Journal of Applied Behavior Analysis

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2017, **50,** 830–842 NUMBER 4 (FALL)

A METHOD TO ESTABLISH STIMULUS CONTROL AND COMPLIANCE WITH INSTRUCTIONS

JOHN G. BORGEN

OREGON INSTITUTE OF TECHNOLOGY

F. CHARLES MACE

ARAN HALL SCHOOL

BRENNA M. CAVANAUGH AND KENNETH SHAMLIAN

UNIVERSITY OF ROCHESTER SCHOOL OF MEDICINE

KEITH R. LIT AND JILLIAN B. WILSON

NOVA SOUTHEASTERN UNIVERSITY

AND

STEPHANIE L. TRAUSCHKE

KENNEDY KRIEGER INSTITUTE

We evaluated a unique procedure to establish compliance with instructions in four young children diagnosed with autism spectrum disorder (ASD) who had low levels of compliance. Our procedure included methods to establish a novel therapist as a source of positive reinforcement, reliably evoke orienting responses to the therapist, increase the number of exposures to instruction–compliance–reinforcer contingencies, and minimize the number of exposures to instruction–noncompliance–no reinforcer contingencies. We further alternated between instructions with a high probability of compliance (high-p instructions) with instructions that had a prior low probability of compliance (low-p instructions) as soon as low-p instructions lost stimulus control. The intervention is discussed in relation to the conditions necessary for the development of stimulus control and as an example of a variation of translational research.

Key words: children with ASD, compliance, noncompliance, stimulus control, translational research

Compliance with instructions is essential for young children, especially those with autism spectrum disorder (ASD), to acquire skills, to initiate and maintain involvement in constructive social activities, and to maintain child safety. It is one of the key skills that kindergarten teachers report predicts readiness for school (Lin, Lawrence, & Gorrell, 2003). Difficulty attending to social stimuli may serve as a barrier for the development of compliance among children with ASD.

Several interventions have been used to improve compliance, including positive reinforcement of compliance (Parrish, Cataldo, Kolko, Neef & Egel, 1986; Russo, Cataldo & Cushing, 1981); timeout (Rortvedt & Milenberger, 1994); spanking (Forehand & McMahon, 1981); social punishment (Doleys, Wells, Hobbs, Roberts & Cartelli, 1976); escape extinction (Zarcone, Iwata, Mazaleski & Smith, 1994); the high-probability instructional sequence (Austin & Agar, 2005; Davis, Brady, Hamilton, McEvoy,

Address correspondence to: F. Charles Mace, Aran Hall School, Gwynedd, UK. Email: fcmace@gmail.com

doi: 10.1002/jaba.419

& Williams, 1994; Mace et al. 1988); graduated guided compliance (Wilder et al., 2012); a package of antecedent interventions (proximity, posture, eye contact, attention and response interruption; Stephenson & Hanley, 2010); and video self-modeling (Axelrod, Bellini & Markoff, 2014), among others. Although these interventions have been shown to improve compliance, and none has significant limitations, some can be time consuming to implement or impractical (e.g., video self-modeling requires multiple video clips to be made of the child that capture the child being compliant in multiple contexts and video viewing prior to evaluation of the intervention; Axelrod et al., 2014). Others employ aversive procedures that may produce pain (spanking; Forehand & McMahon, 1981) or possible emotional distress such as a loud scolding voice or visual glare (Doleys et al., 1976), or have relatively long latencies to reach target levels of compliance (e.g., seven treatment sessions to increase compliance above 80%; Rortvedt & Miltenberger, 1994).

Consideration of the nature of stimulus control may be useful in the development of additional interventions for noncompliance. Compliance is an example of stimulus control. A stimulus (instruction) that previously exerted no control over compliant behavior acquires the capacity to reliably occasion a response specified in the instruction. Understanding the conditions necessary and sufficient to establish stimulus control may lead to an efficient approach to rapidly produce compliance. A necessary condition for stimulus control to develop is for a reinforceable response to reliably follow the presentation of a stimulus. However, this may not be a sufficient condition to establish stimulus control. It is further necessary that the probability of a reinforcing event given the stimulus must be substantially higher than the probability of the reinforcer given the absence of the stimulus. Thus, each stimulus–response–reinforcer contingency (S–R–S) strengthens stimulus control and each stimulus–no response (S–noR) and each stimulus–no reinforcer (S–noS) sequence weakens stimulus control. As a mathematical expression, the magnitude of p(S–R–S) > p(S–noR) and p(S–noS) should be high; however, this magnitude has yet to be established in applied research. The roots of these relations can be traced back to Dinsmoor (1985), Skinner (1933) and Spence (1936).

Considering this particular conceptualization, therapists attempting to teach compliance should deliver instructions that maximize the likelihood that a compliant response will follow each instruction and produce a reinforcer. Instructions that are not reliably yielding compliance should be avoided during the early stages of compliance training. Likewise, reinforcers used to teach compliance should be minimally available outside of compliance training sessions to avoid creating an open economy that could decrease the value of the reinforcer used during compliance training (Reed, Niileksela & Kaplan, 2013). Failing to adhere to these latter two recommendations may weaken the stimulus control of instructions.

We developed a compliance training procedure for young children with ASD, based on the concepts described above, and evaluated its efficacy with four children with ASD. Although our procedure involves the identification of requests with a high- and low-probability (low-p) of compliance, it is unlike the high-probability (high-p) request sequence commonly reported in the literature (e.g., Mace et al., 1988). The current procedure began by delivering time-contingent food on a variable time (VT) schedule followed by reinforcement of orientation to the therapist when the therapist said the child's name. After reliable orientation occurred, a series of three to eight high-p requests were presented at a minimum of 1-min intervals and compliance was reinforced with food and praise. Following consistent compliance with the high-p requests, successive low-p requests were introduced and compliance was

reinforced until low-p compliance was lost, at which time, the therapist returned to delivering high-p requests in order to minimize the child's experience with S–noR–noS contingencies.

METHOD

Participants, Setting and Materials

Four young children diagnosed with an ASD participated in the study. Lucy and Patty were both 2 years old. Lucy spoke in phrases and Patty had no vocal speech. Charlie and Linus were both 3 years old. Charlie spoke five to seven 1-word mands, and Linus had a three- to five-word echoic repertoire. All participants had receptive language sufficient to respond to the instructions used in the study and could follow one-step instructions. Preference assessments showed that all participants preferred snack foods, but Lucy also preferred toy shapes. All met the inclusion criterion of $\leq$ 20% compliance with a set of low-p instructions identified by parental report prior to training.

All children were enrolled in an early intervention program. Sessions were conducted in a large classroom within a treatment space that was 4 m square. The classroom was equipped with a play area, tables, and chairs. The play area featured a variety of toys including jigsaw puzzles, toy cars, and building blocks. Therapists were doctoral students in clinical psychology. Children attended the program 3-5 hr per day, 3-5 days per week.

Target Behaviors, Data Collection and Interobserver Agreement

The target behavior of interest was compliance with low-p and high-p instructions. Compliance was defined as initiating the requested behavior within 5 s of the instruction and completing the behavior within 10 s to 15 s. Independent observers took trial data for each instruction. These data were expressed as percentage compliance with the two types of instructions and also, for two participants, as a cumulative record of compliance with instructions on a trial-by-trial basis within and across sessions. Interobserver agreement (IOA) was computed on a trial-by-trial basis. IOA was collected on 62% of the sessions for Patty and Lucy and ranged from 90% to 100%. Agreement was collected 60% of the sessions for Charlie and Linus and was always 100%.

Procedure

The study was composed of three phases. The first was a baseline phase without the stimulus control procedure or reinforcement for compliance with low-p instructions. Following baseline, the stimulus control of compliance procedure (SCP) began and then was reintroduced as needed when there was a loss of compliance with low-p instructions. Parent training was then introduced for Patty, who was the only participant available long enough to participate in the third phase (see procedures below).

Baseline. Prior to study commencement, four to seven low-p instructions were identified by parent interview. During baseline sessions, a single therapist at a time delivered low-p instructions to the child at a minimum of 1-min intervals. *Stand up*, *come here*, *give me*, and *sit down* were low-p instructions for all participants. *Stop it* was an additional low-p instruction for Patty and Lucy, and *take out* was an additional low-p instruction for Patty. Instructions were issued once per trial, compliance with low-p instructions was praised on a fixed ratio 1 (FR1) schedule of reinforcement. Noncompliance was ignored.

Stimulus control of compliance procedure (SCP). Ten steps were used to establish stimulus control of compliance (see Supplemental Materials for list). The steps were followed in the same sequence across participants, but there were variations in the final steps across participants. Our first assumption is that it is easiest to establish stimulus control of compliance with a person with which the child has no

history of noncompliance, thus, training begins with a novel therapist. Preferred foods were then identified using a preference assessment (RAISD, Fisher, Piazza, Bowman, & Amari, 1996; MSWO, DeLeon & Iwata, 1996). Patty preferred potato chips and pretzels, Lucy and Charlie Oreo® cookies, Charlie and Linus gummy bears and M&Ms®, and Patty and Lucy preferred goldfish crackers. These foods were initially given to the child by the therapist on a variable time (VT) 60-s schedule. This continued for approximately 5 to 8 min. Next, an orienting cue was delivered at a point in time in which the child had paused engagement in an activity for approximately 2 to 3 s. For example, the therapist waited for child to pause in activities such as touching, looking at or manipulating a toy. Following the pause, an orienting cue was presented saying the child's name in an intonation and cadence that was novel to increase the likelihood of orientation to a novel sound (Catania, 2013). Contingent on an orienting response, the therapist held out a piece of food approximately 1 m from the child. Just as the child was about to take the food, the therapist gave the instruction, "Take it," the single high-p request for all participants. The purpose of this procedure was to establish the conditions for stimulus control to occur. That is, a reinforceable response (compliance) followed an instruction, permitting compliance to be reinforced with food (i.e., the S–R–S contingency). Food deliveries were coupled with enthusiastic praise. After compliance with three to eight high-p instructions, low-p instructions were introduced. With the exception of Charlie and Linus discussed below in the next paragraph, enthusiastic praise continued on an FR1 schedule but the schedule of food reinforcers was faded to the leanest variable ratio (VR) schedule possible for Lucy (VR 2) and Patty (VR 6) and the response requirements in the instructions were also gradually increased. No other differential consequences for compliance and noncompliance were provided. Response requirements were not increased systematically, nor measured. Examples, include having the child walk a further distance in response to the low-p instruction, *come here*, and requiring the child to *come here and sit down*, after the child reliably came to the therapist. For Lucy, this occurred after compliance with 22 low-p instructions using only 3 high-p instructions or, on a second occasion when there was compliance with 15 low-p instructions using only 1 high-p instruction. For Patty, schedule thinning began following compliance with 15 low-p instructions using only 1 high-p instruction.

For Charlie and Linus, a variation was made in steps 9 and 10 to evaluate the strength of the stimulus–response relation without reinforcement. In place of the fading procedure, therapists discontinued all reinforcer deliveries for compliance with low-p instructions (sessions 7-11 for Linus and session 8 for Charlie with Therapist 2). This was done to evaluate conditions representative of failures in treatment integrity and to determine the number of sessions required to reestablish stimulus control. Additional evaluation of the SCP for Charlie and Linus was not completed due to the high levels of compliance observed.

To begin compliance training sessions, steps 3 through 6 (VT food, orienting cue at schedule changeover, high-p request reinforced with food and enthusiastic praise) were repeated before low-p instructions were introduced for the first 5 to 10 days of compliance training. This was to ensure that stimulus control was present prior to giving low-p instructions. After one or two consecutive low-p instructions were not followed, high-p instructions resumed to re-establish stimulus control.

Mean duration for each baseline and treatment session was approximately 45 min. However, there was considerable variability across participants and across sessions within participants depending on how responsive they were to treatment and how unresponsive they were

to baseline low-p requests. These patterns are evident in the trial data presented for Patty and Charlies.

Generalization and parent training. For Patty, compliance generalized to a novel therapist without explicit training. During parent training, the therapist reviewed the protocol with the parent and then coached parents to correctly implement the procedure as it was practiced. Six sessions of parent training were conducted, four of which were run by the parent and two of which were run by the therapist to assist in establishing general stimulus control. Parent training was not conducted with Lucy due to scheduling conflicts and her leaving the early intervention program. Charlie received a single session each of baseline and parent training in the use of the SCP. Finally, Linus' mother was unavailable beyond an initial baseline session.

Experimental Design

The experimental design for Lucy and Patty was a multiple baseline design across participants with a brief return to baseline with a different therapist for Patty. The design for Charlie was a mixed schedule design with two different therapists and a parent in baseline and the same two therapists in baseline implementing treatment. The experimental design for Linus was an ABAB design with a different therapist implementing each baseline and treatment phase, followed by a phase without reinforcement for compliance with low-p instructions.

RESULTS

Figure 1 shows that both Lucy and Patty responded quickly to the stimulus control procedures. Lucy's baseline percentage of compliance with low-p instructions was 9% and increased to 58% after one treatment session and reached over 80% compliance on the second treatment session and over 90% compliance on the fifth treatment session. Patty's average baseline compliance was 16% and compliance was below 10% in the two sessions preceding treatment. Compliance increased to 83% and remained high for the remainder of treatment. Compliance decreased to 17% during baseline with Therapist 2. However, during treatment with Therapist 2, compliance increased to 100% and averaged 99% over the following 17 sessions. During four sessions of parent training, compliance averaged 90%.

A cumulative record of compliance with high-p and low-p instructions for Patty is depicted in Figure 2. The figure represents the first four sessions of treatment and illustrates how high-p and low-p instructions alternately were delivered. Each session began with the delivery of high-p instructions. In session one, compliance to low-p instructions was not achieved within five high-p instructions; therefore, additional high-p instructions were reintroduced on trial 6. High-p instructions were also reinstated on trials 20 and 21. This resulted in compliance to 15 consecutive low-p instructions for the remainder of the session. Session 2 required four high-p instructions to establish 24 consecutive trials of low-p compliance. For session 3, a series of four high-p instructions established compliance for 20 consecutive low-p trials, but again had to be reinstated to regain stimulus control. Session 4 required eight high-p trials to establish stimulus control to 22 consecutive low-p instructions. The complete data set is extensive and is available from the corresponding author on request.

Session results for Charlie are presented in Figure 3. Baseline compliance for Therapist 1, Therapist 2, and his parent was 20%, 40% and 40%, respectively. By contrast, compliance with low-p instructions using the stimulus control procedure averaged 86% for Therapist 1 and 94% for Therapist 2. Charlie's cumulative compliance with low-p and high-p

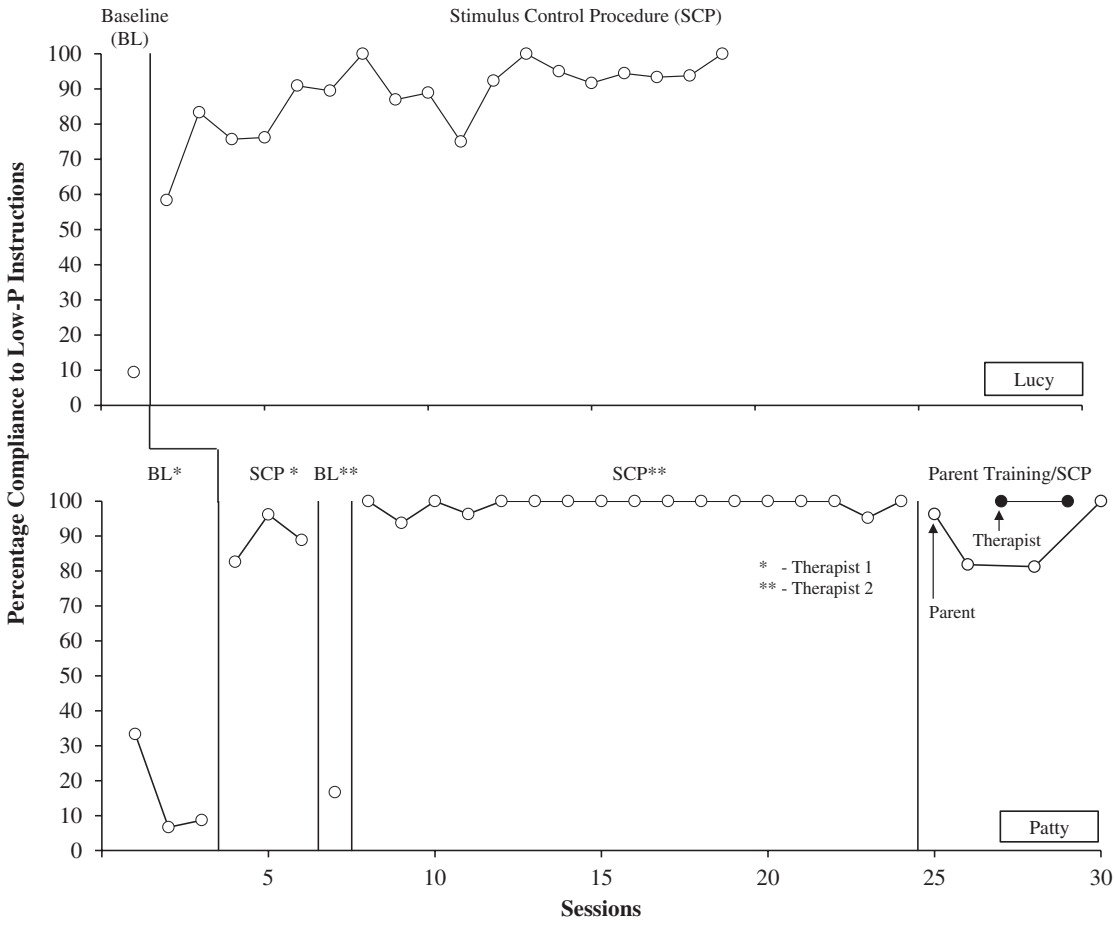

Figure 1. Percentage compliance to low-p instructions per session across one therapist for Lucy and across two therapists and Patty's mother for Patty.

instructions is presented in Figure 4. The first session represents baseline in which there were only 2 occurrences of compliance to low-p requests out of 10. The second session shows the introduction of the stimulus control procedure, which resulted in immediate high levels of high-p compliance. When low-p instructions were first introduced at trial 18, there was noncompliance. High-p instructions were then reintroduced but failed to produce compliance with low-p instructions. However, at trial 29, compliance with low-p instructions began to occur. Over successive trials, high-p instructions were reintroduced shortly after there was noncompliance to low-p instructions. This procedure eventually maintained high levels of low-p compliance which was transferred to the parent in the final phase (see Figure 4).

Session results for Linus are shown in Figure 5. The initial baseline compliance with low-p instructions with Therapist 1 was 15% and increased immediately to 92% during SCP. Low-p compliance with a second therapist under baseline conditions was 29%, but increased to 83% by the first session of SCP with Therapist 2. After Linus demonstrated compliance with the standard SCP, Therapist 1 then reintroduced low-p instructions without

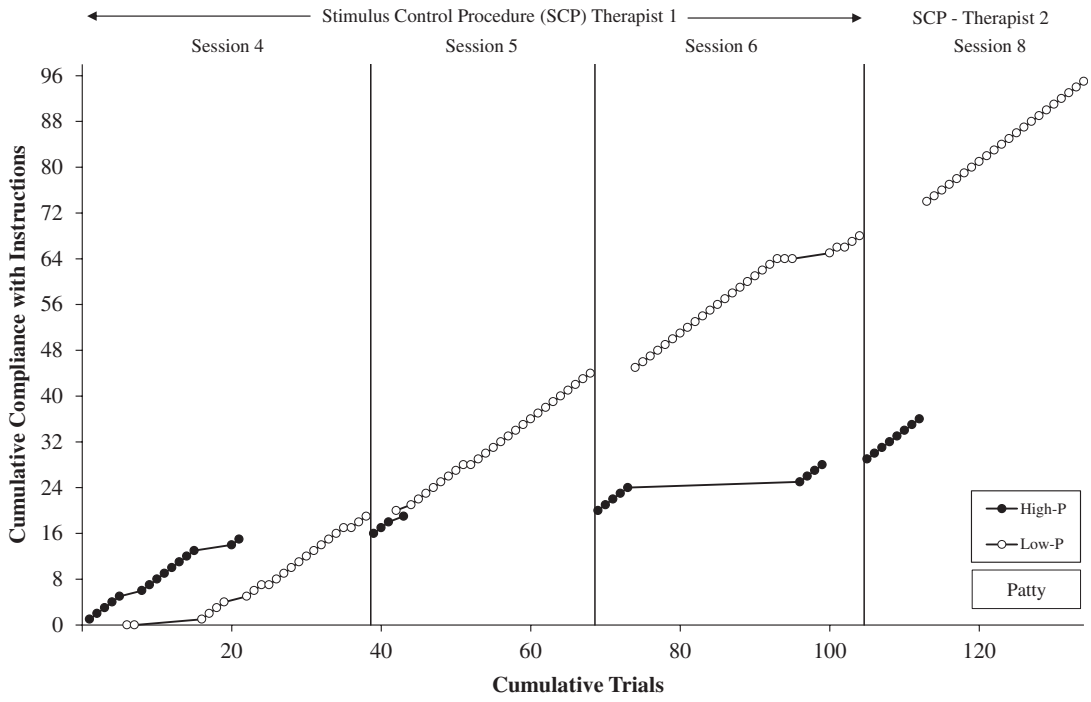

Figure 2. Cumulative record of compliance to high-p and low-p instructions given by two therapists for Patty's first four therapy sessions (cumulative sessions 4, 5, and 6 with Therapist 1, session 8 with Therapist 2).

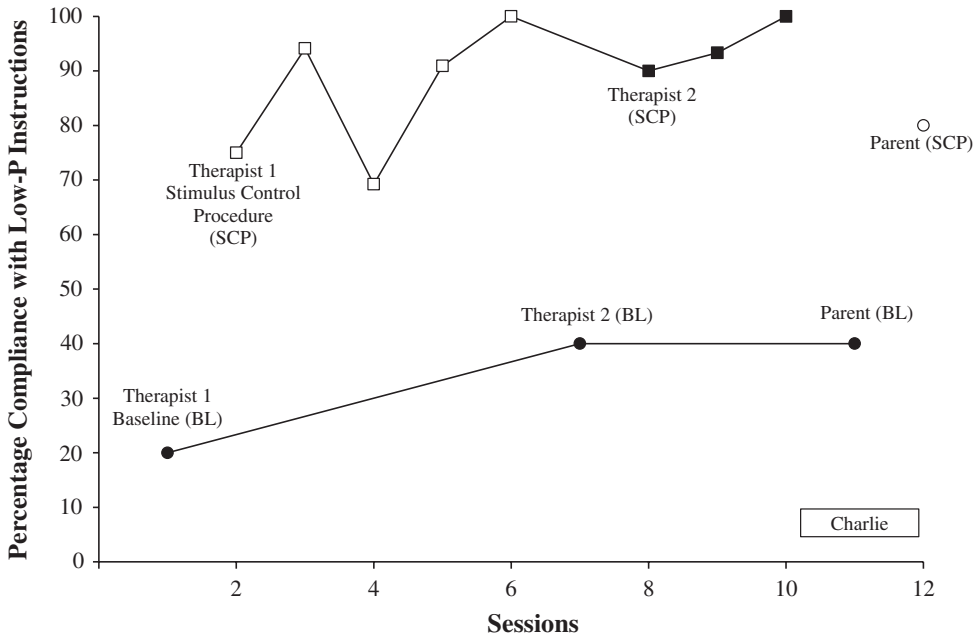

Figure 3. Percentage compliance to low-p instructions per session across two therapists and Charlie's mother.

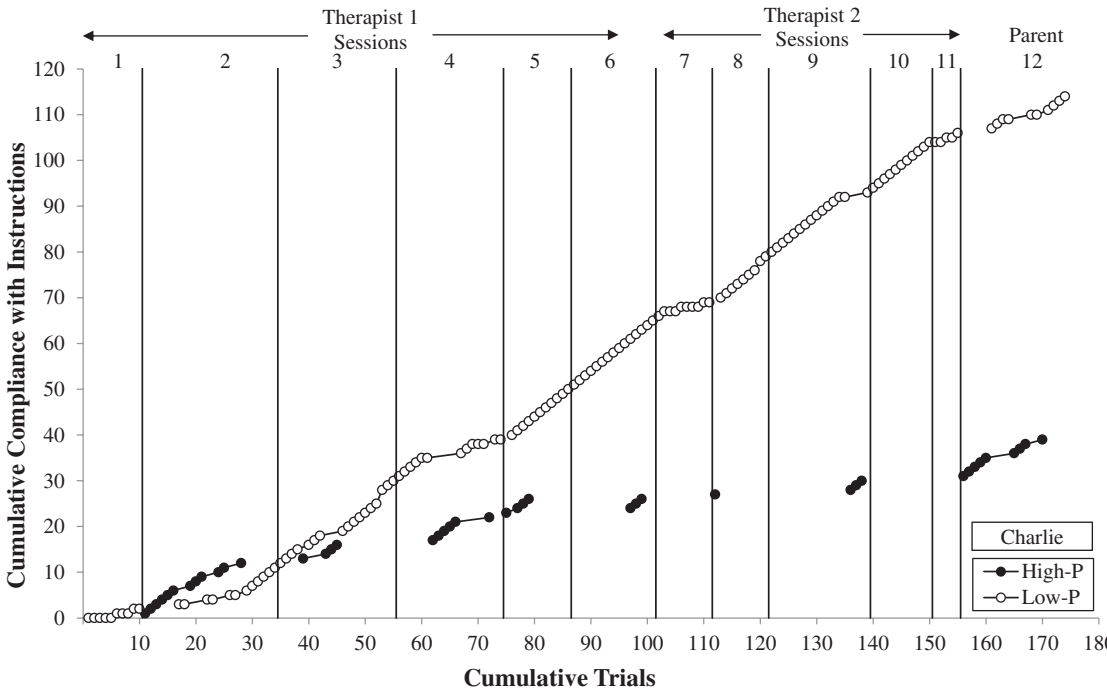

Figure 4. Cumulative record of compliance to high-p and low-p instructions across 12 therapy sessions implemented by two therapists and Charlie's mother.

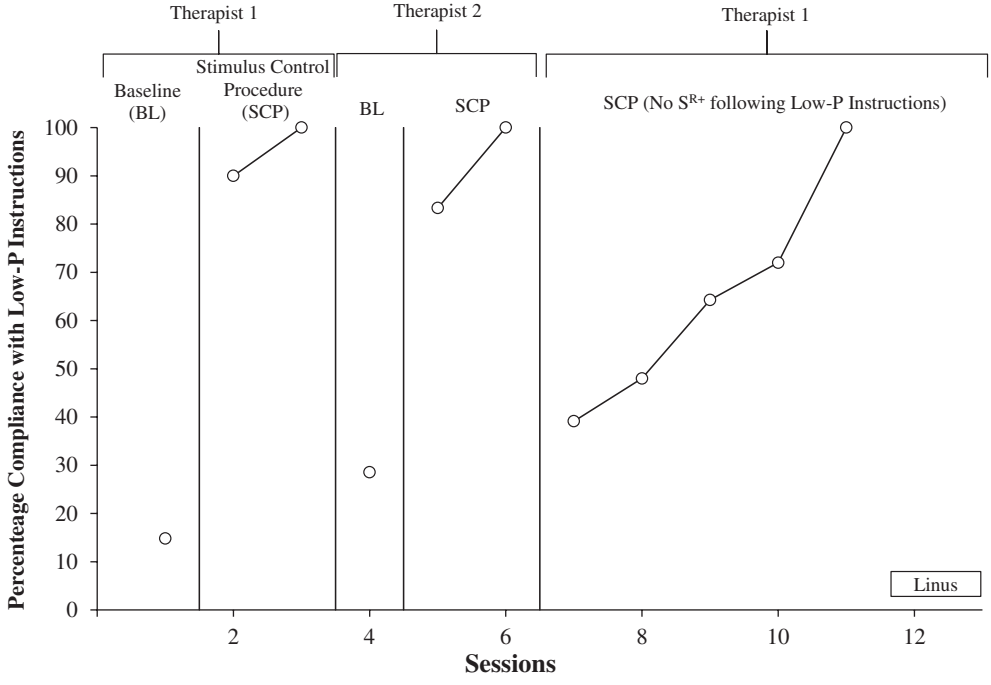

Figure 5. Percentage compliance to low-p instructions per session.

reinforcement for compliance. Initially, compliance dropped to 35% but steadily rose to 100% over the next four sessions.

As noted above, the SCP procedure was designed to maximize exposure to the S–R–S contingencies and minimize the number of S–noR and S–noS contingencies experienced by the participants. That is, the aim was for the probability of an instruction–compliance–reinforcer contingency was arranged to be high compared to the probability of an instruction–no response (noncompliance) as well as the probability of an instruction–no reinforcer contingency. Probabilities conditional on the use of use of the SCP were calculated across all trials for each participant, excluding baseline without SCP. If a = compliance to an instruction, and b = noncompliance to an instruction, the following conditional probabilities are possible: (1) a/a+b and (2) b/a+b. In all treatment trials, an instruction was given and each compliant response was reinforced. For Patty these values were 1 = 0.96; 2 = 0.04, for Lucy 1 = 0.87; 2 = 0.13, for Charlie 1 = 0.85; 2 = 0.15, and for Linus 1 = 0.87; 2 = 0.13.

DISCUSSION

We evaluated a unique method for establishing stimulus control and compliance with instructions for four young children diagnosed with ASD. Before intervention, all four participants had low levels of compliance (20% < compliance). After a single session of intervention, compliance increased markedly (59%, 83%, 75%, and 90% for Lucy, Patty, Charlie and Linus, respectively). A second intervention session increased compliance to over 80% for Lucy and over 95% for the other three participants, indicating that the procedure can produce rapid clinical improvements in compliance.

The procedure specifies four elements. First, we identified a novel therapist with no history of interaction with the children to deliver tangible reinforcers on a time-contingent schedule (Mace et al., 2010; Mace, Pritchard & Penney, in press; Pritchard, Hoerger & Mace, 2014). This procedure was designed to increase the likelihood that each child would begin to orient to the therapist when the therapist approached the child (Dinsmoor, 1985). Second, after several VT reinforcer deliveries, the therapist introduced an orienting cue consisting of saying the child's name in a novel tone and cadence. Novel stimuli have consistently been shown to evoke orienting responses in several species (Pavlov, 1927; Sokolov, 1963). When the child oriented to (i.e., looked at) the therapist, the reinforcer was then delivered. The timing of the orienting cue was contingent on the child pausing the activity in which he or she was engaging for at least 2 s. The purpose of this timing was to increase the likelihood that the child would switch from the current activity to the compliance training activity. This conceptualization is consistent with a changeover on a concurrent schedule of reinforcement (Ferster & Skinner, 1957; Herrnstein, 1961, 1970). Third, following the orienting cue, the therapist held his or her hand out with the reinforcer at eye level to the child. As the child reached to take the reinforcer, the therapist gave the instruction, "Take it." The *take it* instruction had a very high probability of compliance because it was the response the child was in the process of emitting. These elements of the compliance training procedure resulted in the instruction → compliance → reinforcer (S–R–S) contingency that is essential to establish stimulus control (Spradlin & Simon, 2011). Fourth, after the child contacted several of these S–R–S contingencies, low-p instructions were first introduced. When the child paused in his or her current activity, the orienting cue was delivered with the reinforcer held out at eye level. As the child approached the reinforcer to take it, the therapist held the reinforcer next to the chair and said, "Sit down" (McIlvane & Dube, 1992). Response requirements were then gradually increased by having

the therapist stand, for example, next to a chair. The orienting cue was provided when the child was 2 to 3 m from the therapist and chair, thus requiring the child to walk to the therapist.

Several of the other steps in the compliance training procedure (see Supplemental Materials) are common, well-established procedures in behavior analysis. Tangible reinforcers were correlated with potential social reinforcers (enthusiastic praise) in an attempt to strengthen the reinforcing value of praise. After experiencing several tangible-social reinforcer contingencies, the schedule of tangible reinforcement was gradually faded to the thinnest VR schedule that the child could tolerate while maintaining social reinforcement on an FR1 schedule (Wilder, Nicholson, & Allison, 2010). Each compliance training session began with a repetition of the first five steps of compliance training to re-establish the stimulus control of instructions before introducing low-p instructions. This procedure is consistent with errorless learning instructional procedures (Ducharme & Popynick, 1993).

Low-p instructions were identified for several key behaviors that were reported to be important for the child to be safe and successful in other settings or activities. By parental report, these low-p instructions were met with very low levels of compliance, which was confirmed in our baseline data. To introduce a child to community-based activities with success, the child will need to be reliably compliant with instructions such as *Come here*, *Stay with me*, *Sit down*, and several social responses (e.g., *Say hi*, *Give it to her*, *Stand in line*) that were not evaluated in this study but may be important for success when introduced to a particular community activity. Support for this assumption awaits further research.

Compliance, or cooperation, has been the target of intervention for several decades (Forehand, Gardner & Roberts, 1978). Although a wide variety of interventions have targeted compliance by manipulating *antecedents* (e.g., Stephenson & Hanley, 2010) and/or *consequences* for compliance (e.g., Russo et al., 1981) and noncompliance (e.g., Doleys et al., 1976), we are unaware of interventions aimed expressly at establishing the stimulus control of instructions. We designed our intervention to maximize the number of experiences the participants had with the S–R–S contingency and, at the same time, minimizing the number of experiences participants had with S–noR–noS contingencies. We maximized S–R–S contingency exposures by beginning each compliance training session with VT deliveries of preferred foods, orienting cues and high-p requests. This ensured that prior to the introduction of low-p instructions, each child had experienced multiple S–R–S contingencies, which are probably necessary for instructions to acquire stimulus control over cooperative behavior (Spradlin & Simon, 2011).

Given the above, if stimulus control is strengthened when p(S–R–S) is relatively high compared to p(S–noR–noS), it may likely follow that when this relation is reversed and a child experiences a relatively high number of p (S–noR–noS) contingencies, stimulus control of instructions will be weakened or not develop at all. If this proposition is accurate, it has important clinical implications. In our work with numerous families whose children present with noncompliance, it is common to observe parents deliver and repeat the same instruction multiple times if the child is noncompliant or uncooperative. This situation exposes the child to a relatively high number of S–noR–noS contingencies and thereby may weaken the stimulus control of instructions, resulting in the problem of noncompliance. A therapist who observes this parent–child interaction, and is aware of the conditions important for the development of stimulus control, may request that the parent not repeat instructions that are not followed and instead practice delivering instructions that the child is known to reliably follow before presenting known low-p instructions. Such cases may be good candidates for

use of the SCP evaluated in this work, but this too awaits further research.

This research also gives guidance to therapists working with children who become uncooperative with specific instructions during the course of ABA therapy. The present study suggests that if a child becomes unresponsive to a given instruction, the therapist should discontinue the problematic instruction and instead provide several high-p instructions at intervals up to 1 min to re-establish the stimulus control of instructions. We followed this procedure and returned to high-p instructions after one or two instances of noncompliance with low-p instructions occurred (see Figures 2 and 4). In our analyses with Patty and Charlie, this resulted consistently in a resumption of compliance with low-p instructions. Although shifting from low-p to high-p instructions contingent on noncompliance carries the risk of negatively reinforcing noncompliance, the shift in this study increased compliance to low-p instructions after stimulus control was re-established with high-p instructions. Presumably, the SCP would be contraindicated for children who also demonstrate problem behavior related to low-p instructions.

Although the present study used high-p instructions to establish compliance, the SCP differs significantly from the high-p intervention commonly used in the literature (Mace et al., 1988). First, the conventional high-p procedure presents high-p instructions in a rapid sequence, typically at 5- to 10-s intervals. This is thought to establish a behavioral momentum-like effect that makes compliance resistant to disruption by a low-p request delivered immediately after the high-p sequence (Nevin, 1996, 2015). However, the high-p effect has been shown to be highly dependent on a short interval between the last high-p instruction and delivery of the low-p instruction (e.g., 5 s vs. 20 s; Houlihan, Jacobson & Brandon, 1994; Mace et al., 1988). Second, when Mace, Mauro, Boyajian, & Eckert (1997) presented successive low-p instructions separated by 15 s to 20 s following the conventional high-p treatment, compliance decreased with each successive low-p instruction. In the current study, the intervals between high-p instructions and low-p instructions were a minimum of 1 min, making a momentum effect unlikely. For these reasons, we consider it unlikely that the current procedure invoked behavioral persistence consistent with behavioral momentum theory.

The present study is not without limitations. First, the SCP contained multiple procedures comprising a treatment package, and it is unknown which procedural steps were requisite for improvement in compliance. The treatment package is novel, and future investigators may want to analyze which components are critical to producing clinical benefit. Second, it would be an oversimplification to conclude that stimulus control per se was responsible for the results. Stimulus control develops from multiple procedures (e.g., differential reinforcement). Third, there are possible concerns about the practicality of providing high rate food reinforcement for performing relatively low-effort responses. Future research is needed to determine if, over longer periods time food reinforcement can be faded and more high effort responses will be responsive to the intervention (cf. Hanley, Jin, Vanselow & Hannratty, 2014). Finally, the purpose of this study was to introduce a novel and comparatively simple procedure to improve compliance, but we do not know whether this procedure would be more or less efficacious than other established treatments (e.g., differential reinforcement of compliance, Parrish et al., 1986; timeout for noncompliance, Rortvedt & Miltenberger, 1994; a package of antecedent procedures, Stephenson & Hanley, 2010; emphasizing DRA for "do" versus "don't" requests, Neef, Shafer, Egel, Cataldo & Parrish, 1983; among others). Comparative studies are warranted to assess the relative efficacy of the current SCP.

The current research was stimulated by recent trends in translational research (Critchfield, 2011; Mace, 1994; Mace & Critchfield, 2010). Several steps in our SCP were based on basic research elucidating the behavioral processes involved in the development of stimulus control. These included using a novel therapist to establish a new history of reinforcement, rather than competing with a history of reinforcement for noncompliance (Nevin, 2015). Second, we used an orienting cue to evoke an orienting response from the children before giving an instruction. Third, prior to delivering low-p instructions, we gave instructions that had a very high probability of resulting in compliance because the child was in the act of taking the tangible reinforcer just as the instruction, "Take it," was delivered. Finally, this procedure ensured that participants would have a high number of exposures to the S–R–S contingency necessary for the development of stimulus control (Spradlin & Simon, 2011). In our view, designing interventions based on the basic behavioral processes that need to be invoked to result in behavior change represents the future of applied behavior analysis.

REFERENCES

Austin, J. L., & Agar, G. (2005). Helping young children follow their teachers' directions: The utility of high probability sequences in Pre-K and Kindergarten classrooms. *Education and Treatment of Children*, *28,* 222-236.

Axelrod, M. I., Bellini, S., & Markoff, K. (2014). Video self-modeling: A promising strategy for noncompliant children. *Behavior Modification*, *38,* 1-20. https://doi.org/10.1177/0145445514521232

Catania, A. C. (2013). Learning *(5th ed.)*. Cornwall-on-Hudson, NY: Sloan.

Critchfield, T. S. (2011). Translational contributions of the experimental analysis of behavior. *The Behavior Analyst*, *34,* 3-17. https://doi.org/10.1007/BF03392227

Davis, C. A., Brady, M. P., Hamilton, R., McEvoy, M. A., & Williams, R. E. (1994). Effects of high-probability requests on the social interactions of young children with severe disabilities. *Journal of Applied Behavior Analysis*, *27,* 619-637. https://doi.org/10.1901/jaba.1994.27-619

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis*, *29,* 519-533. https://doi.org/10.1901/jaba.1996.29-519

Dinsmoor, J. A. (1985). The integrative power of the CS–US interval in other contexts. *Behavioral and Brain Sciences*, *8*, 336-337. https://doi.org/10.1017/S0140525X00020926

Doleys, D. M., Wells, K. C., Hobbs, S. A., Roberts, M. W., & Cartelli, L. M. (1976). The effects of social punishment on noncompliance: A comparison with timeout and positive practice. *Journal of Applied Behavior Analysis*, *9,* 471-482. https://doi.org/10.1901/jaba.1976.9-471

Ducharme, J. M., & Popynick, M. (1993). Errorless compliance to parental requests: Treatment effects and generalization. *Behavior Therapy*, *24,* 209-226. https://doi.org/10.1016/S0005-7894(05)80264-3

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement*. East Norwalk, CT: Appleton-Century-Crofts.

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal of Mental Retardation*, *101,* 15-25.

Forehand, R., Gardner, H., & Roberts, M. (1978). Maternal response to child compliance and noncompliance: Some normative data. *Journal of Clinical Child Psychology,* 2, 121-124. https://doi.org/10.1080/15374417809532837

Forehand, R. L., & McMahon, R. J. (1981). *Helping the noncompliant child: A clinician's guide to parent training*. New York, NY: Guilford Press.

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis*, *47*(1) 16-36. https://doi.org/10.1002/jaba.106

Herrnstein, R. J. (1961). Relative and absolute strength of response as a function of frequency of reinforcement. *Journal of the Experimental Analysis of Behavior*, *4,* 267-272. https://doi.org/10.1901/jeab.1961.4-267

Herrnstein, R. J. (1970). On the law of effect. *Journal of the Experimental Analysis of Behavior*, *13,* 243-266. https://doi.org/10.1901/jeab.1970.13-243

Houlihan, D., Jacobson, L. & Brandon, P. K. (1994). Replication of a high-probability request sequence with varied interprompt times in a preschool setting. *Journal of Applied Behavior Analysis*, *27,* 737-738.

Lin, H.-L., Lawrence, F. R., & Gorrell, J. (2003). Kindergarten teachers' views of children's readiness for school. *Early Childhood Research Quarterly*, *18,* 225-237. https://doi.org/10.1016/S0885-2006(03)00028-0

Mace, F. C. (1994). The significance and future of functional analysis methodologies. *Journal of Applied*

Behavior Analysis, *27,* 385-392. https://doi.org/10.1901/jaba.1994.27-385

Mace, F. C., & Critchfield, T. S. (2010). Translational research in behavior analysis: Historical traditions and imperative for the future. *Journal of the Experimental Analysis of Behavior, 93,* 293-312. https://doi.org/10.1901/jeab.2010.93-293.

Mace, F. C., Hock, M. L., Lalli, J. S., West, B. J., Belfiore, P., Pinter, E., & Brown, D. K. (1988). Behavioral momentum in the treatment of noncompliance. *Journal of Applied Behavior Analysis*, *21,* 123-141. https://doi.org/10.1901/jaba.1988.21-123

Mace, F. C., Mauro, B. C., Boyajian, A. E., & Eckert, T. L. (1997). Effects of reinforcer quality on behavioral momentum: Coordinated applied and basic research. *Journal of Applied Behavior Analysis*, *30,* 1-20. https://doi.org/10.1901/jaba.1997.30-1

Mace, F. C., McComas, J. J., Mauro, B. C., Progar, P. R., Taylor, B., Ervin, R., & Zangrillo, A. N. (2010). Differential reinforcement of alternative behavior increases resistance to extinction: Clinical demonstration, animal modeling, and clinical test of one solution. *Journal of the Experimental Analysis of Behavior*, *93,* 349-367. https://doi.org/10.1901/jeab.2010.93-349

Mace, F.C., Pritchard, D., & Penney, H. (in press). Schedules of reinforcement. In W. Fisher, C. Piazza & H. R. Roane (Eds.), *Handbook of applied behavior analysis, 2nd Edition*. New York: Guilford Press.

McIlvane, W. J., & Dube, W. V. (1992). Stimulus control shaping and stimulus control topographies. *The Behavior Analyst*, *15,* 89-94.

Neef, N. A., Shafer, M. S., Egel, A. L., Cataldo, M. F., & Parrish, J. M. (1983). The class specific effects of compliance training with "do" and "don't" requests: Analogue analysis and classroom application. *Journal of Applied Behavior Analysis*, *16*(1), 81-99. https://doi.org/10.1901/jaba.1983.16-81

Nevin, J. A. (1996). The momentum of compliance. *Journal of Applied Behavior Analysis*, *29,* 535-547. https://doi.org/10.1901/jaba.1996.29-535

Nevin, J. A. (2015). *Behavioral momentum: A scientific metaphor*. CreateSpace Independent Publishing Platform.

Parrish, J. M., Cataldo, M. F., Kolko, D. J., Neef, N. A., & Egel, A. L. (1986). Experimental analysis of response covariations among compliant and inappropriate behaviors. *Journal of Applied Behavior Analysis*, *19,* 241-254. https://doi.org/10.1901/jaba.1986.19-241

Pavlov, I. P. (1927). *Conditioned reflexes*. Oxford, England: Oxford University Press.

Pritchard, D., Hoerger, M., & Mace, F. C. (2014). Treatment relapse and behavioral-momentum theory. *Journal of Applied Behavior Analysis*, *47,* 814-833. https://doi.org/10.1002/jaba.163

Reed, D. D., Niileksela, C. R., & Kaplan, B. A. (2013). Behavioral economics: A tutorial for behavior analysts in practice. *Behavior Analysis in Practice*, *6,* 34-54.

Rortvedt, A. K., & Miltenberger, R. G. (1994). Analysis of a high-probability instructional sequence and time-out in the treatment of child noncompliance. *Journal of Applied Behavior Analysis*, *27,* 327-330. https://doi.org/10.1901/jaba.1994.27-327

Russo, D. C., Cataldo, M. F., & Cushing, P. J. (1981). Compliance training and behavioral covariation in the treatment of multiple behavior problems. *Journal of Applied Behavior Analysis*, *14,* 209-222. https://doi.org/10.1901/jaba.1981.14-209

Skinner, B. F. (1933). The rate of establishment of a discrimination. *The Journal of General Psychology*, *9,* 302-350. https://doi.org/10.1080/00221309.1933.9920939

Sokolov, E. N. (1963). *Perception and the conditioned reflex*. Oxford: Pergamon Press.

Spence, K. W. (1936). The nature of discrimination learning in animals. *Psychological Review*, *43,* 427-449. https://doi.org/10.1037/h0056975

Spradlin, J. E., & Simon, J. L. (2011). Stimulus control and generalization. In W. W. Fisher, C. C. Piazza, & H. S. Roane (Eds.), *Handbook of applied behavior analysis* (p. 77). New York, NY: Guilford Press.

Stephenson, K. M., & Hanley, G. P. (2010). Preschoolers' compliance with simple instructions: A descriptive and experimental evaluation. *Journal of Applied Behavior Analysis, 43*, 229-247. https://doi.org/10.1901/jaba.2010.43-229

Wilder, D. A., Myers, K., Fischetti, A., Leon, Y., Nicholson, K., & Allison, J. (2012). An analysis of modifications to the three-step guided compliance procedure necessary to achieve compliance among preschool children. *Journal of Applied Behavior Analysis*, *45,* 121-130. https://doi.org/10.1901/jaba.2012.45-121

Wilder, D. A., Nicholson, K., & Allison, J. (2010). An evaluation of advance notice to increase compliance among preschoolers. *Journal of Applied Behavior Analysis*, *43,* 751-755. https://doi.org/10.1901/jaba.2010.43-751

Zarcone, J. R., Iwata, B. A., Mazaleski, J. L., & Smith, R. G. (1994). Momentum and extinction effects on self-injurious escape behavior and noncompliance. *Journal of Applied Behavior Analysis*, *27,* 649-658. https://doi.org/10.1901/jaba.1994.27-649

Received February 5, 2016
Final acceptance October 4, 2016
Action Editor, David Wacker

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's website.