An Evaluation of Instruction in Visual Imagining on the Written Spelling Performance of Adolescents with Learning Disabilities

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Abstract Recent research has evaluated the utility of teaching potentially covert strategies to mediate overt performance. As an extension of this developing literature, the current study used a multiple-probe design to evaluate the effects of instructing in a visual imagining strategy on correct written spelling responses with three adolescents with various learning disabilities. After the participants were presented with the textual target stimuli, they were instructed to imagine the word in their head before writing it down. All three participants demonstrated improvements in spelling after this instruction, but two of them required additional consequences to meet the mastery criterion.

Keywords Covert behavior · Problem solving · Visual imagining · Spelling · Learning disability

Skinner (1957) stated collateral or mediating behavior could provide supplementary stimulus control to an individual's overt or covert verbal responding. Collateral behaviors may be helpful in the emergence of academic repertoires such as dictation taking (e.g., written spelling), which is a written behavior controlled by a vocal stimulus (Skinner). In experiment 1 of De Souza and Rehfeldt (2013), four young adult males with intellectual disabilities demonstrated emergence of vocal spelling of target words after being instructed in written spelling. One participant was observed tracing letters on the table or in the air during posttest probes while the other participants were observed repeating the dictated word during pretest and posttest probes. It is possible these collateral verbal responses may have mediated the participants' vocal spelling responses.

Another important repertoire that tends to occur covertly is problem solving (e.g., grouping stimuli, visual imagining, observing the environment), through which individuals may emit behavior that evokes a solution to a problem (Palmer 1991). Recent studies

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have demonstrated the possibility of teaching problem-solving strategies, such as self-prompts and a visual imagining strategy, to facilitate the acquisition of complex verbal repertoires (Kisamore et al. 2011; Sautter et al. 2011). In relation to dictation taking, Sears and Johnson (1986) showed that typically developing elementary school children who were instructed to either “see” the words covertly before writing a response (i.e., visual imagining instruction) or to copy the target words had a significantly higher written spelling performance than participants who were instructed to spell the target words aloud. Furthermore, a descriptive assessment revealed those who were instructed in visual imagining had higher written spelling performances than those who only copied the text.

Additional behavioral research is needed to evaluate the role of covert behavior to facilitate overt academic performance. The purpose of the present study was to examine the instruction of visual imagining (as presented in Sears and Johnson 1986) on the acquisition of written spelling responses with adolescents with complex learning disabilities. Collateral responses were also evaluated to examine the possibility of these responses mediating overt responding as was observed in De Souza and Rehfeldt (2013).

Method

Participants and Setting

Participants were one male and two female adolescents with learning disabilities between 17–18 years of age. All three participants attended a nonprofit boarding school for adolescents with complex learning disabilities. Mary was a 17-year-old female diagnosed with receptive-expressive language disorder, auditory processing disorder, attention-deficit/hyperactivity disorder (ADHD), dyscalculia, and dyslexia. Steven was an 18-year-old male diagnosed with ADHD and Asperger’s Syndrome. Stacy was a 17-year-old female diagnosed with ADHD. Participants were observed following vocal instructions during all conditions without difficulty. All participants were able to identify as a listener, tact, and write all letters. Sessions were conducted at the school in an isolated office consisting of a large desk and two chairs. Sessions lasted between 3 to 20 min and occurred three to five times per week.

Materials and Stimuli

Materials included a pen, 21.6 cm×27.9 cm college-wide binder paper for pretest and posttest probe sessions and 7.6 cm×5.0 cm strips of blank white paper for all conditions. Target stimuli were 10, 6–12 letter words selected for each participant from an online American College Test (ACT®) preparation source (“ACT® prep words”). ACT® preparation words were considered relevant target stimuli due to the participants preparing to take the ACT® exam. The target stimuli were printed on 7.6 cm×12.0 cm blank flash cards and were presented during all instructional conditions (see Table 1).

Response Measurement

The dependent variable was the percentage of correct written spelling responses per 30-trial block during pretest and posttest probes and all instructional conditions. A correct

Table 1 Words targeted during testing and instruction

Participant	Target stimuli
Mary	Agrarian
	Connoisseur
	Incorrigible
	Inevitable
	Irrefragable
	Languid
	Pendulous
	Propensity
	Regalia
	Zealot
Steven and Stacy	Cavalier
	Complaisant
	Deliquesce
	Exegesis
	Forebode
	Ingratiate
	Malign
	Proselyte
	Repost
	Respite

response was defined as a response that demonstrated point-to-point correspondence to the vocal form of the written word. For example, if the participant spelled “L-A-N-G-U-I-D” in written form after the experiment said, “Write languid,” the response was deemed correct. An incorrect response was defined as a response that did not have point-to-point correspondence to the vocal form of the written word, or the participant did not initiate a response within 5 s. Each target word was presented three times per 30-trial block in random order during all probes and instructional sessions. Collateral responses from each participant such as finger spelling, vocal spelling, echoing the dictated word, or looking away from their paper before writing a response were individually recorded on a trial-by-trial basis during all sessions. Finger spelling was defined as using a finger or pen to trace the target stimuli with no contact of the paper. Vocal spelling was defined as tacting overtly each letter of the target stimuli presented. Echoing the dictated word consisted of repeating the target stimuli (regardless of volume), which included moving lips to the words without sound. Looking away from paper was defined as the participants’ eyes not facing the paper for more than 2 s after the instruction was presented.

Interobserver Agreement and Procedural Reliability

Interobserver agreement (IOA) and procedural reliability were assessed for 33 % of each participant’s pretest and posttest probes using a second, independent observer. IOA was calculated on a trial-by-trial basis by dividing agreements by agreements plus

disagreements and converting the ratio to a percentage. Mean IOA scores for spelling and collateral responses were 97 and 83 % for Mary, 98 and 100 % for Steven, and 99 and 93 % for Stacy, respectively. Procedural reliability was evaluated by using checklists created specifically for pretest and posttest probes. Steps on the checklist included tasks such as telling the participant the correct instruction of which word to write for each trial and not providing feedback for responses written during the control and visual imagining instruction conditions. Procedural reliability was calculated by dividing the number of steps completed correctly during a session by the experimenter by the number of total of steps on the checklist and converting the ratio to a percentage. Mean procedural reliability scores were 100 % for Mary, 99 % for Steven, and 99 % for Stacy.

Experimental Design

A multiple-probe design across participants was implemented (Horner and Baer 1978). Pretest probes were conducted followed by a presentation of textual stimuli (the control condition), a visual imagining instruction (VI) condition, and a condition that included visual imagining instruction plus consequences (VI+C) condition. Posttest probes were conducted after each condition. Each participant began the next subsequent phase if he or she did not reach the mastery criterion (30 out of 30 words correct) within three consecutive posttest probe sessions with the previous condition.

Procedures

Pretests and Posttests Correct written spelling responses of the target stimuli were examined during pretest and posttest probes. The experimenter provided the following instructions to the participants before each probe session: “I will ask you to spell some words by writing them down on a piece of paper. I will not tell you if the words are spelled right or wrong. I will not repeat the word. Try your best to spell each word on the piece of paper.” Each probe trial began with a practice trial of a three-letter word. If the participant answered correctly, the first of 30 probe trials began. Before each probe trial, the experimenter obtained eye contact from the participant before providing the instruction, “Write ____.” No consequences or prompts were given for responses.

Control Condition The purpose of the control condition was to evaluate the acquisition of spelling responses when presented the textual target stimuli only. The experimenter gave the participants the following instructions before the control condition session began: “I will show you and say a word written on flash cards. You will have 5 s to look at the word and then be instructed to write the word on a small piece of paper.” The control condition began with a practice trial of a three-letter word. If the participant answered correctly, the first of 30 instructional trials was presented. During each instructional trial, the experimenter presented the participant a flash card of a target word for 5 s to the participant and said, “The word is ____.” The experimenter removed the card and instructed the participant to write the word on a strip of paper. No consequences or prompts were given for correct or incorrect responses. If a participant did not initiate a response within 5 s, the experimenter presented the next trial. A new piece of paper was given for each word presented in each trial. At the end of the 30-trial block, the participant began posttest probe sessions.

Visual Imaging Instruction Condition (VI) The purpose of the VI instruction condition was to examine if instructing participants to see the words covertly without

Fig. 1 Percentage of correct written spelling responses for Mary, Steven, and Stacy. *NS* indicates when new stimuli were presented to Steven. *R* indicates when remedial VI instruction sessions were conducted with Mary and Steve

feedback or reinforcement would mediate correct written spelling responses. The experimenter gave the participants the following instructions at the beginning of this instructional session: “I will show you and say a word written on flash cards. You will have 3 s to look at the word after which I will remove the card. I will then instruct you to imagine seeing the word in your head to remember it. Then, you will be instructed to write the word on a small piece of paper.” The session began with a practice trial of a three-letter word. If the participant answered correctly, an instructional trial was presented. On each instructional trial, the experimenter presented a flash card of a word for 3 s to the participant and said, “The word is ____.” Then, the experimenter removed the flash card and said, “See if you can see the written word in your head (3 s pause). Imagine the word on a piece of white paper (3 s pause). Help yourself remember the word by imagining yourself writing over each letter of the word (3 s pause). Write ____.” No consequences or prompts were given for correct or incorrect responses. If the participant did not respond within 5 s, the experimenter presented the next instructional trial. A new strip of paper was given for each word presented in each trial. A remedial VI instruction session was implemented if responding did not reach mastery criterion after three VI instruction posttest probes.

Visual Imagining Instruction+Consequences Condition (VI+ C) This condition was the same as the VI instruction condition except that feedback on correct and incorrect responses were included. For correct responses, the experimenter provided verbal praise such as “That is correct” and before presenting a different target word on the next trial. For incorrect responses, the experimenter modeled the correct response on the same piece of paper, gave the participant a new piece of paper, and repeated the VI instruction with the same word until a correct response was emitted. Such trials were scored as incorrect. If a participant did not respond within 5 s, the experimenter implemented the error correction procedure and repeated the instructional trial. The mastery criterion was 100 % correct written spelling responses (30 out of 30 words) for two consecutive VI+C sessions.

Results and Discussion

Figure 1 shows that the mean percentage of correct spelling responses during pretest probes for all participants were 14 % for Mary (range, 13–17 %), 38 % for Steven

Table 2 Collateral responses in each condition

Participant	Pretest (mean)	Control (total)	Control post (mean)	VI (total)	VI Post (mean)	VI re-medial (total)	VI re-medial posts (mean)	VI+C (total)	VI+C posts (mean)
Mary	6	42	6	28	3	27	2	30	4
Steven	0.3	7	0	1	0.3	0	0	0	0
Stacy	4	0	0	5	0	-	-	-	-

VI visual imagining instruction, VI+ C visual imagining instruction plus consequence

(range, 26–63 %), and 17 % for Stacy (range, 10–20 %). New target stimuli were presented to Steven on the third pretest probe session due to a high percentage of correct responding in the second session.

Mary and Steven mastered correct written spelling responses after the VI+C condition. However, Steve's correct written spelling responses increased greatly after a remedial session of the VI instruction condition. Stacy met mastery criterion after the VI instruction condition only, but she showed a substantial increase in responding after the control condition. Correct written spelling responses during posttest probes ranged from 20 to 100 % for Mary, 40 to 100 % for Steven, and 70 to 100 % for Stacy.

No relation was observed between the participants' collateral responses and correct written spelling responses during posttests (see Table 2). Overall, Mary engaged in the most collateral responses compared to Steven and Stacy during all test probes and instructional sessions. All participants were observed echoing the target words but Mary was mostly observed mouthing out the target words. The present study's results were unlike the relation observed between corollary responses and correct vocal spelling responses observed in De Souza and Rehfeldt (2013). It is possible that all three participants engaged in some type of covert behavior before emitting a written spelling response. However, this is uncertain because correct written spelling responses were the only measurable outcome to support this claim.

A few limitations of the present study and suggestions for future research warrant discussion. During the control condition, each target word was read aloud in the presence of the textual stimuli (without differential performance consequences) for methodology purposes. However, the arrangement may have weakened textual control and should be excluded in future studies. In addition, the repetition of the textual stimuli during all conditions may have increased correct responding alone due to the increasing trend shown in each participant's evaluation. Future research might address the efficacy of providing a prompt or rule to use the visual imagining strategy during posttest probes with another response topography or new set of words after the VI instruction condition is implemented, similar to what was done in Kisamore et al. (2011) and Sautter et al. (2011). In addition, examining the effects of error correction or reinforcement on correct responding should be further evaluated because it is uncertain if both were needed for Mary and Steven to master correct written spelling responses. The use of a less stringent mastery criterion may also be used in future research. Finally, instructing participants to engage in a collateral response (e.g., finger spelling) or implementing a talk aloud procedure (Rehfeldt and Hayes 2000) could assist the investigation of the role of overt and covert mediating behaviors on performance.

The present study extends the literature on problem solving (and potentially covert behavior) to the facilitation of overt academic performance and was the first to include people with learning disabilities. However, these results are preliminary, and further replications are needed to determine whether instruction in covert behavior can reliably facilitate overt performance and under what conditions.

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