

## EXPERIMENTAL ANALYSIS OF RESPONSE COVARIATION AMONG COMPLIANT AND INAPPROPRIATE BEHAVIORS

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Reliable changes in a variety of behaviors, or classes of behaviors, when only one is manipulated experimentally, have demonstrated that even topographically dissimilar responses can be functionally related. We investigated such a relationship between topographically different child behaviors (compliance and inappropriate activities) by using a methodology that tests for response covariation. Five conditions were provided to sequentially increase and decrease first one and then the other of these behaviors, with the degree of covariation between the two behaviors (i.e., the relationship between changes in the targeted and nontargeted behaviors) being the finding of interest. Results showed that, regardless of the intervention used, the behavior targeted, or the direction manipulated, the nontargeted behavior reliably covaried inversely with the targeted one. The findings have immediate relevance to the clinical treatment of multiple behavior problems exhibited by children. Furthermore, the study of relationships between responses and the processes underlying these relationships can have important implications for understanding the complexity characteristic of human behavior not yet analyzed by behavioral research.

DESCRIPTORS: response covariation, compliance, child behavior problems

Early basic operant research included investigations of variables affecting relationships between responses and provided a knowledge base for analyzing complex cases of behavior (e.g., Skinner, 1935). Yet, in the subsequent five or so decades, applied research has focused primarily on more simple behavioral relationships, demonstrating their power and utility in resolving important problems. That applied behavior analysis should begin in the simplest way and build up to the complex, step by step, is characteristic of scientific analysis and the course by which scientific knowledge grows.

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Thus, "... although a functional analysis begins with relatively isolated relations, an important part of its task is to show how its variables interact" (Skinner, 1953, pp. 205-206). Response covariation may represent one type of relationship by which such interaction can be studied.

Relationships between behaviors have been described in the basic animal literature on concurrent operants (e.g., Catania, 1966) and multiple response repertoires (e.g., Dunham & Grantmyre, 1982). Response covariation, the observation that two or more behaviors vary directly or inversely, has also been reported in numerous analogue and clinical situations (e.g., Buell, Stoddard, Harris, & Baer, 1968; Epstein, Doke, Sajwaj, Sorrell, & Rimmer, 1974; Nordquist, 1971; Risley, 1968; Russo, Cataldo, & Cushing, 1981; Sajwaj, Twardosz, & Burke, 1972; Twardosz & Sajwaj, 1972; Wahler, Sperling, Thomas, Teeter, & Luper, 1970). From an applied standpoint, a better understanding of response covariation could result in interventions that simultaneously modify multiple behaviors, obviating less economical sequential treatments designed to change only one behavior at a time.

Inverse relationships between appropriate and inappropriate behaviors have been noted across multiple target/nontarget behaviors and across age groups from infancy to adolescence, using a wide range of interventions (e.g., Ayllon & Roberts, 1974; Bucher & Lovaas, 1968; Buell *et al.*, 1968; Epstein *et al.*, 1974; Koegel, Firestone, Kramme, & Dunlap, 1974; Nordquist, 1971). Such inverse relationships have been described as collateral or side effects (either beneficial or detrimental) of procedures aimed at changing other behaviors. That is, these studies were designed experimentally to analyze changes in targeted behaviors, rather than response covariation *per se*.

With few exceptions (e.g., Neef, Shafer, Egel, Cataldo, & Parrish, 1983), child compliance with adult instruction is one area of investigation in which collateral effects have been observed but not analyzed experimentally as response covariation (Budd, Green, & Baer, 1976; Cataldo, Ward, Russo, Riordan, & Bennett, *in press*; Nordquist, 1971; Russo *et al.*, 1981; Wahler *et al.*, 1970; Zeilberger, Sampen, & Sloane, 1968). Compliance training involving contingent reinforcement, timeout, and/or physical guidance has frequently been the focus of analogue as well as clinical investigations (e.g., Bucher, 1973; Goetz, Holmberg, & LeBlanc, 1975; Peed, Roberts, & Forehand, 1977; Russo *et al.*, 1981; Whitman, Zakaras, & Charodos, 1971).

In one such study (Russo *et al.*, 1981), reinforcement contingent on compliance not only resulted in increases in compliance, but also in decreases in untreated inappropriate behaviors. To test whether compliance and inappropriate behaviors are inversely related, the authors suggested an experiment in which contingencies would be applied only to a member of one class of behavior (class A, for example, compliance with adult instructions) while collateral changes in the other class (class B, for example, inappropriate behaviors) were monitored. Following discontinuation of this condition, contingencies could be placed in effect only for class B, while correlated changes in class A were recorded. We report an investigation to test this thesis.

## METHOD

### *Subjects*

Four children ranging in age from 3 years 1 month to 5 years 3 months participated in the study. Three were male. Psychometric evaluation (Stanford-Binet and the Bayley Scales of Infant Development) at intake indicated that three (Dan, Seth, and Mary) were moderately and one (Tim) was mildly mentally retarded. Each had been identified by both parents and by at least one professional as being noncompliant with adult requests and as exhibiting inappropriate behaviors (e.g., aggression, disruption, property destruction, and pica) to a degree warranting intensive professional intervention. Inclusion in this investigation was based on (a) receptive language skills sufficient to enable the children to respond to one-step requests; (b) a history of having complied (albeit inconsistently) with the requests used in the study; (c) general compliance with adult requests occurring 60% or less; and (d) the occurrence of three or more different types of inappropriate behaviors at least 20% of the time observed.

### *Settings*

Sessions were conducted in either a 2.6 m × 2.9 m individual treatment room or a 15 m × 8 m group activity room in which three to five other handicapped children also received intensive behavioral and academic programs. The individual treatment room was equipped with a work table and two chairs; the group activity room contained several tables and chairs, storage cabinets, a television and record player, and a swing. In both settings, children had free access to educational materials and toys such as books, blocks, plastic rings, stuffed animals, puzzles, plastic cars and trucks, paper and crayons, and a plastic bucket. One to four ( $M = 3$ ) 10-min sessions were conducted during morning and afternoon periods dependent on the child's other scheduled activities, with each child taken out of the treatment area for at least 5 min between sessions.

### Target Behaviors

**Compliance.** Each child's compliance with adult requests was observed. Compliance was defined as completion of the requested action within 20 s of the initial request. Each request could be completed in 2 s or less. Requests targeted for assessment were selected on the basis of a series of interviews with the parents and direct observations of parent-child and therapist-child interactions, with the parent or therapist instructed to issue requests typically made of the child at home. Those requests most frequently issued but only occasionally completed were identified for each child. The interviews and direct observations yielded 10 one-step requests that were common to all children. Table 1 presents the requests and their operational definitions. Dan, Tim, and Seth were issued these one-step requests; the requests issued to Mary consisted of the same items combined to form two-step requests. For each child the same requests were used across all experimental conditions.

**Inappropriate behavior.** Four inappropriate behaviors (aggression, disruption, property destruction, and pica) were measured simultaneously with compliance across all conditions for each child. *Aggression* was defined as pushing, pinching, hitting, biting, kicking, or pulling hair perpetrated against the therapist. *Disruption* was defined as whining, crying, screaming; attempting to escape session area or therapist; climbing on furniture; or

banging furniture, walls, or floor with open hand(s). *Property destruction* was defined as pushing, kicking, or overturning furniture; stomping on educational materials or toys; pounding on objects with closed fist; throwing an object; breaking or tearing educational materials, toys, furniture, or clothing of therapist; or writing on furniture, walls, or floor. *Pica* was defined as placing any inedible object on the lips or in the mouth.

### Procedures

To provide a preliminary analysis of the generality of the phenomenon, a variety of different conditions were placed in effect. We reasoned that the generality of our findings would be enhanced greatly if we could demonstrate similar results regardless of the procedures used, the order in which they were implemented, or the sequence in which they were introduced across settings.

During all interventions, the method of issuing requests remained the same. At the beginning of each minute, the therapist established eye contact with the child, and stated the child's name followed by the request, including the label of the specific referent when applicable. If the child did not initiate the requested action within 5 s, the request was repeated with an appropriate accompanying gesture (e.g., pointing to the bucket in which the identified toy was to be placed). Thereafter, no further requests or prompts were provided for the remainder of the 20-s scoring interval.

Table 1  
Response Definitions of Requests

Request	Definition
Sit down	Alter position so that buttocks are on flat surface of chair with both feet touching floor.
Stand up	Alter position so that body weight is distributed on both feet.
Open (close) the door	Pull (push) door so that there is visible space (no visible space) between door and door jamb.
Give me the _____	Place labeled object in therapist's outstretched hand.
Pick up the _____	Grasp specified object and stand with object in hand.
Put the _____ in the _____	Place labeled object in identified receptacle.
Come here	Move to within 2 feet of and facing therapist.
Touch your _____	Make hand contact with labeled body part (e.g., nose, top of head).
Clap your hands	Make audible contact of one open hand with another.
Put the _____ on the _____	Place labeled object on the identified surface.

*Extinction.* During the extinction condition, regardless of the child's behavior, the therapist provided no verbal or nonverbal consequences and did not interact with the child other than to issue scheduled requests. If a child aggressed, the therapist made the least obtrusive self-defense response possible.

*Social disapproval.* This condition was the same as the extinction condition except that the therapist issued statements of concern (e.g., "You're going to break that") contingent on the occurrence of any targeted inappropriate behavior. To avoid the therapist disrupting any attempts the child might make to comply, such statements did not occur during the 20-s period following a request. As in extinction, no other differential consequences followed either compliance or noncompliance. This condition resulted from noting that the children's problem behaviors typically elicited parental concern, and was implemented as a means of simulating the home environment.

*Reinforcement for compliance.* If the child complied with the verbal request within the allotted 20 s, the therapist immediately provided praise (e.g., "That's it; you put the puzzle piece on the table") and, in some cases, an edible reinforcer (e.g., corn chip, piece of cookie, piece of chocolate candy, popcorn, or soft drink) and physical affection (e.g., hugs, pats, rubs, tickles). If, by the end of the 20-s interval, the child had not complied, the therapist repeated the request and provided any physical guidance necessary for the child to complete the requested task, with no reinforcement provided. Because physical guidance only required leading the child by one hand rather than two, the occurrence of inappropriate behaviors was not precluded by this guidance.

Following reinforcement for compliance or physical guidance contingent on noncompliance, the child was permitted to return to whatever academic/play activity or inappropriate behavior he or she chose to engage in until the next trial was initiated. Contingencies in effect for compliance or noncompliance were delivered irrespective of the occurrence or nonoccurrence of any targeted inappropriate behavior (i.e., compliance would be rein-

forced even if an inappropriate behavior had occurred at the same time). No consequences were provided contingent on the occurrence or nonoccurrence of any targeted inappropriate behavior.

*Differential reinforcement of other behavior (DRO).* The DRO contingency consisted of praise, edibles, and/or physical affection contingent on a 5-s period during which none of the targeted inappropriate behaviors occurred. This contingency was in effect except during a 25-s period after each initial request by the experimenter (i.e., the 20-s period allotted for the child to comply plus 5 s for the experimenter to be cued to resume the DRO contingency). The condition was structured to avoid the inadvertent reinforcement of compliance (or noncompliance). No contingencies were in effect for compliance/noncompliance.

*Contingent observation.* The contingent observation condition was used only when a child was in the group activity room. Similar to the social disapproval and DRO conditions, contingent observation was carried out except during the period immediately following a request (i.e., 25 s). The contingent observation condition consisted of removing the child from an ongoing activity contingent on the occurrence of a targeted inappropriate behavior and seating the child in a chair facing the activity for a period of 1 min with a 10-s change-over delay. In this position, the child had an opportunity to observe other children receiving reinforcers contingent on appropriate behavior. A cassette tape with cued intervals used for observational purposes was stopped as soon as the therapist initiated the contingent observation procedure and was resumed upon attainment of the change-over criterion. Observers did not record inappropriate behaviors that occurred during the contingent observation. In this way, the length of the observation period was held constant across sessions. No contingencies were in effect for compliance or noncompliance.

Each child's performance was evaluated with a reversal design (Baer, Wolf, & Risley, 1968), with the order of conditions varied across children and settings.

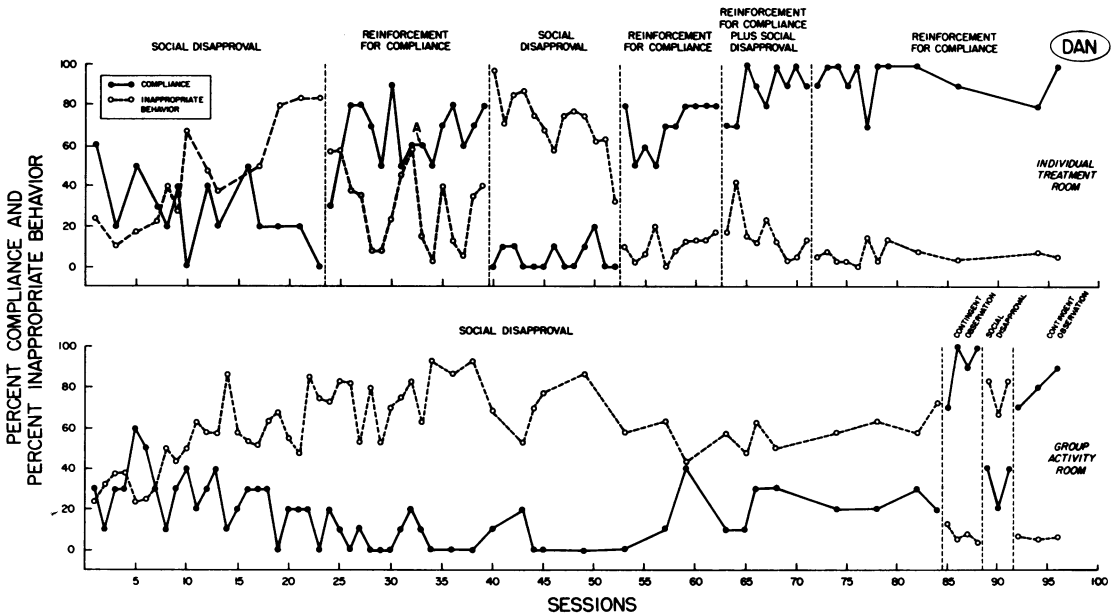


Figure 1. Percentage of occurrence of Dan's compliant (closed circles) and inappropriate behaviors (open circles) across settings and experimental conditions. "A" indicates onset of use of edibles in addition to praise and physical affection.

*Data Recording and Reliability Assessment*

Every compliance trial was recorded by the observer(s) as correct (compliant) or incorrect (non-compliant), as defined in Table 1. Inappropriate behaviors were scored using a 10-s continuous interval recording procedure simultaneously with the measurement of compliance. For all inappropriate behaviors, the presence or absence of each behavior during each 10-s interval was noted. Inappropriate behaviors could occur either simultaneously with or in close temporal proximity to compliance, and were not physically incompatible with compliance or each other. Compliant behaviors could be carried out in a few seconds. Thus, for the first 10-s observation interval after a request, compliant and inappropriate behaviors could occur simultaneously or in sequence; thereafter, for each of the remaining five 10-s intervals before the next request, inappropriate behaviors could continue to occur. These procedures were designed to maximize the likelihood that data showing covariation would reflect a functional rather than structural relationship.

Measures of interobserver agreement were obtained randomly during 40%–46% of sessions across all measures, children, therapists, and experimental conditions (see Table 2). Reliability was determined by comparing the records of two independent observers, neither one of whom was the therapist, and dividing the number of agreements by number of agreements plus disagreements and multiplying by 100. Various pairs of observers were used with the same child to increase the probability of obtaining unbiased recordings. For inappropriate behaviors, reliability was calculated for occurrences, nonoccurrences, and occurrences plus nonoccurrences.

RESULTS

The predicted inverse relationships were observed; as inappropriate behaviors decreased, compliance increased and vice versa. Specific findings will be discussed separately for each child. Each figure expresses the results as the percentage of compliance and percentage of intervals during which inappropriate behaviors were observed.

Table 2  
 Percentage Agreement (Means and Ranges) Between Observers on Dependent Measures for Each Child During Each Experimental Condition in Each Setting

Setting/condition	Compliance/ noncompliance	Inappropriate behaviors		
		Occurrences	Nonoccurrences	Total
<b>Dan</b>				
Individual treatment room/social disapproval	98.2 (90.0–100.0)	85.1 (72.2–96.4)	87.1 (50.0–98.3)	93.5 (83.3–98.3)
Individual treatment room/reinforcement for compliance	97.3 (90.0–100.0)	85.3 (61.5–100.0)	94.0 (73.1–100.0)	96.2 (88.3–100.0)
Individual treatment room/reinforcement for compliance plus social disapproval	100.0	87.8 (60.0–100.0)	84.0 (58.3–100.0)	95.0 (91.7–100.0)
Group activity room/social disapproval	97.2 (80.0–100.0)	84.8 (67.0–96.8)	79.7 (68.8–96.6)	91.7 (85.0–98.3)
Group activity room/contingent observation	98.0 (90.0–100.0)	82.0 (62.5–100.0)	97.8 (94.5–100.0)	98.2 (95.0–100.0)
<b>Tim</b>				
Individual treatment room/social disapproval	91.8 (70.0–100.0)	87.6 (63.6–97.7)	83.6 (73.9–95.2)	93.6 (88.3–98.3)
Individual treatment room/reinforcement for compliance	98.3 (90.0–100.0)	87.4 (82.5–92.9)	81.2 (74.1–90.5)	92.2 (88.3–95.0)
Individual treatment room/differential reinforcement of other behavior	97.7 (80.0–100.0)	88.6 (75.0–100.0)	95.2 (65.4–100.0)	97.1 (85.0–100.0)
<b>Seth</b>				
Group activity room/extinction	96.9 (80.0–100.0)	87.2 (77.1–100.0)	80.4 (60.0–100.0)	92.5 (86.7–100.0)
Group activity room/social disapproval	96.0 (80.0–100.0)	90.7 (84.2–95.6)	82.2 (76.9–88.2)	93.7 (90.0–96.7)
Group activity room/differential reinforcement of other behavior	96.7 (90.0–100.0)	88.3 (50.0–100.0)	98.3 (90.4–100.0)	98.3 (91.7–100.0)
Group activity room/reinforcement for compliance	94.4 (80.0–100.0)	87.7 (67.0–100.0)	95.3 (91.2–100.0)	96.7 (91.7–100.0)
Individual treatment room/extinction	95.7 (90.0–100.0)	83.5 (72.2–100.0)	91.1 (85.7–100.0)	94.5 (90.0–100.0)
Individual treatment room/social disapproval	98.8 (90.0–100.0)	91.5 (73.3–100.0)	88.3 (73.1–100.0)	95.0 (88.3–100.0)
Individual treatment room/reinforcement for compliance	100.0	100.0	100.0	100.0
<b>Mary</b>				
Group activity room/extinction	100.0	92.6 (81.8–100.0)	87.1 (63.2–100.0)	95.4 (88.3–100.0)
Group activity room/reinforcement for compliance	99.2 (80.0–100.0)	90.3 (75.0–100.0)	91.6 (28.5–100.0)	95.8 (83.3–100.0)
Individual treatment room/extinction	99.6 (90.0–100.0)	90.9 (60.0–100.0)	91.0 (40.0–100.0)	95.7 (80.0–100.0)
Individual treatment room/differential reinforcement of other behavior	98.3 (90.0–100.0)	95.9 (85.7–100.0)	98.5 (95.3–100.0)	98.9 (96.7–100.0)

Figure 1 shows Dan's performance in individual treatment (top graph) and group activity rooms (bottom graph). As the initial social disapproval condition proceeded in the individual treatment room, compliance decreased ( $M = 26\%$ ) while inappropriate behaviors increased ( $M = 49\%$ ). Following the introduction of reinforcement for compliance, compliance increased ( $M = 65\%$ ) and inappropriate behavior decreased ( $M = 30\%$ ). A return to the social disapproval condition resulted in immediate decreases in compliance ( $M = 5\%$ ) and increases in inappropriate behaviors ( $M = 70\%$ ). Resumption of reinforcement for compliance immediately increased compliance ( $M = 70\%$ ) and decreased inappropriate behavior ( $M = 10\%$ ), replicating the outcome of the first application of reinforcement for compliance, with the exception that variability in Dan's overall performance decreased and the percentage of inappropriate behaviors was much lower than in the initial reinforcement phase.

Subsequent to the initial social disapproval condition, we chose to evaluate first whether reinforcement for compliance would have the anticipated desired effects on Dan's behavior before alternately manipulating contingencies on either compliant or inappropriate behaviors. Because the implementation of reinforcement for compliance following the social disapproval condition required changing two variables at once (i.e., the introduction of reinforcement contingent upon compliance and the withdrawal of attention contingent upon the occurrence of inappropriate behavior), a phase in which social disapproval was added to reinforcement for compliance was conducted. This phase occurred following the replication of the reinforcement effects and was implemented to assess whether previously observed changes were a function of adding reinforcement for compliance or removing social disapproval.

When social disapproval was added, the level and variability of compliance increased ( $M = 88\%$ ), and the level and variability of inappropriate behaviors remained essentially the same ( $M = 16\%$ ). Continuation of reinforcement for compliance in the absence of social disapproval resulted in maintained high levels of compliance ( $M = 90\%$ ) and

low levels of inappropriate behavior ( $M = 9\%$ ). These results suggest that the presence or absence of social disapproval by the therapist had relatively little impact on Dan's performance and that the observed covariation may be primarily a function of the reinforcement contingency for compliance.

Concurrently, in the group activity room, the social disapproval condition was implemented, with the percentage of compliance averaging 18% and the percentage of inappropriate behavior averaging 60%. No evidence consistently supported either generalization of treatment effects from the individual treatment room sessions to the group activity room sessions or contrast effects. Following the social disapproval condition, contingencies tied only to the occurrence or nonoccurrence of inappropriate behaviors were instituted to study the effects of such contingencies on compliance. A contingent observation procedure resulted in sizeable decreases in inappropriate behaviors and, concomitantly, large increases in compliance, despite the absence of a contingency for compliance or noncompliance.

Resumption of social disapproval led to a reversal of these effects, with the percentage of inappropriate behaviors averaging 78% and the percentage of compliance averaging 33%. Reintroduction of the contingent observation procedure again resulted in rapid, large decreases in inappropriate behaviors ( $M = 7\%$ ) and similar increases in compliance ( $M = 80\%$ ).

Figure 2 shows the results for Tim in the individual treatment room. Because of staffing shortages and the brevity of Tim's hospitalization, no data were collected in the group activity room. During the initial social disapproval condition designed to simulate home conditions, mean compliance was 10% and mean occurrence of inappropriate behaviors was 70%. With the introduction of reinforcement for compliance, instruction-following gradually increased ( $M = 52\%$ ), while inappropriate behavior decreased ( $M = 46\%$ ). These results suggested that Tim's compliance was responsive to reinforcement contingencies, thus permitting additional manipulations to investigate covariation.

From this point forward, an ABAB reversal design was completed in which alternating phases of

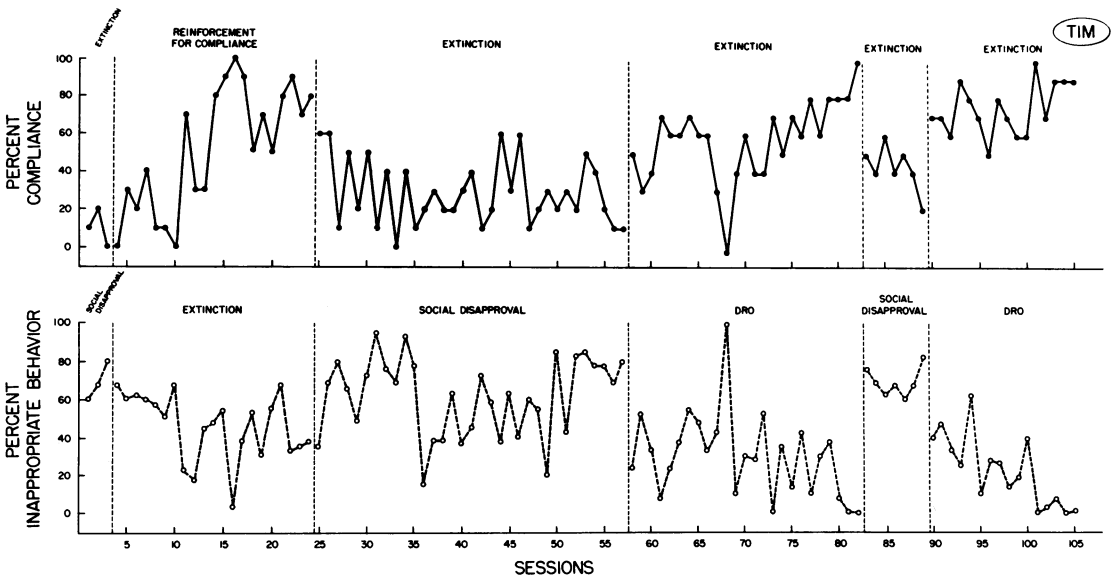


Figure 2. Percentage of Tim's compliant (closed circles) and inappropriate behaviors (open circles) across experimental conditions conducted in the individual treatment room.

social disapproval and differential reinforcement were in effect for inappropriate behaviors, while extinction was in effect for compliance or noncompliance. An ensuing social disapproval condition led to a sizeable decrease in compliance ( $M = 28\%$ ) and a slight increase in inappropriate behaviors ( $M = 59\%$ ). Next, a DRO procedure was implemented, resulting in a decrease in inappropriate behaviors ( $M = 32\%$ ) and a concurrent increase in compliance ( $M = 61\%$ ). Return to the social disapproval condition produced large increases in inappropriate behaviors ( $M = 69\%$ ) and decreases in compliance ( $M = 43\%$ ). Finally, the reintroduction of the DRO procedure again produced a reduction in the percentage of inappropriate behaviors ( $M = 24\%$ ), with the percentage during the last five sessions consistently being below 10%. Simultaneously, although there were no consequences for noncompliance, compliance immediately increased ( $M = 80\%$ ).

Figure 3 shows the results for Seth in both settings. An extinction condition preceded the social disapproval condition in order to assess provisionally whether Seth's problem behavior was maintained by contingent parental attention. During the initial extinction condition in the group activity room (top graph), inappropriate behaviors aver-

aged 28%, while the mean level of compliance was 41%. When the therapist issued statements of concern contingent upon inappropriate behaviors, targeted problem behaviors increased dramatically to a mean of 71%. Concurrently, compliance decreased to a mean of 20%. Following the introduction of the DRO procedure, inappropriate behaviors decreased considerably ( $M = 9\%$ ) and compliance increased ( $M = 86\%$ ), despite the absence of any direct programmed contingencies for compliance or noncompliance. A reversal to the social disapproval condition revealed a predicted separation between inappropriate behavior and instruction-following, with the former rising to a mean of 56% of intervals and the latter falling to 30%. Reinstitution of the DRO contingency again resulted in rapid decreases in inappropriate behavior ( $M = 12\%$ ) and increases in compliance ( $M = 70\%$ ).

During the second extinction phase in the group activity room, the mean levels of compliance and inappropriate behaviors were 23% and 71%, respectively. The level of inappropriate behaviors in this extinction condition was higher than the level observed in the first extinction phase and similar to that seen in the preceding social disapproval conditions. Reinforcement for compliance pro-



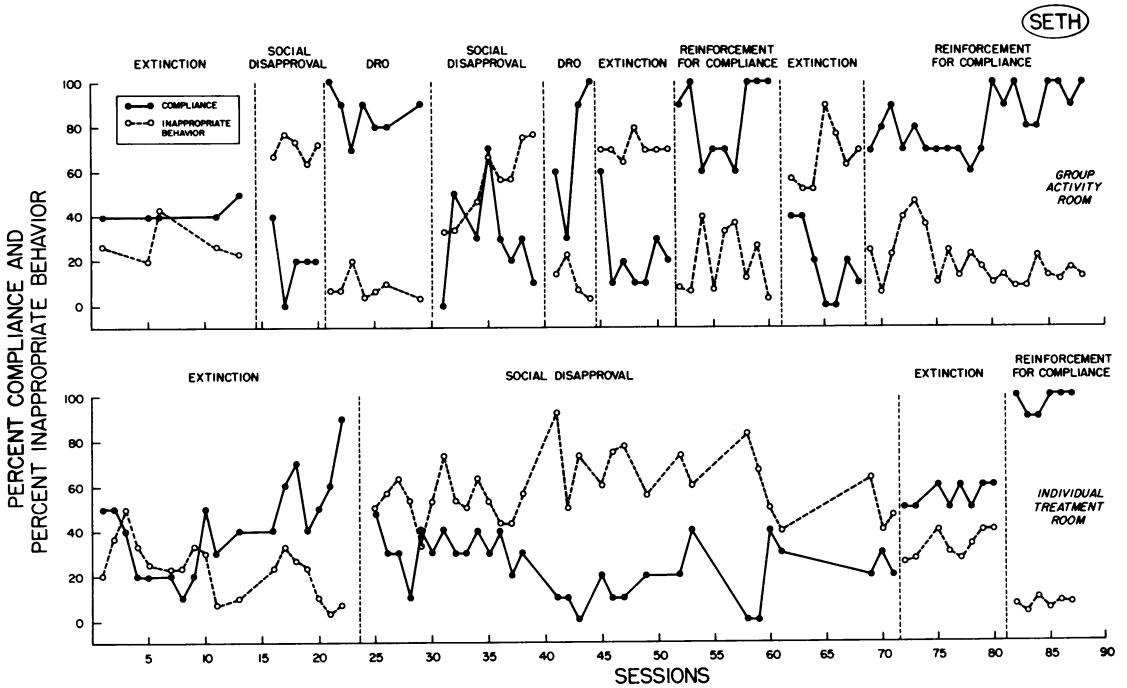


Figure 3. Percentage of Seth's compliant (closed circles) and inappropriate behaviors (open circles) across settings and experimental conditions.

duced immediate increases in compliance ( $M = 83\%$ ), with associated decreases in inappropriate behaviors ( $M = 19\%$ ). A reversal to an extinction condition led to a sharp drop in compliance ( $M = 20\%$ ) and a rapid increase in inappropriate behaviors ( $M = 61\%$ ). Resumption of reinforcement for compliance resulted not only in desirable increases in compliance ( $M = 79\%$ ), with compliance averaging 91% in the last 10 sessions, but also in sizeable decreases in problem behaviors ( $M = 17\%$ ).

Concurrent with the implementation of reversal phases in the group activity room, extended extinction and social disapproval phases were established in the individual treatment room prior to a replication of the effects of reinforcement for compliance. During the first extinction phase in this setting, the percentage of compliance was extremely variable, averaging 45%. At the same time, the mean level of inappropriate behaviors was 23%. When social disapproval was provided, inappropriate behaviors increased to 59% and compliance dropped to a mean of 25%. A brief return to an extinction condition resulted in levels of compli-

ance that averaged 57%, while inappropriate behaviors averaged 34%. Following the introduction of reinforcement for compliance, compliance increased ( $M = 97\%$ ) and inappropriate behaviors decreased ( $M = 6\%$ ) in the absence of any direct contingencies for the latter, thereby replicating the effects of reinforcement for compliance in the group activity room.

Figure 4 shows the results for Mary in both settings. During the extinction condition in the group activity room, the mean level of compliance was 10%, while the mean level of inappropriate behaviors was 59%. Following the introduction of reinforcement for compliance, the percentage of compliance increased to a mean of 68%, with compliance averaging 95% subsequent to the use of edible reinforcers. Concomitantly, despite the absence of any direct contingencies, inappropriate behaviors quickly decreased ( $M = 41\%$ ). During a reversal to the extinction condition, compliance rapidly declined ( $M = 5\%$ ), with inappropriate behaviors returning to the level ( $M = 54\%$ ) observed in the first extinction phase. Subsequent to the reintroduction of reinforcement for compliance,

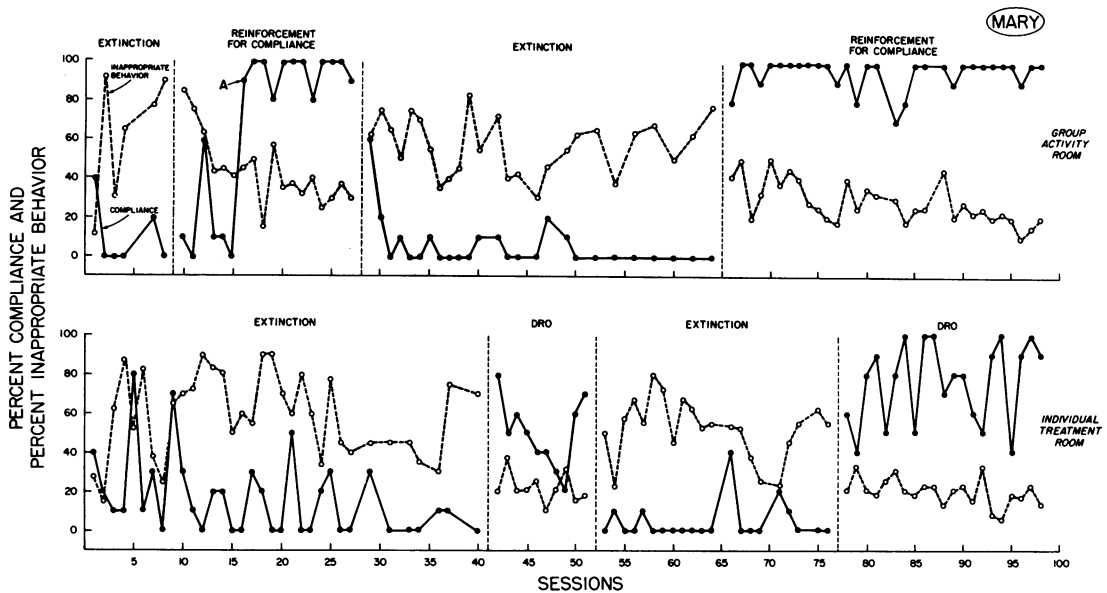


Figure 4. Percentage of Mary's compliant (closed circles) and inappropriate behaviors (open circles) across settings and experimental conditions. "A" indicates onset of use of edibles in addition to praise and physical affection.

compliance again increased and remained at or near 100% ( $M = 96\%$ ), and inappropriate behaviors gradually decreased as the phase proceeded ( $M = 26\%$ ).

In the individual treatment room during the initial extinction condition, both compliance and inappropriate behavior were extremely variable, with compliance averaging 16% and inappropriate behavior 56%. When DRO was implemented to reduce inappropriate behaviors, these targeted behaviors decreased in frequency and variability ( $M = 22\%$ ), and compliance increased ( $M = 50\%$ ). With the resumption of extinction, inappropriate behavior increased ( $M = 49\%$ ) to levels during previous extinction conditions, and compliance decreased ( $M = 4\%$ ) to below previous levels. When the DRO contingency was reintroduced, inappropriate behaviors again decreased ( $M = 17\%$ ), and compliance increased ( $M = 76\%$ ), replicating the effects of the initial DRO phase.

## DISCUSSION

Results of this investigation demonstrate that compliant and inappropriate behaviors are inverse-

ly related. Specifically, reinforcement contingent on compliance produced not only increases in compliance, but also decreases in inappropriate behaviors. Conversely, contingencies that decreased inappropriate behaviors resulted in concomitant increases in compliance, despite the absence of reinforcement contingencies for compliance. Previous studies have analyzed the effects of contingencies on targeted behaviors, with observed corollary changes in untreated behaviors reported as serendipitous findings (e.g., Buell *et al.*, 1968; Twardosz & Sajwaj, 1972). We experimentally analyzed the inverse relationship between compliant and inappropriate behaviors by manipulating either type of behavior to produce a change in the other and demonstrated the robustness of this relationship across behavior change procedures, subjects, and settings.

The assumption that these results exemplify a relationship between these two types of behaviors must be considered in contrast to other explanations more typically the subject of applied behavioral studies. Three such alternative explanations are particularly noteworthy. The first is that the compliant and inappropriate behaviors could have

been mutually exclusive (physically incompatible), thereby explaining the inverse patterns observed. Both types of behavior could co-occur in each 10-s interval, however. Compliant behaviors were chosen that could be emitted in 2 s or less. Further, the completion of a request did not preclude the occurrence of inappropriate behavior (i.e., the child could simultaneously be compliant and aggressive, disruptive, destructive, or emit pica). To assert the possibility that both behaviors could co-occur still leaves unresolved whether they did. Analysis of the data across all experimental phases showed that, during intervals when compliance was scored, inappropriate behaviors were also observed during 12.7%, 19.6%, 15.5%, and 13.9% of the intervals for Dan, Tim, Seth, and Mary, respectively.

A second possible alternative explanation is that the physical guidance provided during phases of reinforcement for compliance punished co-occurring inappropriate behaviors, thus accounting for the concurrent decreases observed in these behaviors. If this account were the case, one would expect to find decreases in inappropriate behaviors following guided compliance. Detailed interval-by-interval analyses of the rate of inappropriate behaviors within each minute immediately before and after the delivery of physical guidance did not reveal any suppression of inappropriate behaviors among the four children studied. In fact, for two of the children studied (Tim and Mary) inappropriate behaviors increased (from 2.76 to 4.78 and from 2.50 to 3.16 occurrences per minute, respectively), suggesting that if physical guidance had an effect over and above demonstrating the behavior requested it was one that reinforced concurrent inappropriate behavior.

Third, during phases of differential reinforcement of other behavior, compliance may have been reinforced adventitiously, thereby explaining the observed concurrent increases in instruction-following as the DRO procedure produced decreases in inappropriate behaviors. This possibility was investigated in two ways. An extensive analysis of the integrity of the DRO procedure indicated that reinforcement was not delivered during the stated 25-s delay following each request for compliance.

Furthermore, if adventitious reinforcement were in effect, one would likely observe sizeable changes in the probability of compliance to the next request following shorter (delivery of differential reinforcement within the 10-s interval following the 25-s delay) versus longer delays (delivery of differential reinforcement occurring after this first 10-s interval). In none of the cases was the probability of compliance substantially higher subsequent to shorter versus longer delays in the delivery of differential reinforcement. The probability of compliance following shorter (longer) delays was .74 (.71), .79 (.93), and .56 (.68) in the cases of Tim, Seth, and Mary, respectively. Differential reinforcement of other behavior was not used with Dan. Hence, there is no evidence suggesting the operation of adventitious reinforcement upon compliant behavior during the DRO phases.

#### *Mechanisms of Response Covariation*

The experimental analysis of behavior literature is particularly relevant to our findings. For example, research on concurrent operants has shown that they are related not in terms of rates of occurrence (i.e., changes in the rate of one operant do not necessarily alter the rate of other operants) but, rather, with respect to their consequences (Catania, 1963, 1966, 1969, 1973). That is, given a concurrent schedule, an increase in the reinforcement of one response generally produces a decrease in the rate of the other response; conversely, when one response is punished, an increase in the rate of the unpunished response occurs. Such outcomes appear to parallel the effects noted in our study.

Which concurrent operants change may be related to other basic research on the effects of punishment on unpunished responses (Dunham, 1971, 1972). For example, when one response is punished, only the most probable of the alternative responses increases, and the response most likely to follow the punished response is also suppressed (Dunham & Grantmyre, 1982). Thus, compliance may be a highly probable response in some settings and at certain stages of children's development, whereas under other conditions similar covariation may be observed between other types of behaviors.

Applied research pertaining to the formation of response classes is relatively sparse. In the case of imitative behaviors, some investigators have asserted that, through repeated trials, "similarity" between the model's behavior and that of the observer sets the occasion for reinforcement and becomes both a discriminative stimulus for reinforcement and a conditioned reinforcer (Baer, Peterson, & Sherman, 1967; Baer & Sherman, 1964; Brigham & Sherman, 1968; Lovaas, Berberich, Perloff, & Schaeffer, 1966). A similar argument has been extended to instruction-following behaviors (Martin, 1971; Neef *et al.*, 1983). For example, if a child has a history of receiving reinforcement for compliance, requests may become discriminative stimuli for reinforcers such that all instruction-following behaviors increase in probability although each may not have a specific reinforcement history. Similarly, compliant and inappropriate behaviors may form inversely related response classes (Russo *et al.*, 1981). Such response classes may develop because parents are more likely to reinforce compliance when it is not accompanied by inappropriate behavior. Or, when parents withhold reinforcement or punish inappropriate behavior, children may emit highly probable, unpunished alternative behaviors such as instruction-following.

#### *Future Research Considerations*

Our study generates additional questions about covariation. For example, what affects the generality of covariation across children or the apparent individual differences in the magnitude of the covariation? Of the four children, Tim's behaviors appeared to covary the least. Tim was relatively unresponsive to reinforcement contingencies directed at either compliant or inappropriate behaviors. In contrast, Dan, Seth, and Mary typically exhibited almost immediate and relatively stable separations between the two targeted groups of behavior. Another question concerns changes over time in the degree of covariation observed. On a few occasions, condition changes did not result in complete reversals. In general, covariation increased as each child progressed through the series of experimental manipulations. For both questions, we fa-

vor an explanation based on differential learning histories, presumed to occur prior to this study in the first case and as a result of the conditions of this study in the second.

Having experimentally demonstrated a phenomenon, one then examines its parameters. Questions of this nature include: What are the conditions under which behaviors do not covary? What conditions limit covariation? Would covariation be observed if an appropriate behavior other than compliance was targeted for change? Would covariation occur if contingencies were established for only one inappropriate behavior that does nor does not covary with compliance?

This study was not designed to examine the phenomenon of response covariation in the natural environment but, rather, to demonstrate an inverse relationship between compliant and inappropriate behaviors. A consideration of which interventions resulted in the most covariation and/or the most sizeable clinical gains was beyond the scope of this study. Systematic replications of the findings presented here in less structured, more applied settings, such as outpatient clinics, classrooms, residential centers, and at home, would provide both a test of the external validity of the conclusions and a demonstration of the utility of a covariation approach to treatment. These settings may be characterized by a larger number of response options, with some of these options having reinforcement schedules different from those used in this study.

Research using correlational techniques has shown that behaviors are organized into clusters and that a variety of responses covary (e.g., Wahler, 1975; Wahler *et al.*, 1970; Wahler & Fox, 1980). Such clusters have been found to differ across and within children and across settings. Intervention procedures based on assessed covariation may be more efficient than alternative strategies designed to treat one target behavior at a time, especially if it were possible to predict collateral effects so that they may be promoted or prevented. Such procedures could result in more effective treatments for complex constellations of behaviors (Kazdin, 1982, 1983, 1985) and may engender additional interventions designed to teach adaptive

behaviors inversely related to aberrant responses, thereby obviating ethically problematic strategies that rely on suppression of such responses (Russo et al., 1981).

Indeed, covariation may prove not to be the best description of the functional process underlying the data obtained. Alternatively, the data obtained could be considered the result of not two but one response class: generalized compliance. With the consistent application of behavioral contingencies, the children may in fact have learned to respond differentially with respect to which contingencies were programmed, and to have done so with greater efficiency (more rapidly) as they were repeatedly exposed to the cues that signaled shifts in contingencies. Issues such as these require further investigation before a response covariation approach to treatment can be used to full advantage.

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