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The Emergence of Autoclitic Frames in Atypically and Typically Developing Children as a Function of Multiple Exemplar Instruction

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In two experiments, we tested the effect of multiple exemplar instruction (MEI) for training sets on the emergence of autoclitic frames for spatial relations for novel tacts and mands. In Experiment 1, we used a replicated pre- and post-intervention probe design with four students with significant learning disabilities to test for acquisition of four autoclitic frames with novel tacts and mands before and after MEI. The untaught topographies emerged for all participants. In Experiment 2, we used a multiple probe design to test the effects of the MEI procedures on the same responses in four typically developing, bilingual students. The novel usage emerged for all participants. In the latter experiment, the children demonstrated untaught usage of mand or tact frames regardless of whether they were taught to respond in either listener or speaker functions alone or across listener and speaker functions. The findings are discussed in terms of the role of MEI in the formation of abstractions.

Key words: verbal behavior, autoclitic frames, verbal developmental theory, relational frame theory, multiple exemplar instruction, naming

This paper describes two experiments that were conducted to investigate autoclitic frames for spatial relations, how they might be induced, and what relationship the frames might have to other forms of verbal phenomena (Luke, 2009). These experiments test a way to teach autoclitic frames to students who do not have that functional class of responding. We examine both the teaching procedure itself and the application of it to new content as our two areas of interest. Autoclitic frames for spatial relations are defined, in this research, as a specific subset of autoclitics that have to do with the relationships between objects and/or objects and one's self in physical space.

An autoclitic is described by Skinner as verbal behavior ''which is based upon or depends upon other verbal behavior'' (1957, p. 315). It ''clarif (ies) or alter(s) the effect of verbal behavior upon the listener'' (Skinner, 1957, p. 332). The autoclitic is defined by its effect on the listener, by its function as part of a verbal exchange, and, unlike grammatical classifications, depends on the entire exchange for its classification. For example, ''the box under the table,'' functions as an autoclitic only if it changes the listener's behavior relative to a function for the speaker. Similar to the functional independence of the mand and the tact operants (Lamarre & Holland, 1985; Twyman, 1996), Skinner conceived of the autoclitic as a distinct verbal operant within the context of a functional communicative exchange.

Spatial relations are defined as a demonstrated ''comprehension'' (Sidman, 1994) of the relationship of oneself in space to other objects or people by the use of language identifying the relationship between objects and/or self in dimensions of physical space. It can be expressed in verbal terms when someone says, ''The car is *in* the garage,'' or when they say, ''I am *under* the table, hiding,'' or ''Please give me the picture *on the left*,'' and has an autoclitic function when it affects the behavior of the listener. This term is defined in this paper to encompass specific types of both spatial relations and deictic relations as they are defined by relational frame theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001).

RFT proposed ''families'' of relational frames. Hayes et al. (2001) identified frames of coordination as the most fundamental type of relational frame and included the naming phenomenon (Horne & Lowe, 1996; Lowe & Horne, 1996) as an example of a simple frame of coordination. Additional relational frame families included opposition, distinction, comparison, hierarchical, temporal, spatial, conditionality and causality, and

deictic. Two relational frame families are significant in the context of autoclitic frames as they are addressed in this paper; spatial relations and deictic relations. Spatial relations deal with the ''arrangement of objects or aspects of objects in space, relative to each other'' (Hayes, et. al., 2001, p. 38). Examples of spatial relations as they are defined in RFT include in-out and over-under. Deictic relations are those that specify a relation in ''terms of the perspective of the speaker'' (Hayes et. al., 2001, p. 38). Examples of deictic relations include left-right and I-you.

There is, however, an acknowledged lack of information about how these frames relate with one another and what the effects of learning to respond in accordance with one type of frame might have on responding to other frame types. ''For the time being, … such issues will have to await systematic empirical investigation'' (Hayes, et. al., 2001, p. 39). The difficulty with most research in this area has been its distance from the applied field and the use of subjects who quickly and easily demonstrate the behaviors of interest. Applied researchers needed an application from this empirical, laboratory-restricted work (such as that reported in Berens & Hayes, 2007) that could be applied in the field of education, right in the schools where children live and learn.

Our interest in this research has been in identifying ways to induce this type of verbal behavior in individuals who do not already demonstrate its use. One approach that has been successful in inducing novel verbal behavior is multiple exemplar instruction (MEI). MEI consists of arranging instructional presentations in such a way as to mimic naturally occurring rotation across exposure to stimuli and the expectation of different responses to those stimuli. MEI has been used to induce naming (Horne & Lowe, 1996; Lowe & Horne, 1996), novel dictation, verb tense formation, novel metaphors, novel mands or tacts, oral and written spelling, word suffixes, and more (Gilic, 2005; Greer & Ross, 2008; Greer & Yuan, 2008; Greer, Stolfi, Chavez-Brown, & Rivera-Valdez, 2005; Greer, Yuan, & Gautreaux, 2005; Lee-Park, 2005; Mariano-Lapidus, 2005; Matthews, 2005; Murphy & Barnes-Holmes, 2009; Nirgudkar, 2005; Nuzzolo-Gomez & Greer, 2004). Multiple exemplar instruction can be conducted across sets of stimuli, across response types, and across establishing operations.

Several studies found that naming emerged as a function of MEI across speaker and listener training sets (Fiorile, 2005; Gilic, 2005; Greer et al., 2005; Greer, Stolfi, Pistoljevic, et al., 2007; Pistoljevic, 2008). The participants, both typically and atypically developing preschoolers, in these studies acquired speaker and listener functions for novel stimuli without direct instruction (i.e., learning word-object relations incidentally). The experiment by Greer et al. (2007) compared training sets of stimuli using massed instruction (training the speaker functions and listener functions separately) for each response to the MEI procedure of rotating training all responses. The numbers of instructional presentations were constant for each type of training and the design included both an experimental and control component and a multiple probe design component. Naming did not emerge when responses were trained separately, but did emerge when responses were rotated across speaker and listener functions.

Speckman-Collins, in three experiments, tested the effects of MEI across speaker and listener functions on the untaught use of suffixes such as ''-er'' and ''-s'' as autoclitic frames (2004). Each of these experiments demonstrated that multiple exemplar instruction across response types (listener and speaker) was required before the participants accurately used the suffix endings ''-er'' and ''-s'' when presented with opportunities to tact pictures of people engaged in activities (i.e., bikers, skaters) or opportunities to tact attributes of a picture when compared to another picture (i.e., wetter, bigger). Greer and Yuan (2008) found that MEI across tacts of pictures of actions with visual contexts for tense resulted in the induction of untaught regular and irregular verb tense formation, which is another type of autoclitic frame. Only after instruction was rotated across present and past tense exemplars did the participants demonstrate novel use of past tense verb formation.

Limited research or conceptual analyses exist on the various iterations of autoclitics, and even less information exists on strategies that may be successful in inducing autoclitic use in spatial relations across response forms and functions, for those learners who had not

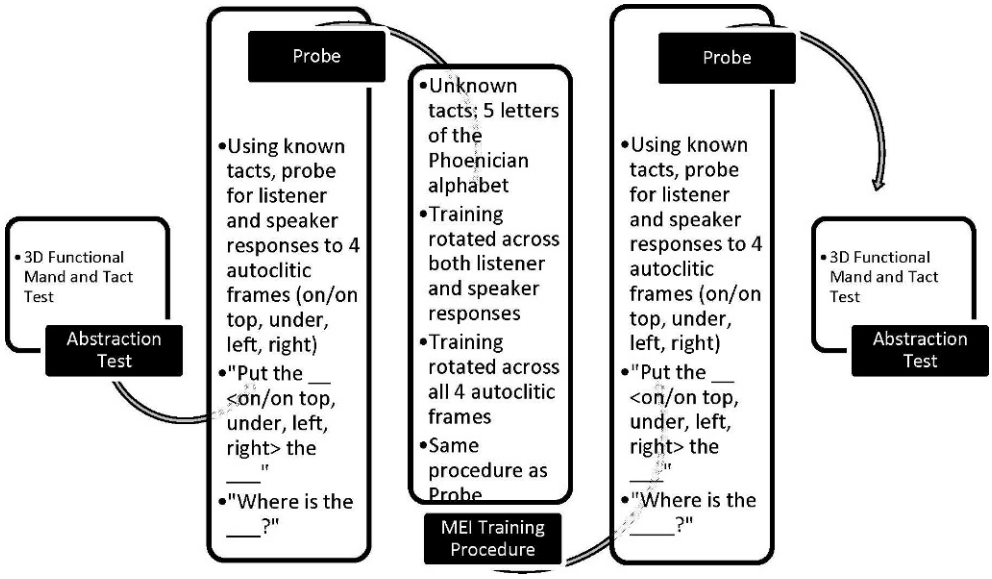

Figure 1. Procedural steps for Experiment 1.

acquired their use incidentally. Often, research including autoclitic frames does not even identify itself as such (for some examples see Lamarre & Holland, 1985; Lee, 1981; Nuzzolo-Gomez & Greer, 2004; Wynn & Smith, 2003). Autoclitic frames for spatial relations present as an important verbal phenomenon, but very little is known about them. In addition, little is known about the relation of autoclitics to other forms of verbal behavior such as the mand or tact or to phenomena such as naming or relational operants (Berens & Hayes, 2007) other than the studies cited above.

The research questions in the present series of experiments were: Can MEI successfully induce the acquisition and abstraction of autoclitic frames for spatial relations? And, what type of MEI is required to achieve this effect? We used multiple probes, and the MEI teaching procedure, with eight children, ranging in age from 3 to 7 years, who were either learning disabled or typically developing. Our method and some of our findings are described below, followed by a discussion of the findings.

GENERAL METHOD

Dependent Variables

The dependent variable in both experiments was the novel use of the autoclitic frames as either a listener or a speaker. Novel use was measured through both an acquisition probe and an abstraction test. The acquisition probe assessed the accurate use of the autoclitic frames with familiar two-dimensional pictures (probe with known tacts for acquisition tests); for example, ''Where is the banana?'' or ''Put the horse above the cat.'' The abstraction test assessed the accurate use of the autoclitic frames in generalized mand and tact functional settings with familiar three-dimensional objects as either a listener or a speaker (abstraction test/functional mand and tact test); for example: ''Where is the bear?'' or ''You can have the sticker that is to the right of the box.'' The participant was not required to accurately tact the ground picture or the object but because these were known objects, most of the participants did so as a matter of course. Data were only collected on the use of the autoclitic frame. See Figures 1 and 2 for an outline of the steps taken in each experiment and the order in which they were completed.

Procedure

Probes for the acquisition of autoclitic frames. The spatial relations that were tested in autoclitic functions were: on/on top/above, under/below, left, and right. Speaker and

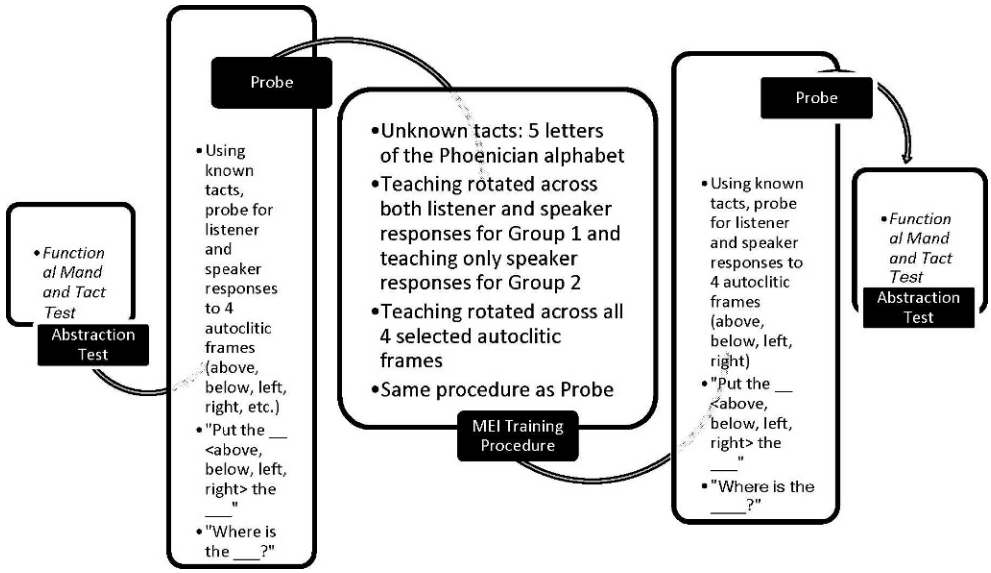

Figure 2. Procedural steps for Experiment 2.

listener topographies of tact functions were assessed in pre- and post-MEI intervention probes that tested for the presence or absence of autoclitic frames. In these probes, the experimenters used two-dimensional stimuli (2″ × 3″ color photos) that were familiar to each participant. To test the listener response, the experimenters presented a picture to the participant and asked her to place the picture in a specific relation to the ''ground'' picture which was placed on the table (e.g., ''Put the sandwich under the girl.''). To test the speaker response, the experimenters presented the ground picture, placed a second picture, and asked the participant to say where the second picture was in relation to the first (e.g., ''Where is the flower?''). No correction or reinforcement for responses to the probe trials was provided. We considered 80% correct responding in one session, consisting of a block of 40 probe trials, to be evidence of the acquisition of autoclitic frames for spatial relations. Materials used in the probes for the presence or absence of autoclitic frames were not used during any other phase of the experiments.

To test for the presence or absence of the autoclitic frames, pictures of common items the participants could tact and either point to or match were used (i.e., cat, dog, bicycle, pear, orange, apple, bed, sandwich, cup, chair, lion, car, shoes, girl, boy, flower, and fish). These pictures were presented to each participant until ten known pictures were identified. These 10 items were used randomly across the 40 trials (10 trials for each of the four autoclitic frames; 20 trials for speaker and 20 trials for listener responses; four instances of exposure to each of the 10 items).

Test for abstraction across mand and tact. The abstraction test included three-dimensional objects across listener and speaker responses: (a) tact trials, (b) mand trials, (c) standard listener trials, and (d) listener trials with preferred items. The abstraction test was conducted across the four autoclitic frames that were taught during intervention. The abstraction test was conducted at the beginning and end of the experiment. Materials used in the abstraction test were not used during any other element of the experiments but their familiarity to the participants was established prior to the experiment. Six pairs of identical objects were used for each participant; 2 identical small bears/pigs, 2 identical transparent cups, 2 identical napkins, 2 identical small cars/trains, 2 identical transparent, small boxes, and 2 identical, preferred reinforcers specific for the participant (2 identical M&Ms, 2 identical stickers, etc.). Preferred stimuli were identified using the direct, approach-based method of preference assessment (Hagopian, Long, & Rush, 2004). Mastery for abstraction measures was

Table 1
Examples of Trials Presented in Abstraction to 3D Functional Mand and Tact Test

	Listener trial with preferred items	Standard listener trial
Antecedent:	Place one candy under cup and one candy on top of cup, and say, ''Your candy/You can have the candy that is under the cup.''	Place a cup and a napkin on the table, hand the student a bear, and say, ''Put the bear in the cup.''
Correct Response:	Student lifts cup	Student places bear in cup
Incorrect Response:	Student reaches to take candy off top of cup	Student does not place bear in cup
	Mand trial	**Tact trial**
Antecedent:	Place one candy under cup and one candy on top of cup, and say, ''Which one do you want?''	Place a cup and a napkin on the table, put a bear in the cup and ask, ''Where is the bear?''
Correct Response:	Student responds vocal-verbally with the autoclitic frame to specify location of preferred candy (''on top'')	Student responds vocal-verbally with the autoclitic frame to specify location of bear (''in'')
Incorrect Response:	Student responds without autoclitic frame to specify location of preferred candy	Student responds without autoclitic frame to specify location of bear

defined as 80% correct responding in one session. The abstraction test consisted of 40 probe trials: 20 mand-function trials and 20 tact-function trials. Trials were rotated evenly across mand and tact functions, across autoclitic frames, and across listener or speaker responses. See Table 1 for examples of these trials.

The instructor presented the antecedent to the participant and scored the participant's response as correct or incorrect. Mand function trials were only presented when motivation for the object was established (the participant reached for it or asked for it). After mand function trials, the experimenter delivered the preferred stimulus to the participant if the participant manded accurately, according to the antecedent (i.e. reached for the correct item or used the autoclitic frame of location to identify the preferred item) and the experimenter provided generalized reinforcement (praise) throughout each testing session without specific reference to test responses or the accuracy of the responses to test items. No correction procedures were employed. Autoclitic frames for spatial relations assessed in the abstraction test were: on/above, under/below, left, and right. A fifth autoclitic frame was included in the abstraction test: in Experiment 1, in, and in Experiment 2, between.

Multiple exemplar instruction. The independent variable in this experiment was the use of MEI across response types (listener and speaker) and relational frames: spatial frames (on and under or above and below) and deictic frames (left and right; Hayes et. al., 2001). In this case, multiple responses were taught across stimuli that were designed to evoke four autoclitic frames for spatial relations: on/on top/above, under/below, left, and right. These were the same autoclitic frames that were probed and tested, but the stimuli used during MEI were unfamiliar to the participants.

Teaching of these autoclitic frames took place with a set of unfamiliar stimuli, as the participant was directed to ''Put the __ (on/on top/above, under/below, to the left of, or to the right of) the ____,'' when teaching the listener response or directed to answer the question, ''Where is the ___?'' when teaching the speaker response. The four autoclitic

frames specifying spatial relations were taught with a single set of five unknown items (Phoenician letters as two –dimensional symbolic tacts: A [aleph], B [beth], E [he], H [heth], Q [qōph]). The experimenter rotated instructions by rotating the four autoclitic frames and the five Phoenician letters equally across 20 instructional trials of speaker responses and 20 instructional trials of listener responses that met the criterion for learn units for a single session of 40 learn units. The order of learn units was arranged to rotate across response type, frame, and letters, such that a response type, frame, or letter was not targeted for two or more consecutive learn units. For a correct listener response, the participant was required to put the picture in the correct location as directed by the teacher, who then responded as a consequent speaker (e.g., ''Put heth above qōph.'' [observe response] ''Good job, you put heth above qōph.''). Participants were allowed access to tangible reinforcement or breaks to play on a variable schedule. For a correct speaker response, the participant was required to say the correct location aloud, using the correct autoclitic frame of location, after which the experimenter functioned as a consequent listener and subsequent speaker (e.g., ''Where is beth?'' [Listen] ''That's right! Beth is under he.''). The participant was not required to accurately tact the letter, only its location, however, all of the children did learn the names of the letters through the correction procedure and were observed to say the names of the letters as they progressed through the instructional sessions. The experimenter asked the question as soon as the pictures were in place and waited 3–5 seconds for an independent response. If the participant made an error or did not respond, the experimenter modeled the correct response, waited for the participant to place the letter or echo the correct response, and moved to the next trial. Sessions continued until the participant met the criterion of 90% combined correct responses across two consecutive sessions. A session lasted from 10 to 20 minutes.

Instructional trials that met the requirements for learn units were used in MEI. Learn units are comprised of interlocking three-term contingencies between experimenter and participant, in which the participant's attention (participant oriented toward experimenter) functions as an antecedent for the experimenter, who presents an antecedent to the participant (i.e. ''Point to the car in the cup''), and for whom the participant's response functions as both a consequence for the experimenter and a second antecedent, prompting the experimenter to deliver a consequence for the participant (either reinforcement for a correct response or correction for an incorrect response in which the participant must emit the corrected response while viewing the stimulus). Several experiments have identified that providing instructional presentations that include all of the components of the learn unit is a strong predictor for learning to occur (Albers & Greer, 1991; Bahadourian, Tam, Greer, & Rousseau, 2006; Emurian, Hu, Wang, & Durham, 2000; Greer & McDonough, 1999; Greer & Ross, 2008; Ingham & Greer, 1992; Selinski, Greer, & Lodhi, 1991).

The experimenter sat beside the participant, while the participant was seated at a child-sized desk. The experimenter presented listener and speaker learn units, in rotated order, and provided either correction or reinforcement, depending on the participant's response. Sessions occurred at least once per day and no more often than three times in a single day. Sessions taught in the same day were separated by at least two hours and a variety of regular classroom activities. Learn units were presented and correct and incorrect responses to learn units were recorded and graphed for immediate visual inspection. See Figures 1 and 2 for a display of the experimental procedures for Experiments 1 and 2.

EXPERIMENT 1

Participants

The participants in the first experiment were four elementary-school age participants, three males and one female. Participant A was 7 years old, Participants B and C were both 6 years old, and Participant D was 5 years old. All four were diagnosed with autism spectrum disorders (ASD). Participants were selected for this study because of low accurate responding to all pre-tests and pre-intervention probes on the use of autoc-

litic frames with known objects. They were selected from 5 self-contained classrooms for Kindergarten to Grade 5 students diagnosed with a variety of developmental delays. Classes were taught using behavior analytic instruction and curricula. Participants were assessed according to the New York State Curricular Standards (www.emsc.nysed.gov), the Preschool Inventory of Repertoires for Kindergarten (Greer & McCorkle, 2003; Reed, Osborne, & Corness, 2006; Waddington & Reed, 2009) and the Verbal Capabilities Checklist (Greer & Ross, 2008). Instructional objectives were selected based on these assessments as well as each participant's IEP goals.

The participants were selected from self-contained classrooms in several school districts that employed the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) (Greer, Keohane, & Healy, 2002; Lamm & Greer, 1991; Selinski, Greer, & Lodhi, 1991; Reed et al., 2006) model. CABAS® is a behavioral approach to schooling that employs a tested systems-wide analysis of the effects on student performance as the variable driving relationships within the schooling system, and among students, parents, teachers, supervisors, and the university training program. Tactics and strategies from the applied, basic, and experimental branches of behavior analysis are used based on the responses of individual students.

Setting

The study took place in the classroom, with the instructor and participant seated at a table or desk, both in child-sized chairs. The instructor and the participant sat side by side, at any table that was free of other student and teacher groups. Instructional materials were kept together in a box and placed beside the instructor, either on the floor or on the table. The other students in the classroom continued their work with other teachers as the experimenter worked with the participant.

Design

A single-case, simultaneous replicated pre- and post-intervention probe design across participants was used for this experiment (Baer, Wolf, & Risley, 1968; Johnston & Pennypacker, 1993). All participants were assessed with abstraction tests and acquisition probes before and after meeting criterion on the MEI intervention. Criterion for mastery of the MEI intervention condition was set at 90% correct responding across two consecutive sessions.

Interobserver Agreement (IOA) and Procedural Integrity

IOA was collected during abstraction tests, acquisition probes, and MEI intervention. IOA was collected using the Teacher Performance Rate and Accuracy Scale (TPRA; Greer, 2002; Greer, McCorkle, & Williams, 1989; Ingham & Greer, 1992). The total number of agreed items (both correct and incorrect responses) was divided by the total number of items and multiplied by 100. This type of IOA can be called Trial-by-Trial IOA (Cooper, Heron, & Heward, 2007). The TPRA assesses procedural integrity as well as the accuracy of recording participant responses by measuring the accuracy of the experimenter's presentation of unambiguous antecedents, the student's response, and the experimenter's delivery of consequences for student responding. Two trained teachers and four teaching assistants served as observers and experimenters. They were all trained by the primary researcher in procedures for the experiment and all achieved 100% agreement scores on unrelated instructional sessions with the primary researcher a minimum of five times prior to collecting data for this experiment.

IOA was collected for 65% of all pre- and post-MEI probes and tests, with a range for individual sessions of 97%–100% agreement and a mean agreement of 99% for all sessions with all participants for which IOA data were collected. IOA was collected for 72% of all teaching sessions, with a range of 98%–100% agreement and a mean agreement of 99%. Procedural integrity ranged from 93%–100% with a mean of 97%.

Results and Discussion

Participants A, B, C, and D met criterion for intervention in 10, 12, 11, and 8 sessions, respectively, over 3–7 days. Figures 3 and 4

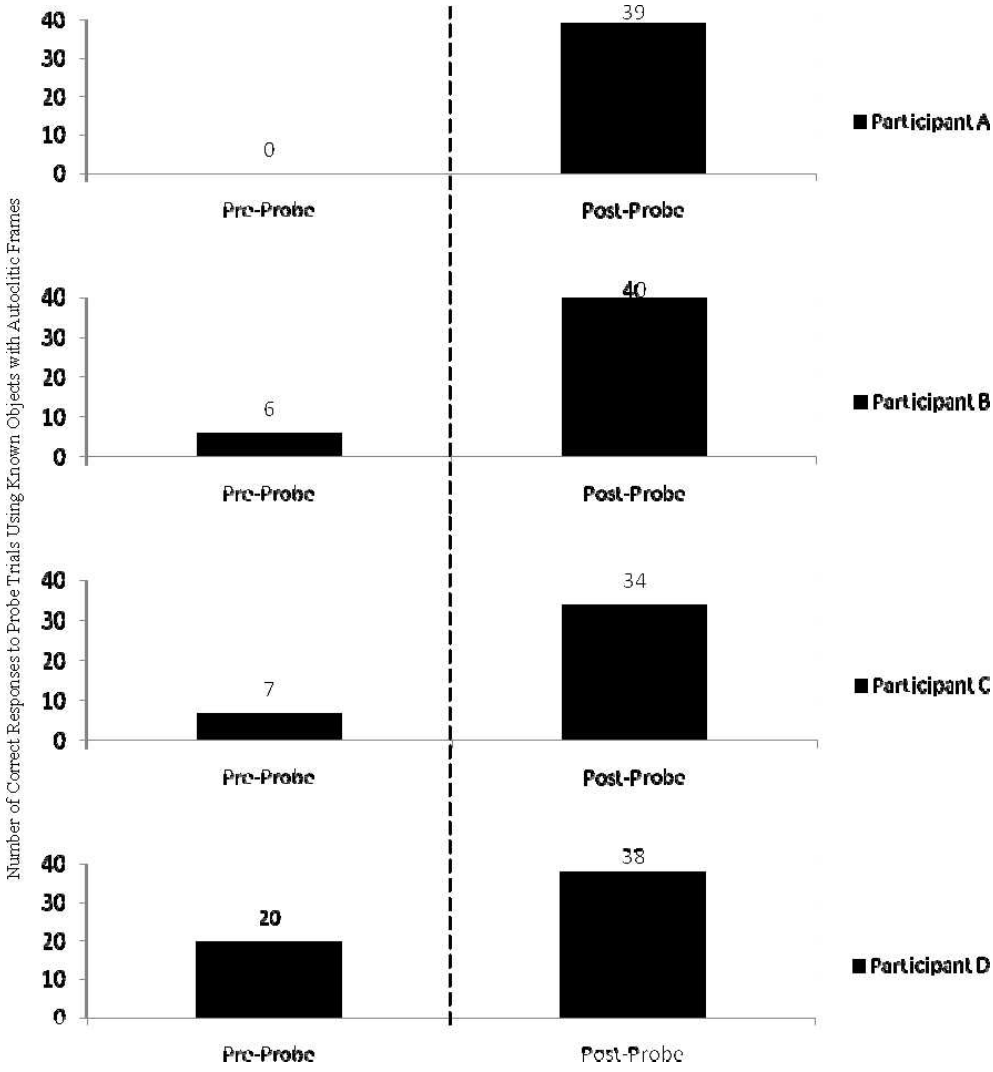

Figure 3. Pre- and post-MEI probe responses combining listener and speaker responses testing for the acquisition of autoclitic frames for the four participants in Experiment 1.

show that all four participants achieved criterion-level responding after intervention, on both the acquisition probe for the autoclitic frame with known, two-dimensional stimuli, across listener and speaker responses (ranging from 34 to 40 correct responses, with a mean of 37.75 correct responses), and on the test for abstraction to mand and tact functions with different, known, three-dimensional stimuli (ranging from 33 to 36 correct responses, with a mean of 34.00 correct responses). MEI was followed by the acquisition and abstraction of autoclitic frames for four specific spatial relationships across two response types (listener and speaker) and two relational frame types (spatial and deictic) for all four participants. But the lack of a true experimental design was identified as a limitation and as a result, a second experiment was conducted.

In the second experiment, we tested typically developing bilingual 4- and 5-year-old children using a multiple probe, time lagged, design to control for instructional experience. We also tested the gener-

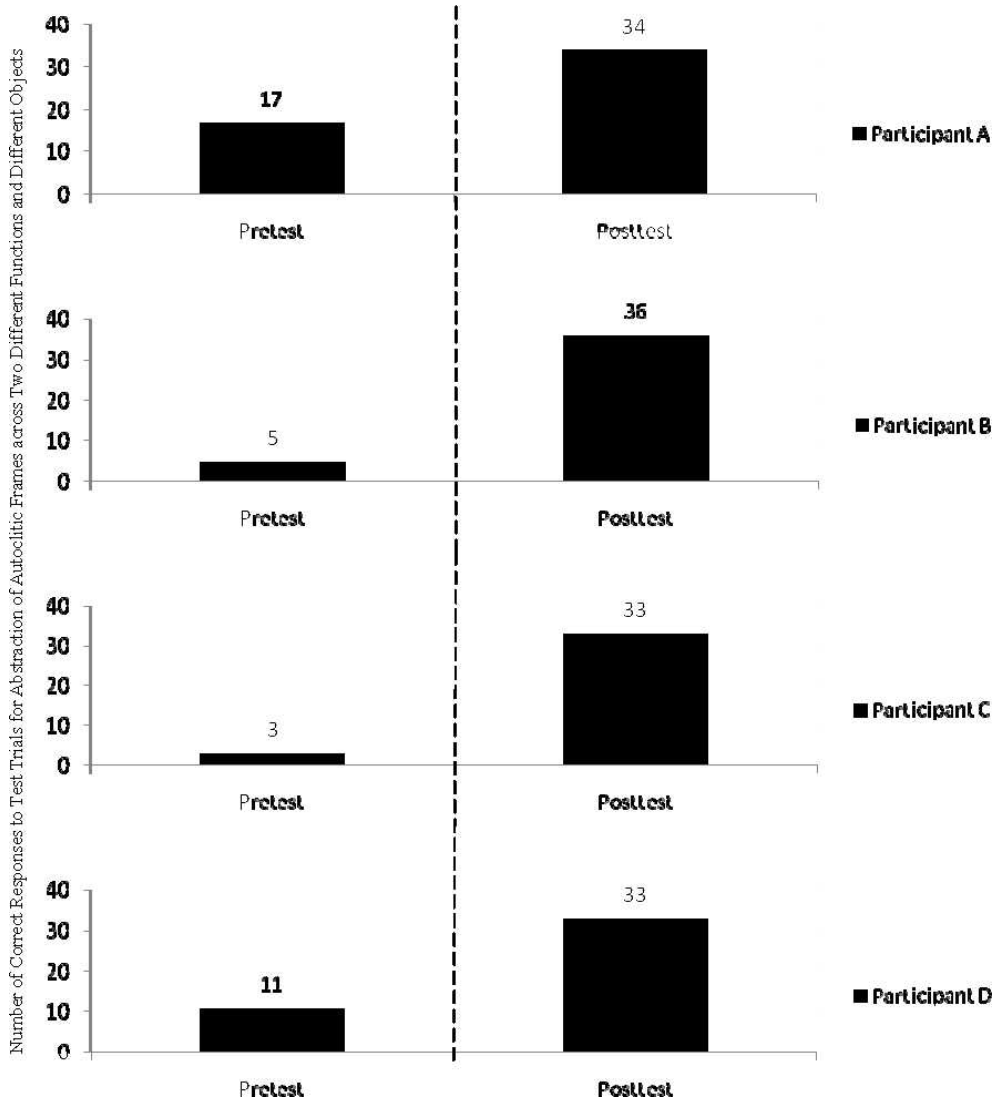

Figure 4. Pre- and post-MEI listener and speaker responses for abstraction across mands and tacts and listener trials with and without preferred items for the four participants in Experiment 1.

ality of our procedure by selecting typically developing children drawn from a different type of classroom that employed a different teaching methodology for our participants in the second experiment. The second experiment used the same pre- and post-MEI probes and tests and the same MEI intervention. It differed from Experiment 1 in terms of the participant population and the experimental design. In addition, Experiment 2 included an assessment of the naming capability that was conducted before and after the experiment in order to investigate the relationship between this capability and the autoclitic frame for spatial relations.

EXPERIMENT 2

Special Procedural Modifications

Assessment of the naming capability. The participants in the second experiment were tested for the naming capability by teaching them to match a set of five 2″×3″ color photos of unknown items (dog breeds: Dalmatian, Rottweiler, Pomeranian, Poodle,

Bassett hound) to 90% accuracy over two consecutive sessions of 20 learn units each, and then testing for point, tact, and intraverbal responses to the same stimuli, over a total of 60 test trials, 20 trials of each response type. This procedure is described in detail in the literature (Greer & Ross, 2008). The naming capability was assessed before the participant began the experimental procedures and was assessed a second time when the experiment was completed. Results from this assessment are shown in Figure 7.

Speaker-only MEI. Two of the four participants (Participants B and D) in Experiment 2 were selected to receive speaker-only MEI. They were selected based on their scores in the pre-probes and pre-tests—one participant of the two lowest scoring participants and one participant of the two highest scoring participants. Speaker-only MEI consisted of teaching only the speaker half of the responses taught in MEI (''Where is the __?''). A speaker-only MEI teaching session consisted of 20 instructional trials, all speaker responses, rotated across the five Phoenician letters and the four autoclitic frames. See Figure 2 for a diagram of this procedure.

Participants

The participants in the second experiment were four preschool-age students, two males and two females. Participants A and C were both three years old, Participant B was four years old, and Participant D was five years old. All four were identified as typically developing and were bilingual. These children were all members of a group of children defined as *dual language learners* (Genesee, Paradis, & Crago, 2004). Participants were included in this study because of their low accurate responding to all pre-tests and pre-probes on the use of autoclitic frames with known objects.

The participants were selected from students who attended a private preschool. The preschool was located in a suburban area, outside a major metropolitan city. There were 170 students enrolled in the preschool and 220 students enrolled in the elementary school. The school offered a bilingual French-American curriculum and the preschool followed the French *école maternelle* model (Ministère de l'Education nationale, 2006–2009). The primary language of instruction in all grades was French. The classroom ratio of students to teachers to teaching assistants was 15:1:1. Students were assessed quarterly according to the *école maternelle* model and, in addition, participants in this study were assessed using the Verbal Developmental Capabilities Checklist (Greer, & Ross, 2008).

Setting

The study took place in the classroom, with the experimenter and participant seated at a child-sized table, both on child-sized stools, adjacent to one another. The experimenter and the participant were not screened off or separated from the rest of the class and the rest of the class continued their typical routines. Data were collected each morning or afternoon, during the classroom's 30-minute free play time. A video camera was positioned on a tripod and overlooked the table from beside the experimenter. The video camera was trained on the table and the participant and was present during all sessions. This allowed the experimenter and independent observers to repeatedly observe the stimuli and the experimental procedures as well as the accuracy of the participants' responses.

Design

A single-case, time-lagged, multiple probe design across participants was used for this experiment (Greer & Ross, 2008; Greer, Stolfi, et al., 2005; Greer, Yuan, & Gautreaux, 2005; Johnston & Pennypacker, 1993). Two participants (Participant A and Participant C) received listener and speaker MEI and two participants (Participant B and Participant D) received speaker-only MEI. Participants C and D received two pre-probes and pre-tests before intervention while Participants A and B received one pre-probe and pre-test before intervention.

Interobserver Agreement (IOA) and Procedural Integrity

A trained observer, naïve to the procedures being used in intervention and naïve to pre- and post-intervention status of the probes, was taught to review videotapes of teaching,

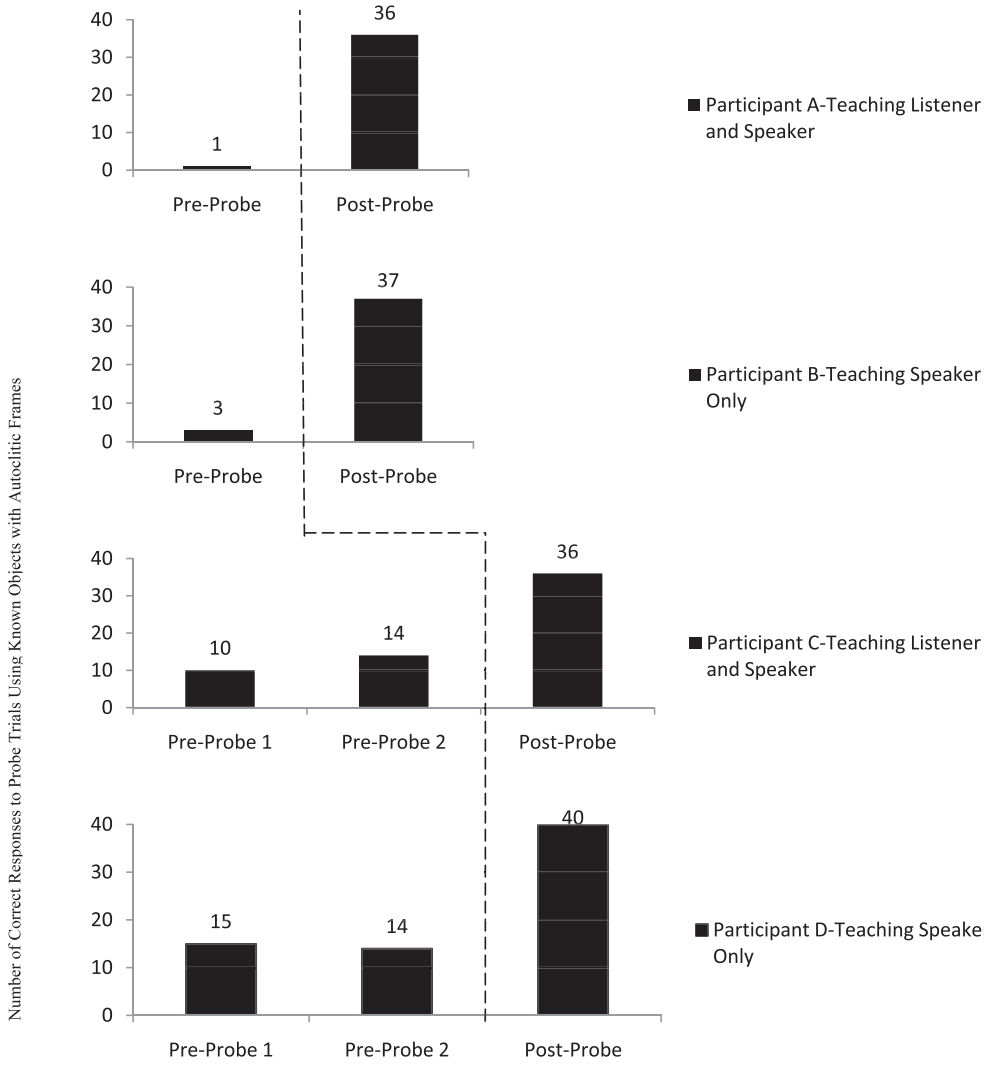

Figure 5. Pre- and post-MEI listener and speaker responses testing the acquisition of autoclitic frames for the four participants in Experiment 2.

probe, and intervention sessions and to complete TPRA forms for each observed session. Completed TPRA forms were compared to data collected by the experimenter. Before beginning to collect data for IOA, the observer practiced observing direct instruction in other academic areas with a nonparticipant until she reached 100% agreement with the experimenter on the TPRA form (Ingham & Greer, 1992) in three consecutive sessions.

The trial-by-trial method of IOA was used (Cooper, Heron, & Heward, 2007). IOA was collected for 85% of all pre- and post-probes and tests; with a range for individual sessions of 83%–100% agreement and a mean agreement of 95% for all sessions for all individuals for which IOA data were collected. IOA data were collected for 100% of all teaching sessions, with a range of 85%–100% agreement and a mean agreement of 94%. Procedural integrity ranged from 97%–100% with a mean of 99%.

Results and Discussion

Participants A, B, C, and D met criterion for intervention in 6, 5, 6, and 5 sessions

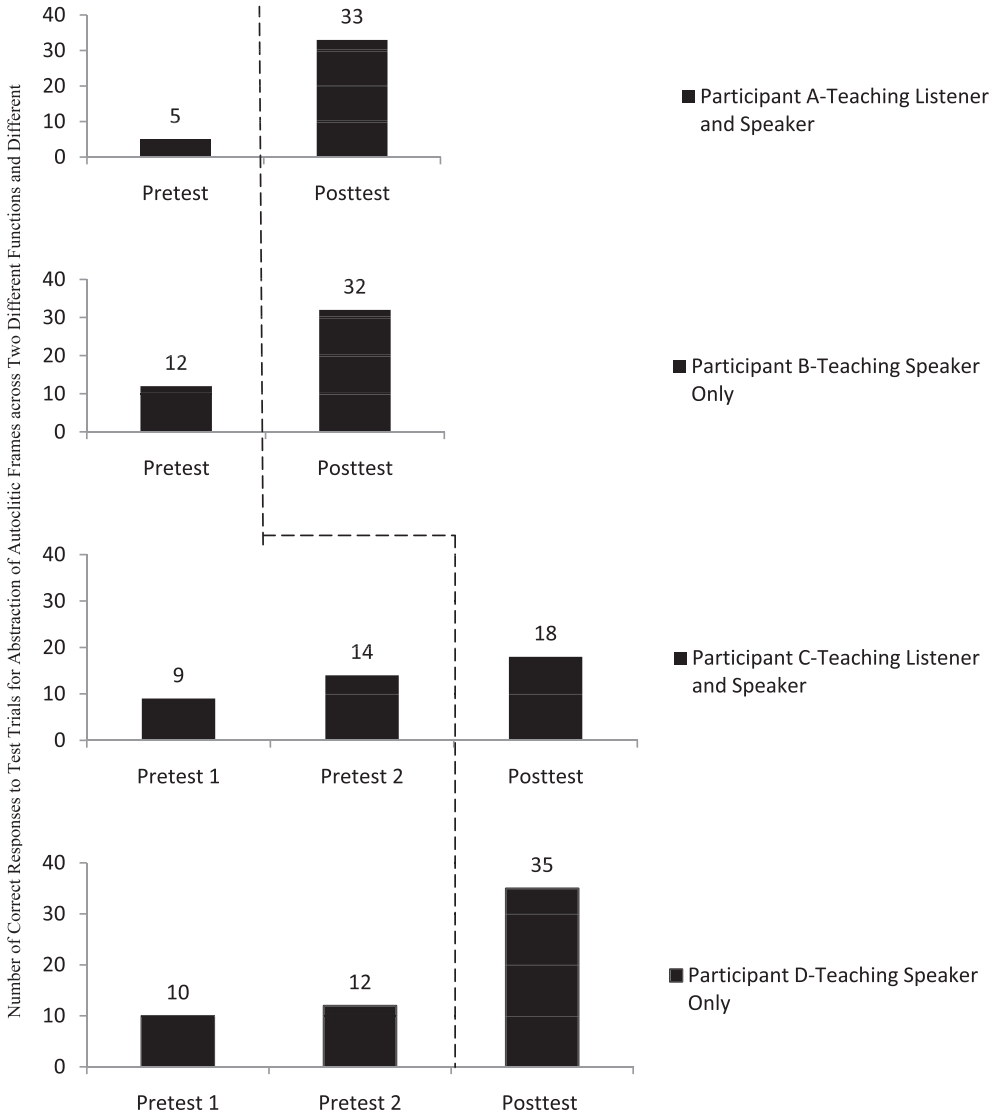

Figure 6. Pre- and post-MEI listener and speaker responses for abstraction across mands and tacts and listener trials with and without preferred items for the four participants in Experiment 2.

respectively, over 4–6 days. Figure 5 shows the four participants' responses to the probes for autoclitic frames before and after the MEI intervention. Figure 6 shows the responses to tests of abstractions across mand and tact functions. After intervention, all four participants achieved criterion-level responding on the acquisition of autoclitic frames with known stimuli (ranging from 36–40, with a mean of 37.25). Three participants achieved criterion on the test for abstraction to mand and tact functions (ranging from 32–35, with a mean of 33.33). A functional relation was demonstrated between the acquisition of autoclitic frames for four specific spatial relations and the use of multiple exemplar instruction across relational frame types for all four participants.

The limitation of this experiment was that Participants C and D performed slightly better on the second pre-probes and pre-tests, yet no additional pre-measures were conducted. As a result, it cannot be ruled out that further improvement would have been observed in

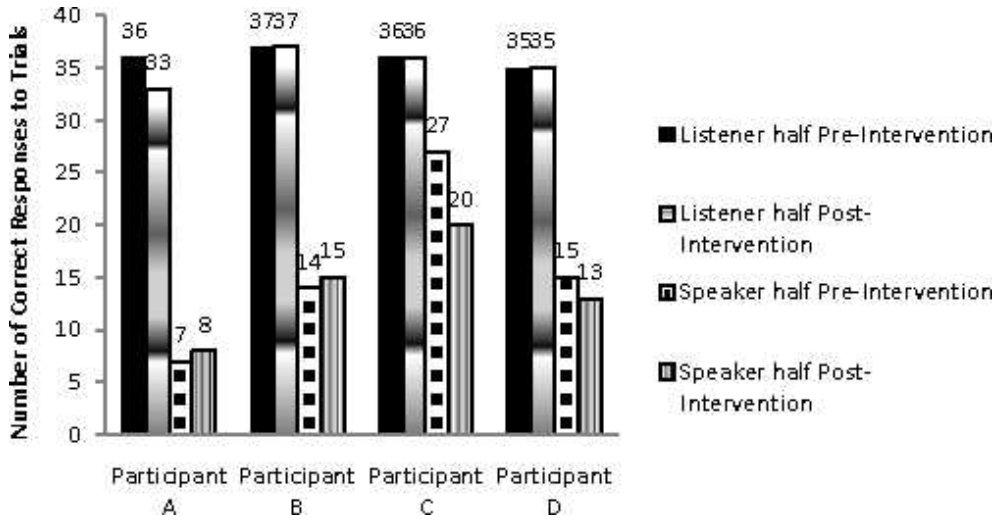

Figure 7. Total correct responses to trials probing the 2D naming repertoire for participants in Experiment 2.

the absence of MEI. Future research in this area might attempt to repeat baseline probes to stability. In the case of typically developing children, they may, over time, acquire the use of these autoclitic frames without intervention. Traditional instructional models teach some of this type of language use (left/right, for example) in the fourth, fifth, or even sixth grades, when children are between nine and eleven years old. Participant C was three years old and took six sessions to meet criterion. She was the only participant from both of the experiments to fail to meet criterion on the abstraction test. She routinely confused the spatial relations across two dimensions and three dimensions, placing a 3D bear, for example, on the far side of the box, when asked to put it ''on top.'' This would have been a correct response if the materials were 2D. Participant D was five years old and it took him five sessions to meet criterion during intervention. An equal amount of time elapsed between each of the pre-probes and the post-probe—about 3 weeks.

Participants in Experiment 2 were probed for the naming capability for two-dimensional objects (2D naming) before and after their participation in the experiment. Naming probes were comprised of 80 possible responses to trials; 40 trials were the listener half of naming (20 match and 20 point trials) and 40 trials were the speaker half of naming (20 tact and 20 intraverbal trials) (see Greer & Ross, 2008, for a description of this procedure). The intervention used in this experiment did not appear to have an effect on the 2D-naming capability of any of the participants. See Figure 7 for a display of these results.

GENERAL DISCUSSION

As behavior analysts, we always seek to improve the teaching strategies that we use with students and find new strategies that help us to improve student outcomes. The intervention used in these two experiments was successful at teaching the participants to use autoclitic frames for spatial relations with untaught, two-dimensional materials. Seven of the eight participants further demonstrated abstracted use of those autoclitic frames with untaught, three-dimensional materials. This suggests that MEI, as a teaching strategy, can have a powerful effect on student learning.

In the second experiment, the MEI intervention was tested using an MEI intervention across listener and speaker responses for two participants and compared to an instructional sequence for speaker responses only for two participants. There was no appreciable difference in the outcomes for the four participants in Experiment 2. This suggests that the autoclitic frame, as identified in this study,

could be acquired if taught only across speaker responses instead of both listener and speaker responses; at least for participants like these. Replication of these results is needed as this finding could suggest ways to economize when teaching autoclitic frames to students who need them.

The autoclitic frame investigated in this research appears to possess the qualities of operant behavior (Hayes, et al., 2001). It can be acquired as a function of experience. It functions in a three-term contingency, showing sensitivity to both antecedent and consequent events.

The separation of the autoclitic frame and our measures of the naming capability begins to suggest the possibility that the autoclitic frame as identified in this study may be a distinct, independently acquired, phenomenon or unit of behavioral measure. This suggestion appears consistent with Skinner's conception of the autoclitic frame (Skinner, 1957). The autoclitic frame described in this research demonstrates a ''unitary contingency of reinforcement,'' which Skinner suggested indicates the ''unitary function of a part of verbal behavior'' (Skinner, 1957, p. 335). The autoclitic frame described in this research also fits Skinner's further description of an autoclitic frame, where ''relational aspects of the situation strengthen a frame, and specific features of the situation strengthen the responses fitted into it'' (Skinner, 1957, p. 336). Skinner's definition of the autoclitic frame is consistent with the parameters encountered in the autoclitic frame described and studied in these experiments.

The phenomenon observed in this work does appear to conform to Skinner's description and can be described in the following ways: the autoclitic frame for spatial relations demonstrates its independence from other verbal units in effect, it is dependent for its function on the interaction of the listener and speaker (for example: ''in'' acquires an autoclitic function only in combination with other verbal behavior; it may be as simple as the dependent interaction between listener and speaker within a single individual that occasions this behavior), and, as studied here, it demonstrates a joining of listener and speaker repertoires within the frame but does not affect this type of relationship for phenomena outside the frame (i.e., naming).

These experiments appear to provide some preliminary evidence of the existence of autoclitic frames as an empirical phenomenon. This is consistent with the findings of other research in the area of relational operants (Berens & Hayes, 2007). The findings from these experiments are meant to encourage further investigation into these types of complex, verbal phenomena, with the hope that replication and extensions of inquiry will lead us to a better understanding of the features of language that are captured in the study of verbal behavior.

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