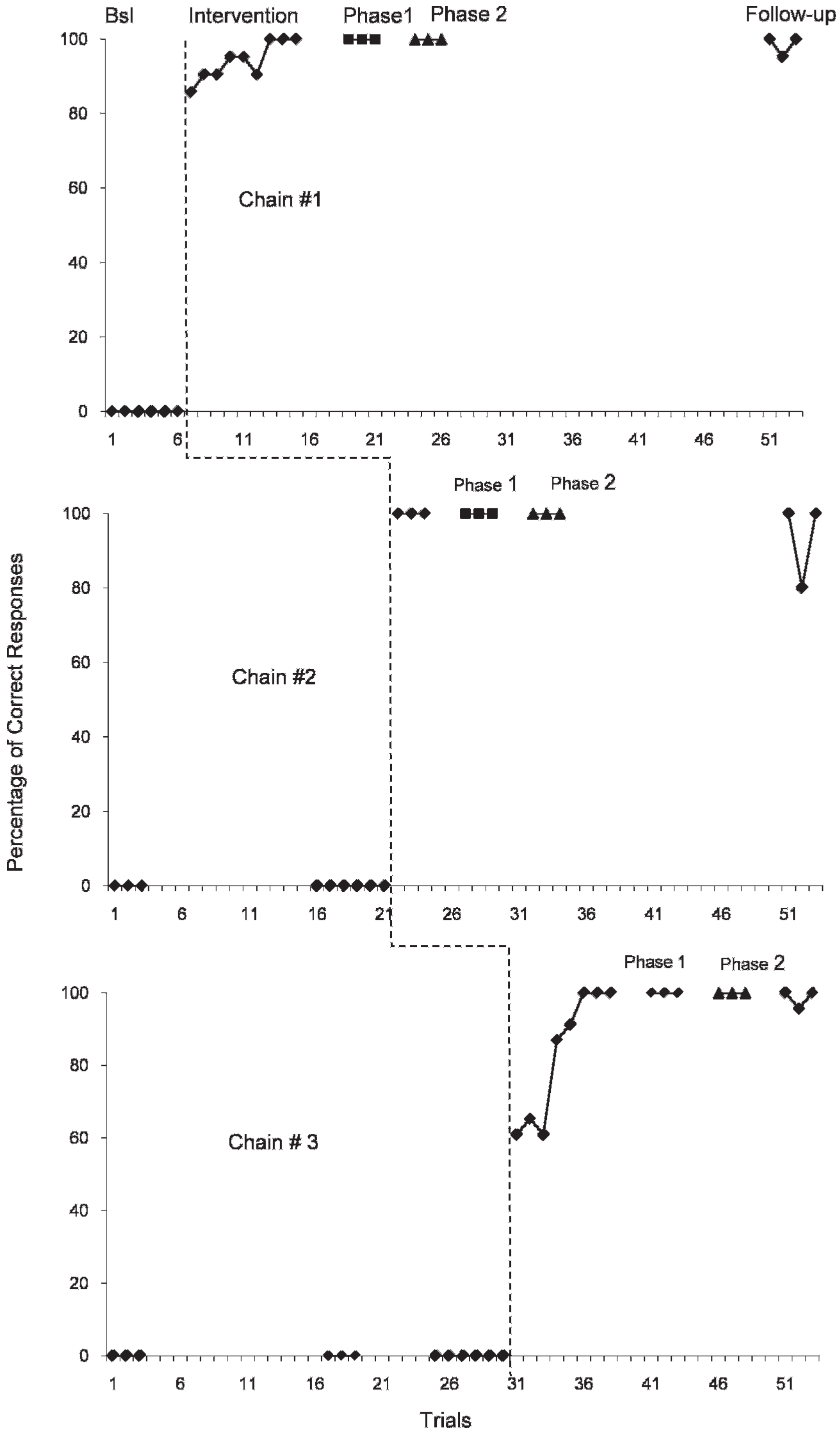

Figure 1. Percentage of correct responding during training of three chains for Simon, the percentages of correct responding (match between nonverbal behavior and self-talk) in testing for overt and covert self-instruction and in testing for blocking. The percentage of correct responding on the follow-up tests is included.

included follow-up data, and these measures should also be included in future research.

It is important to point out that self-talk was not part of Simon's repertoire prior to the onset of the study. Therefore, in pretraining, he was trained to self-talk while performing some simple computer tasks. Earlier studies using the silent dog method have included participants who could already engage in self-talk. Further research should include participants with a limited verbal repertoire to pretrain rule-governed behavior. Thus, if the results from the current study are replicated, this protocol could be used to help develop self-generated instructions in participants with a limited verbal repertoire.

The second control condition (testing for blocking) in Hayes et al. (1998) was employed to demonstrate that task performance is functionally altered whenever modifications in the talk-aloud instructions change the ongoing stream of talk-aloud reports. We found it appropriate to use different math tasks as distracters. These tasks have already been used as distracters in earlier studies (Arntzen, 2006). Rehfeldt and Dixon (2000) found that, during a condition in which participants were required to self-talk while they performed a matching-to-sample task, performance increased in contrast with a condition in which participants were required to recite letters in the alphabet. Other studies have used other forms of distracters such as random numbers spoken by the trainer (Faloon & Rehfeldt, 2008; Taylor & O'Reilly, 1997) or requiring the participants to repeat after the experimenter and solve simple math operations such as, ''What is 2 plus 5 plus 4 divided by 3?'' (Alvero & Austin, 2006). In addition, Cabello and O'Hora (2002) used distracters such as counting forwards and backwards, adding or multiplying numbers, making words out of syllables, reciting words backwards, and repeating the same word a number of times. Their results suggest that some of these distracters did not seem to disrupt on-task behavior but rather disrupted self-talk. However, in the current study it could be argued that the different results obtained with the use of different distracters was largely due to increased demands imposed by adding and multiplication. Although these distracters could have directly disrupted nonverbal performance, they were initially chosen for being compatible with on-task behavior. Thus, an important limitation of this methodology is that distracters could disrupt not only the self-talk but also the on-task behavior, making it difficult to assume that nonverbal behavior is being mediated by verbal behavior. Future research should clarify the types of distracters to be used in the silent dog method. These studies should focus on how distracters along a dimension of demands will affect nonverbal performance.

The effects of blocking in the first test phase with distracters were not satisfactory because there was no reduction in performance. When different distracters with a higher degree of demands were introduced, correct responding was reduced to baseline levels. It is worth noting that the relative reduction in the current study is greater than that obtained in previous studies (e.g., Faloon & Rehfeldt, 2008; Taylor & O'Reilly, 1997). Thus, it can be argued that the distracters used in the current study may have influenced both self-talk and on-task behavior.

In the test for self-instructions as external directives, Philip's responding improved for all three chains. For one of the chains, there was only 43% correspondence between nonverbal and verbal behavior (i.e., self-talk). This may have been due to the types of instructions generated from Simon's verbal reports. Pelaez and Moreno (1998) suggest four dimensions of rules that may affect the performance of the listener: (a) explicitness (when all contingency components are described); (b) accuracy (when there is a high correlation between the verbal description and the consequences of following the rule); (c) complexity (the number of components present in the verbal description); and (d) source (whether self-generated or generated by others). Philip's performance may be explained by the fact that the rules generated from Simon's self-talk were not explicit. An important aspect of the current study is that the silent dog method was used with individuals with a limited verbal repertoire. It is unclear whether Simon engaged in covert self-talk before being directly trained to do so. However, after pretraining and when first required to vocalize during the tests in Phase 2, he immediately engaged in overt self-talk. In addition, there was a 100% correspon-

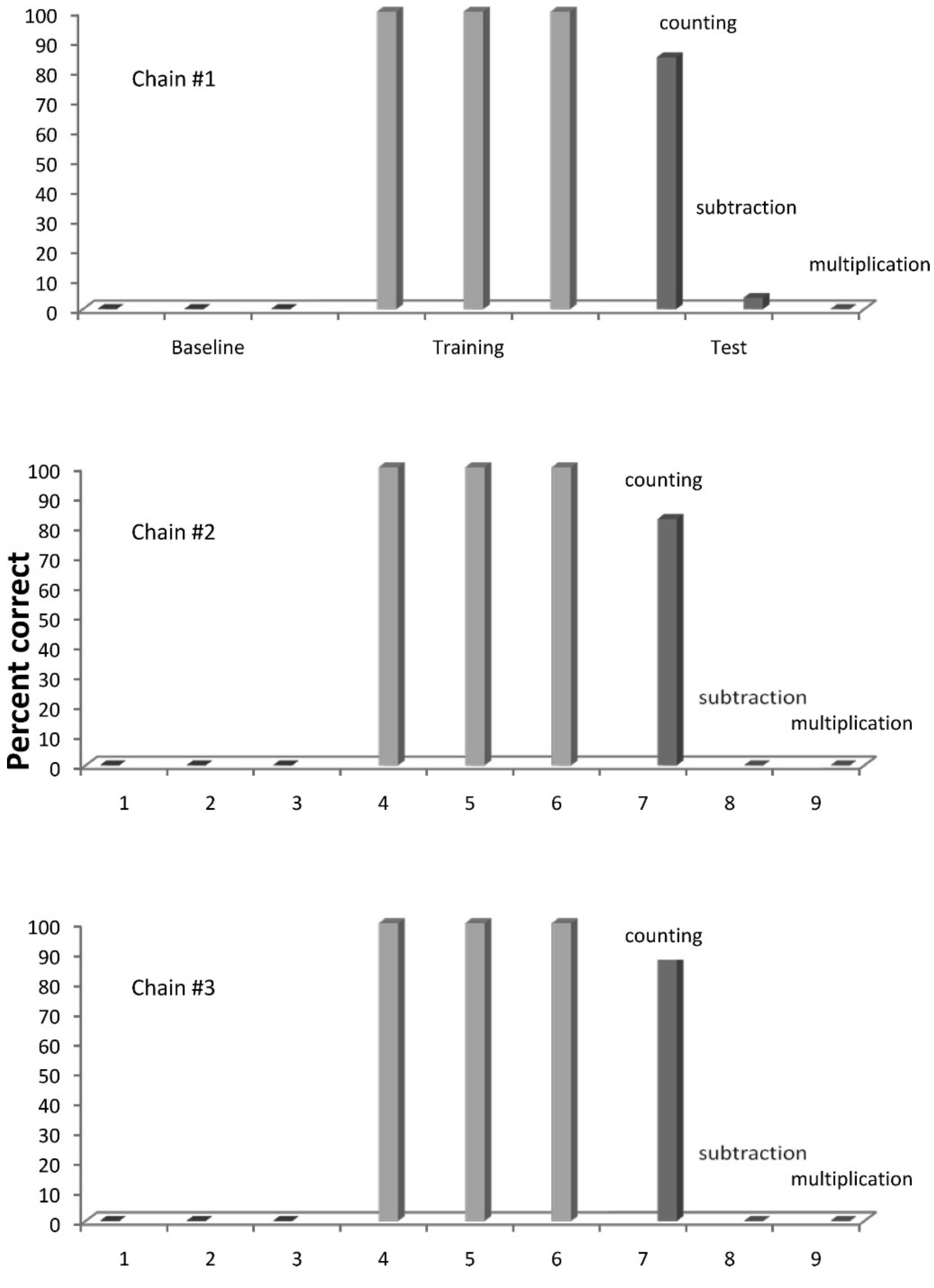

Figure 2. Percentages of correct responding (defined as an identical match between nonverbal behavior and self-talk) in Phase 4 in which three new distracters were presented (testing for blocking).

dence between self-talk and on-task behavior in all three chains without any arranged reinforcement contingencies. It is possible that Simon engaged in covert self-talk during Phase 1. Skinner (1957) argued that there are a number of ways in which overt responses may become covert. Social consequences could play an important role. According to Skinner,

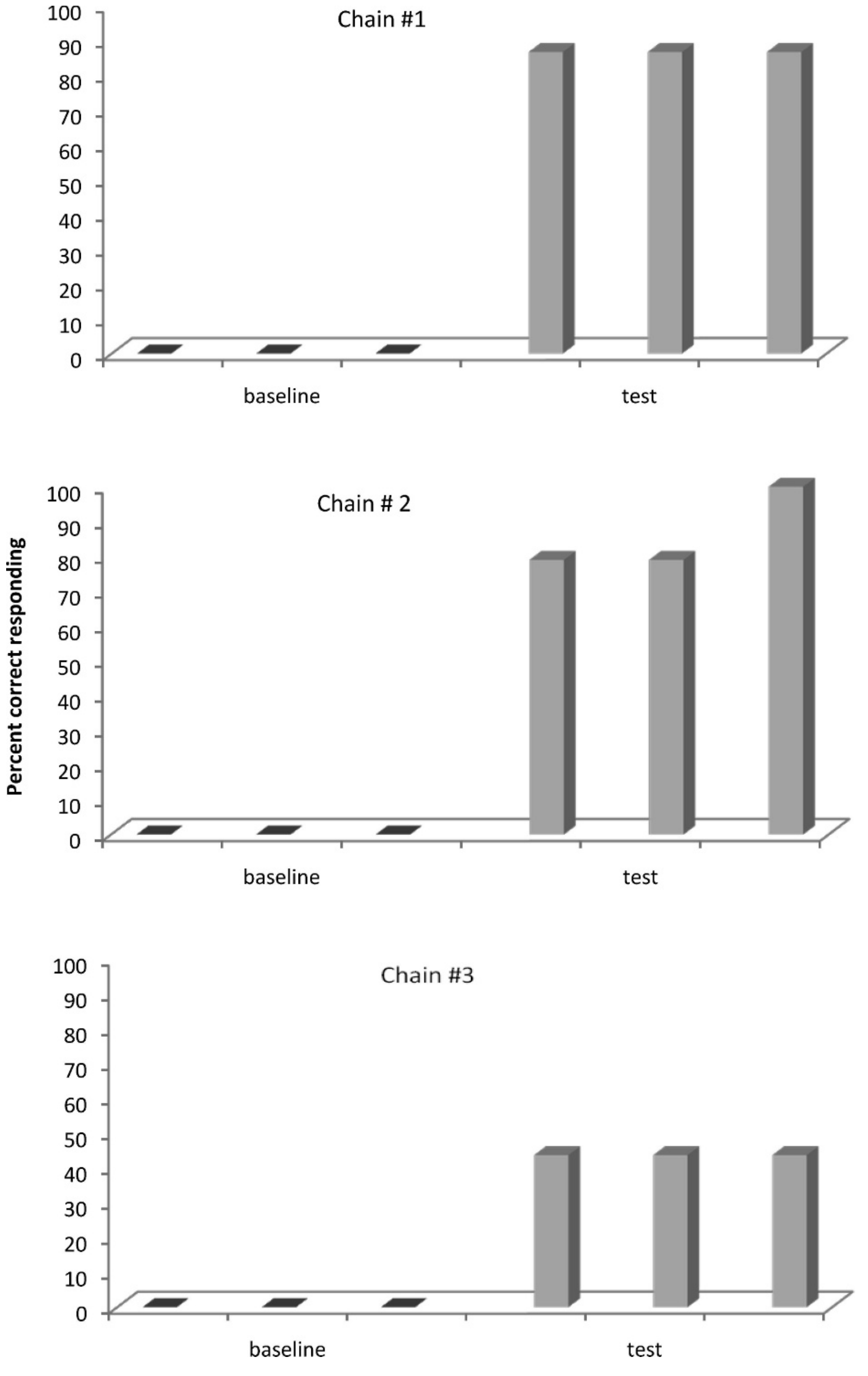

Figure 3. Percentages of correct responding in the three chains generated from testing for self-instructions as external directive.

> Covert speech is not, however, wholly or perhaps even primarily a labor saving practice. As we have seen, verbal behavior is frequently punished. Audible behavior in the child is reinforced and tolerated up to a point; then it becomes annoying, and the child is punished for speaking. Comparable aversive consequences continue into adult years. (p. 436)

Another and more plausible reason in this case could be that the covert response is ''the easiest or, for any reason, the likeliest at the moment'' (p. 436).

Future research should use participants with a limited verbal repertoire and include training different forms of overt self-talk, such as whispering. This could extend our knowledge of instances in which private events as self-generated rules could be a part of more complex behavioral chains (Friman, Wilson, & Hayes, 1998). It is important to take into account everything that may determine human behavior. We should not ignore the possible role of covert verbal stimuli solely because they are not easily accessible (Lowe, Beasty, & Bentall, 1983). It has been suggested that verbal reports could be isolated as an operant response or serve as tacts of related nonverbal behavior (Perone, 1988). Verbal mediation could be inferred from an interview at the end of the experiment or assessed during the experiment by using a procedure similar to the one proposed in the current study. The explanatory status of such verbal reports is discussed elsewhere (e.g., Holth & Arntzen, 1998; Shimoff, 1984, 1986). However, rules need not be provided by others to control behavior; they can be self-generated (Rosenfarb, Newland, Brannon, & Howey, 1992). Vaughan (1989) suggested that ''self-talk may underlie and influence much of human adult responding'' (p. 110).

Simon's self-talk was related only to ongoing tasks on the computer, so the categorization of self-talk was not as troublesome as it could be in many such procedures (see, e.g., Cabello & O'Hora, 2002). The fact that Simon's self-talk was related only to the tasks was probably connected to the point that he had a limited verbal repertoire and also that this was what he had been trained to do during pretraining. Neither Simon nor Philip produced verbal responses that were relevant to the computer task in any of the other phases.

Along with Faloon and Rehfeldt (2008), the current study differed from earlier studies published on the silent dog method and self-instructions with respect to the presentation of feedback at the completion of the chain and not after each step. This minimizes the possibility that chain performance was under control of direct contingencies of reinforcement.

A possible limitation of the study was that written instructions could have guided accurate responding after the physical prompts were no longer delivered. However, this is unlikely given that these instructions were general statements and gave no specific details on how to solve the task. In addition, during baseline the written instructions failed to set the occasion for accurate responding.

The types of computer skills trained in the current study had an applied value for both participants. In addition, the study is further enhanced in that the participants worked in the natural classroom environment. The current study is also one of the few to attempt an analysis of self-talk on on-task performance, and is an innovative approach to instructions. There seems to be great potential for its use in examining relations between covert verbal behavior and overt performance and as an intervention to establish correspondence between a participant's verbal behavior and performance on some tasks. Thus, this seems to be an important area of applied and conceptual research on rule-governed behavior.

REFERENCES

Agnew, J. L., & Redmon, W. K. (1992). Contingency specifying stimuli: The role of ''rules'' in organizational behavior management. *Journal of Organizational Behavior Management, 12,* 67–76.

Alvero, A. M., & Austin, J. (2006). An implementation of protocol analysis and the silent dog method in the area of behavioral safety. *The Analysis of Verbal Behavior, 22,* 61–79.

Arntzen, E. (2006). Delayed matching to sample and stimulus equivalence: Probability of responding in accord with equivalence as a function of different delays. *The Psychological Record, 56,* 135–167.

Blakely, E., & Schlinger, H. D. (1987). Rules: Function-altering contingency-specifying stimuli. *The Behavior Analyst, 10,* 183–187.

Bornstein, P. H., & Quevillon, R. P. (1976). The effects of a self-instructional package on overactive preschool boys. *Journal of Applied Behavior Analysis, 9,* 179–188.

Cabello, F., & O'Hora, D. (2002). Addressing the limitations of protocol analysis in the study of complex human behavior. *International Journal of Psychology and Psychological Therapy, 2,* 115–130.

Duarte, A., & Baer, D. M. (1994). The effects of self-instruction on preschool children's sorting of generalized in-common tasks. *Journal of Experimental Child Psychology, 57,* 1–25.

Faloon, B. J., & Rehfeldt, R. A. (2008). The role of overt and covert self-rules in establishing a daily living skill in adults with mild developmental disabilities. *Journal of Applied Behavior Analysis, 41,* 393–404.

Fjellstrom, G. G., Born, D., & Baer, D. M. (1988). Some effects of telling preschool children to self-question in a matching task. *Journal of Experimental Child Psychology, 46,* 419–437.

Friedling, C., & O'Leary, S. G. (1979). Effects of self-instructional training on second- and third-grade hyperactive children: A failure to replicate. *Journal of Applied Behavior Analysis, 12,* 211–219.

Friman, P. C., Wilson, K. G., & Hayes, S. C. (1998). Behavior analysis of private events is possible, progressive, and nondualistic: A response to Lamal. *Journal of Applied Behavior Analysis, 31,* 707–711.

Greer, R. D., & Speckman, J. (in press). The integration of speaker and listener responses: A theory of verbal development. *The Psychological Record*.

Grote, I. (2003). Individualizing self-instruction for adults with developmental disabilities: Intensifying its occurrence produces generalized compliance with SI. *Journal of Developmental and Physical Disabilities, 14,* 281–289.

Grote, I., & Baer, D. M. (2000). Teaching compliance with experimentally managed self-instructions can accomplish reversal shifts. *Journal of Developmental and Physical Disabilities, 12,* 217–233.

Grote, I., Rosales, J., & Baer, D. M. (1996). A task analysis of the shift from teacher instructions to self-instructions in performing an in-common task. *Journal of Experimental Child Psychology, 63,* 339–357.

Grote, I., Rosales, J., Morrison, K., Royer, C., & Baer, D. M. (1997). A use of self-instruction to extend the generalization of a self-instructed in-common discrimination. *Journal of Experimental Child Psychology, 66,* 144–162.

Guevremont, D. C., Osnes, P. G., & Stokes, T. F. (1988). The functional role of preschoolers' verbalizations in the generalization of self-instructional training. *Journal of Applied Behavior Analysis, 21,* 45–55.

Hagtvet, B., & Lillestolen, R. (1985). *Reynells Språktest [Reynell Developmental Language Scales]*. Oslo: Universitetsforlaget.

Hayes, S. C. (Ed.). (1989). *Rule-governed behavior: Cognition, contingencies, and instructional control*. New York: Plenum.

Hayes, S. C., & Hayes, L. J. (1992). Verbal relations and the evolution of behavior analysis. *American Psychologist, 47,* 1383–1395.

Hayes, S. C., White, D., & Bissett, R. T. (1998). Protocol analysis and the ''silent dog'' method of analyzing the impact of self-generated rules. *The Analysis of Verbal Behavior, 15*, 57–63.

Higa, W. R., Tharp, R. G., & Calkins, R. P. (1978). Developmental verbal control of behavior: Implications for self-instructional training. *Journal of Experimental Child Psychology, 26,* 489–497.

Holth, P., & Arntzen, E. (1998). Symmetry versus sequentiality related to prior training, sequential dependency of stimuli, and verbal labeling. *The Psychological Record, 48,* 293–315.

Horne, P. J., Lowe, C. F., & Randle, V. R. L. (2004). Naming and categorization in young children: II. Listener behavior training. *Journal of the Experimental Analysis of Behavior, 81,* 267–288.

Jay, A. S., Grote, I., & Baer, D. M. (1999). Teaching participants with developmental disabilities to comply with self-instructions. *American Journal on Mental Retardation, 104,* 509–522.

Keohane, D. D., & Greer, R. D. (2005). Teachers' use of a verbally governed algorithm and student learning. *International Journal of Behavioral Consultation and Therapy, 1,* 252–271.

Kirby, K. C., & Holborn, S. W. (1986). Trained, generalized, and collateral behavior changes of preschool children receiving gross-motor skills training. *Journal of Applied Behavior Analysis, 19,* 283–288.

Lowe, C. F., Beasty, A., & Bentall, R. P. (1983). The role of verbal behavior in human learning—Infant performance on fixed-interval schedules. *Journal of the Experimental Analysis of Behavior, 39,* 157–164.

Lowenkron, B. (2004). Meaning: A verbal behavior account. *The Analysis of Verbal Behavior, 20,* 77–99.

Parrott, L. (1987). Rule-governed behavior: An implicit analysis of reference. In S. Modgil & C. Modgil (Eds.), *B. F. Skinner: Consensus and controversy* (pp. 265–276). London: Falmer.

Pelaez, M., & Moreno, R. (1998). A taxonomy of rules and their correspondence to rule-governed behavior. *Revista Mexicana de Analisis de la Conducta, 24,* 197–214.

Perone, M. (1988). Laboratory lore and research practice in the experimental analysis of human behavior: Use and abuse of subjects' verbal reports. *The Behavior Analyst, 11,* 71–75.

Rehfeldt, R. A., & Dixon, M. R. (2000). Investigating the relation between self-talk and emergent stimulus relations. *Experimental Analysis of Human Behavior Bulletin, 18,* 28–29.

Ribes-Iñesta, E. (2000). Instructions, rules, and abstraction: A misconstrued relation. *Behavior and Philosophy, 28,* 41–55.

Roberts, R. N., Nelson, R. O., & Olson, T. W. (1987). Self-instruction: An analyis of the differential effects of instruction and reinforcement. *Journal of Applied Behavior Analysis, 20,* 235–242.

Rosenfarb, I. S., Newland, M. C., Brannon, S. E., & Howey, D. S. (1992). Effects of self-generated rules on the development of schedule-controlled behavior. *Journal of the Experimental Analysis of Behavior, 58,* 107–121.

Sautter, R. A., & LeBlanc, L. A. (2006). Empirical applications of Skinner's analysis of verbal behavior with humans. *The Analysis of Verbal Behavior, 22,* 35–48.

Shimoff, E. (1984). Post-session questionnaires. *Experimental Analysis of Human Behavior Bulletin, 2,* 1.

Shimoff, E. (1986). Post-session verbal reports and the experimental analysis of behavior. *The Analysis of Verbal Behavior, 4,* 19–22.

Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.

Skinner, B. F. (1966). An operant analysis of problem solving. In B. Kleinmuntz (Ed.), *Problem solving: Research, method, and theory* (pp. 225–257). New York: Wiley.

Skinner, B. F. (1969). *Contingencies of reinforcement*. New York: Appleton-Century-Crofts.

Taylor, I., & O'Reilly, M. F. (1997). Toward a functional analysis of private verbal self-regulation. *Journal of Applied Behavior Analysis, 30,* 43–58.

Vaughan, M. (1989). Rule-governed behavior in behavior analysis. In S. C. Hayes (Ed.), *Rule-governed behavior: Cognition, contingencies, and instructional control* (pp. 97–118). New York: Plenum.

Vintere, P., Hemmes, N. S., Brown, B. L., & Poulson, C. L. (2004). Gross-motor skill acquisition by preschool dance students under self-instruction procedures. *Journal of Applied Behavior Analysis, 37,* 305–322.

Wacker, D. P., Berg, W. K., McMahon, C. M., Templeman, M., McKinney, J., Swarts, V., et al. (1988). An evaluation of labeling-then-doing with moderately handicapped persons: Acquisition and generalization with complex tasks. *Journal of Applied Behavior Analysis, 21,* 369–380.