

Review of Response Covariation and Behavioral Interventions: Why It Occurs and How to Prevent It.

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Abstract

Response covariation is a term used by behaviorally-oriented psychologists to connote when one aberrant behavior is suppressed or eliminated, another like behavior is displayed. Historically, psychotherapists—particularly those trained in traditional psychoanalysis—used the term symptom substitution to describe the same phenomenon. This singularity has been described for over 50 years under one of the two aforementioned terms. More recent research, regardless of the orientation, uses response covariation as the preferred and accepted term. Regardless of the term or psychological paradigm assigned to it, response covariation has been a vexing problem to both behavioral and psychoanalytic therapists as well as educators. The underlying issues are why response covariation occurs and how to avoid it during the therapeutic process. The purpose of this article is to review the research on this phenomenon, suggest a theoretical framework for both its occurrence and prevention by embedding strategies within any behavioral or psychoanalytic intervention.

Key words: response covariation; symptom substitution; behavioral intent; functional behavioral assessment; replacement behavior training

Introduction

Review of Response Covariation and Behavioral Interventions: Why it Occurs and How to Prevent It.

Over 50 years ago Cahoon (1968) wrote an article describing “symptom substitution” and its relationship to behavior therapy. The thesis of his article was that psycho-dynamically oriented therapists would eliminate a patient’s distressing symptom (e.g., facial tic, feelings of anger or depression, compulsive behaviors) but by ignoring the underlying cause resulted in other new symptoms being displayed. Cahoon lamented that the term “symptom substitution” was used in an idiosyncratic, inferential way related to whatever school of therapy one ascribes rather than operationally defining the phenomenon in a way that was amenable to empirical research. The hypothesis he wanted to empirically investigate was whether certain types of therapies were more or less likely to result in symptom substitution. In retrospect, his premise was understandable 50 years ago but extremely limiting and no more empirically answerable than the prior theoretical idiocies about which he lamented.

Behavior Therapy and Symptom Substitution

The debate between psychodynamic and behavioral orientations continued into the 1970s. Nurnberger and Hingtgen (1973) reviewed studies at that time in an effort to establish whether or not symptom substitution had been empirically validated with enough data to justify questioning the treatment efficacy of behavioral approaches. They concluded that the occurrence of symptom substitution was extremely low when using behavioral interventions and, in fact, pointed out that behavioral interventions were so effective that they resulted in generalized improvement and expansion of the functional capacities of patients. They further indicated that symptom substitution was of minimal concern and that there were more important issues related to the success or failure of behavioral therapy.

Other researchers during the decades of the 1960s and 1970s discussed how many therapists lacked the awareness of behavioral principles and that interventions in which symptom substitution occurred were due to theoretical gaps in their knowledge. For example, Paul (1969) insisted that many patients had extensive gaps in their learning to display appropriate behaviors when the untoward behaviors were eliminated. Hence these patients presented with skill deficits that needed to be addressed in order to avoid symptom substitution. Wolpe (1969) posited

that teaching prosocial behaviors required shaping and reinforcement to develop new routines while Bandura (1968) advised using modeling and systematic desensitization to avoid the emergence of other non-targeted inappropriate behaviors.

Negative Side Effects of Punishment and Response Substitution

Research on the negative side effects of certain forms of punishment to treat behaviors and conditions such as pica, trichotillomania, stereotypy, and self-injurious behaviors started to appear in the late 1960s and 1970s that led to a reexamination of what was called “response substitution.” Risley (1968) found that a topographically similar inappropriate behavior would increase when a target behavior was suppressed by punishment. He provided the example of a girl with autism who began climbing on a chair after she was punished for climbing on a bookcase. By the late 1970s researchers were beginning to describe more specific types of negative side effects associated with certain types of punishment such as brief contingent electric shock to sensitive parts of the body for engaging in self-injurious behaviors or squirting hot sauce or concentrated lemon juice into the mouth of a person engaging in pica (i.e., eating non-food stuffs).

Rutherford and Neel (1978) described seven negative side effects of punishment—the first being response substitution—an ironic pairing of the operant term “response” (i.e., behavior) to the psychodynamic term “substitution” rather than covariation. There is, however, another negative side effect which is particularly germane to the present discussion, and begins to pave the way for understanding why symptom substitution or the more commonly used term response covariation occurs. The negative side effect is punishment contrast. It is a phenomenon in which a behavior that is punished in one situation or setting increases above its baseline level in a different situation or setting where punishment is not administered (Maag, 2018). An analogy would be taking a recently opened bottle of champagne, placing a thumb over the top, and shaking. Nothing happens while a thumb is over the top, but once removed the champagne sprays out like a geyser. The reason is, of course, because of the pent up seltzer being unable to exit. Another example would be how certain individuals with Tourette’s disorder can sometimes suppress their tics for a period of time. However, eventually the tension mounts to the point where the tic escapes and is worse than it not being suppressed.

Applied Behavior Analysis and Functional Assessment

The two previous examples are only illustrative, but do not empirically explain why punishment contrast occurs. The reason for the occurrence of punishment contrast specifically, and response covariation in general, can be found in the roots of applied behavior analysis (ABA) first described by Baer et al. (1968) as a performance-based self-evaluative method for changing behavior. The theoretical and empirical precises of ABA resulted in researchers focusing on the purpose behavior serves. Almost ten years after the seminal article by Baer and colleagues was published, Carr (1977) described how self-injurious behaviors resulted from either positive reinforcement or negative reinforcement. During this time, Iwata et al. (1982) conducted what many consider the first study on functional behavioral assessment (FBA) which now refers to a series of heuristic approaches for determining the function individuals challenging behaviors serve. Put another way, all behavior serves some purpose—it is intentional and achieves some outcome or goal. Even reflexive behavior is purposeful. If someone abruptly claps their hands in front of an unknowing person’s face, that person will blink to preserve eyesight.

Neel and Cessna (1993) pithily stated that inappropriate behavior is nothing more than a deviant form of a nondeviant intent. They were referring the relation between the behavior exhibited and the outcome desired. When an individual acts, even with behaviors considered to be inappropriate, they do so to achieve some result. The desired result, or outcome, can be viewed as the intent or function of the behavior. In turn, the intent of the behavior will affect the form (i.e., appearance) the behavior takes to achieve a desired outcome. The function a behavior serves may be appropriate, but the form it takes may be inappropriate. For example, a student who makes animal noises may be doing so to obtain attention from his peers or to escape a task he perceives to be aversive. There is nothing inherently wrong with a student wanting attention from peers or escaping something perceived to be aversive. However, there are appropriate behaviors, through which, and times and situations in which, to obtain these outcomes.

Purpose and Considerations of the Current Review

Given this backdrop, the purpose of the present article is to review the theoretical and empirical literature on response covariation, determine if the function a behavior serves has previously been addressed in this context, and identify whether or not covaried behaviors served as dependent measures to be evaluated relative to the experimental variable (i.e., intervention). Finally, implications for clinicians and educators will be addressed that describe appropriate ways to embed strategies in interventions to decrease or eliminate untoward behaviors without someone experiencing a negative side effect of response covariation.

Prior to the method section, however, it is important to provide some context because this systematic review is rather unconventional. Typically, any narrative or meta-analytic review obtains studies for which certain dependent variables are assessed to determine the effectiveness of any given intervention. However, the topic of response covariation is rather unique because many of the “covaried” or “substituted” behaviors were not intentionally targeted as dependent variables. Rather some of the research studies reviewed here only described observing covaried or substituted behaviors without attempting any direct manipulation of them. Therefore, calculating traditional effect sizes (e.g., Cohen’s *d* or Hedges *g*) were not always possible. This situation may also explain why there has only been one cursory, descriptive literature review (versus systematic reviews) on response covariation (i.e., Numberger & Hingtgen, 1973) and also why many of the reviewed studies are decades old. Hence, the bulk of this review will consist of a systematic narrative description and analysis regarding response covariation.

Method

A systematic search was performed to identify the extent research regarding the occurrence of response covariation or symptom substitution using primarily, but not limited to, behavioral interventions. The search methods were as consistent as possible with the 12-item PRISMA statement for reporting meta-analyses (Liberati et al., 2009). The purpose was to ensure as much clarity and transparency of conducting systematic reviews as possible given the uniqueness of the current topic. However, not all of the studies provided enough information to address the 12 PRISMA items.

Academic Search Premier was the search source with the following selected databases: ERIC, MedLINE, PsycARTICLES, and PsycINFO. Besides using Boolean terms/phrases (“response covariation”) AND (“children”) OR (“adolescents”) OR (“youth”) OR (“child”) OR (“teenagers”) OR (“students”) OR (“students with disabilities”), the search

also used four similar terms for response covariation (“response substitution”) OR (“behavior covariation”) OR (“behavior substitution”) OR (“symptom substitution).

Eligibility Criteria and Study Selection

Studies included were those published from 1968 when Cahoon’s article cited previously appeared that year in Psychological Bulletin. Studies had to be in English and published in peer-reviewed journals between January 1, 1968 and December 30, 2021. Participants considered in the present review were school-aged children from 6 years (kindergarten) to 18 years (12th grade) whose behavioral issues required intervention. All types of interventions/therapies were considered, but the majority of studies reviewed tended to be based on operant theory and techniques. Any non-

intervention articles such as epidemiological studies (e.g., Arbeit et al., 2014) were excluded.

Studies were identified and retained at different stages based on PRISMA guidelines, and the results are displayed in Figure 1. There were a total of 184 entries under the following search terms: response covariation (n = 20), response substitution (n = 27), behavior covariation (n = 60), behavior substitution, (n = 27), symptom substitution, (n = 50). From that total, there were 153 entries that appeared more than once under a combination of the five search terms, leaving 31 articles that were read in their entirety, 18 of which were omitted for not meeting search criteria leaving a total of 13 articles to comprise this systematic review.



Figure 1: Search Results using PRISMA Guidelines

Study Characteristics

Seven study characteristics were coded for descriptive analysis. All studies were coded for participant characteristics and setting. Both targeted behaviors and covaried behaviors were identified, type of experimental design used, as well as intervention, and impact of intervention on covarying behaviors. Table 1 presents a summary of each study’s dependent variables, covaried behaviors, interventions implemented and their impact on the occurrence of increases or decreases in covaried behaviors. The experimenter initially coded all variables in

Table 1. A graduate assistant coded the same variables for six randomly selected studies out of the 13 included in the present review. The interrater reliability between the two coders was 94.3% (agreements divided by agreements plus disagreements).

Descriptions of the types of designs and participants are presented narratively in the results. These variables were only coded by the experimenter since they were not appearing in Table 1 and, consequently, the graduate student was not instructed to code them, nor had expertise in determining the type of experimental design used for each study.

Study	Dependent Variables	Co-Varied Behaviors	Intervention
1. Baker (1969)	Parent, teacher, self-report scales for confidence, anxiety, responsibility	When enuresis was reduced or eliminated, participants were able to spend night at friend's house, join the boy scouts, attend summer camp, start a paper route, and take up cooking and sewing hobbies	Behavior therapy with a conditioning device (i.e., buzzer would sound if a participant wet his or her bed.
2. Bierly & Billingsley (1983)	Stereotypy (e.g., repeated movement of an object while held in hand/hands)	When stereotypy was eliminated participants increased appropriate play with toys (e.g., manipulation of "See and Say," cash register, or dump truck)	Positive practice overcorrection
3. Garcia & DeHaven (1975)	Deviant behaviors (e.g., vomiting, spitting, remaining undressed, turning over chairs and tables, knocking over objects)	When defiant behaviors were eliminated, participant's toy-playing behavior, increased, demonstrated more positive interactions with family members, and dressing herself and stayed dressed	Differential reinforcement (i.e., reinforcing the absence of deviant behaviors), omission training, positive reinforcement for appropriate behaviors
4. Houlihan et al. (1991)	On-task behaviors, following directions, proper foot placement, correct answers on worksheet	Decreases in disruptive, oppositional, destructive, and noncompliant behaviors when appropriate behaviors were increased	Modeling, positive reinforcement
5. Lalli et al. (1999)	Aggression (hitting, kicking, biting, throwing objects)	Decrease in aggression when spelling performance increased based on FBA indicating aggression served an escape function	Direct instruction in spelling, removal of academic materials when aggression occurred
6. Maag et al. (1989)	Self-stimulatory behaviors (whipping string back and forth, hand clapping)	Decrease in other nontargeted self-stimulatory behaviors (hand gazing and object mouthing) when stringing and hand clapping was eliminated.	Sensory extinction to eliminate stringing and hand clapping
7. Ottenbacher & Ottenbacher (1981)	Thumb sucking	Enuretic episodes decreased but continued to occur	Token economy to reinforce absence of thumb sucking
8. Parrish et al. (1986)	Directions to engage in certain behaviors (e.g., sit down, stand up, open/close door, pick up object, clap hands)	Reinforcement of compliance requests decreased inappropriate behaviors to requests	Extinction, reinforcement for compliance, DRO to reinforce absence of inappropriate behaviors
9. Rosenberg et al. (2007)	Increase in physical activities, decreases in sedentary behaviors	Decreases in fat and calories	Increase in physical activity and fruit and vegetable intake
10. Russo et al. (1981)	Speed of compliance to directions	Aggression, crying, self-injurious behaviors, hairpulling, thumb sucking decreased when compliance increased	Reinforcement for compliance behaviors
11. Sevin et al. (2002)	Turning head away from food, expelling food, retaining food in mouth but not swallowing	Opening mouth, accepting food, and swallowing increased with interventions for target behaviors	Non-removal of spoon, re-presenting expelled food, collecting food from child's cheek.
12. Souter et al. (1994)	Compliance commands (sit down, stand up, touch your nose, nod your head)	Attending to task and appropriate verbalizations increased when compliance commands also increased	Reinforcement for following compliance commands
13. Sprague & Horner (1992)	Problem behavior, desirable behavior (no operational definitions)	Blocking problem behavior results in another problem behavior; teaching positive behavior resulted in decrease in untreated inappropriate behavior	Blocking one behavior in the same response class; teaching positive behavior in same response class

Table 1: Dependent Variables, Co-Varied Behaviors, and Interventions Used

Results

Type of Experimental Design

Two general types of experimental designs were used in the 13 studies reviewed: group designs and single case research designs. There were two studies using group designs. Baker (1969) used a control group pre-post design study. Rosenberg et al. (2007) used a more robust randomized controlled trial (RCT) group design. The remaining studies used some type of single case research design (SCRD).

In his introduction to evaluating the use of effect size calculations, Maag (2022) described Kazdin's (2020) definition and appraisal of SCRDS as experimental methods for determining effectiveness of an intervention (i.e., corrective action) for individual participants in a study. Kazdin further concluded that SCRDS enable researchers to draw empirically valid inferences and conclusions regarding treatment effects better than case studies. SCRDS have been used with various populations in a range of settings including, but not limited to, hospitals, residential facilities, out-patient clinics, schools, and in the workplace (e.g., Kratochwil & Levin, 2014). Kazdin believed the term single-case can be misconstrued to mean restricted to one individual whereas SCRDS can be applied to large groups such as all students in a classroom (e.g., McNiff et al., 2019), although their primary concern focuses at the individual level. There are four commonly accepted SCRDS that can establish experimental control and account for confounding variables: reversal design, multiple baseline design, changing conditions design (a variation of the reversal design), and alternating treatments design (Maag, 2018). The simple AB design which consists of only two phases—baseline (A) and intervention (B)—is unable to establish experimental control nor account for extraneous or confounding variables.

Two of the 11 SCRDS used only an AB design (Garica & DeHaven, 1975; Ottenbacher & Ottenbacher, 1981). Therefore, results of these two studies are equivocal because of the two serious design flaws inherent in the AB design described previously. The most commonly used SCRDS was the reversal design ($n = 6$). Only one study used a multiple baseline design (Russo et al., 1981). The remaining two studies used a changing conditions design (Houlihan et al., 1991; Sevin et al., 2002) which is used to determine the effectiveness of two or more interventions on a target behavior. Sometimes this technique is called an ABC design in which A refers to the baseline, B refers to the first intervention, and C designates the application of a second intervention. As is the case with an AB design, a functional relation between a target behavior and intervention cannot be determined unless there is a return-to-baseline phase between the two different intervention phases. In the present review, both Houlihan et al. and Sevin et al. studies included another baseline phase before implementing the second intervention, hence establishing experimental control.

Participants

There were understandably more participants in the two group design studies. There were 90 elementary school participants in the Baker (1969) study, 30 with enuresis and 60 controls. The RCT conducted by Rosenberg et al. (2007) had 878 adolescents with a mean age of 12.7 years. Although both studies had enough participants to have sufficient statistical power, neither described much detail about their characteristics. For example, the only additional information Baker provided was that the enuretic group consisted of 20 males and 10 females whose ages ranged from six to 12 years old. No information was provided regarding the 60

participants in the control group. Rosenberg and colleagues provided the age range of their participants to be between 10 to 15 years old, with 54% being females, as well as the percentages for ethnic composition. No information was provided about their level of physical activity or caloric intake, even though both were dependent variables in the study. Rather, participants were recruited from two health care systems.

The remaining 11 SCRDS collectively consisted of a much smaller number of participants, due to the nature of these studies' designs. Nevertheless, there was more information provided about the participants' characteristics. There were a total of 23 participants (16 males, 7 females). Participants for four studies had between moderate to severe intellectual disabilities (Garcia & DeHaven, 1975; Lalli et al., 1999; Parrish et al., 1986; Sprague & Horner, 1992), three studies had participants with autism (Bierly & Billingsley, 1983; Maag et al., 1986; Souter et al., 1994), participants of two studies either had an emotional disability or displayed severe noncompliance (Houlihan et al., 1991; Russo et al., 1981), and there were three studies, one each with an intellectual disability and autism (Sprague & Horner, 1992), another with food refusal (Sevin et al., 2002), and the last with no condition (Ottenbacher & Ottenbacher, 1981). The Sprague and Horner study had participants with just an intellectual disability and another who had autism and an intellectual disability.

Dependent Variables

Dependent variables, co-varied behaviors, and interventions for each study are presented in Table 1. Dependent variables for the two group design studies were rather different than for those using SCRDS. For example, Baker (1969) used parent, teacher, and self-report rating scales for measuring participants' confidence, anxiety, and responsibility for both pre- and post-treatment of behavioral therapy for enuresis. In the case of the other group design study, Rosenberg et al. (2007) used the University of Minnesota Data System to estimate dietary nutrient intake (e.g., total daily kilocalories, total calories from fat, total grams of fiber, and servings per day of fruit and vegetables).

Dependent variables for the 11 SCRDS were much more specific and amounted to operationally targeted behaviors. For example, Bierly and Billingsley (1983) defined stereotypy as repeated movement of an object when held in hand(s) while Garcia and DeHaven (1975) defined deviant behaviors as vomiting, spitting, reminding undressed, turning over chairs and tables, and knocking over objects. Similarly operationally defined target behaviors were provided for four more studies as well (Lalli et al., 1999; Maag et al., 1986; Ottenbacher & Ottenbacher, 1981; Sevin et al., 2002). Two studies simply had lists of compliance commands such as "sit down," "touch your nose," or "nod your head" (Parrish et al., 1986; Souter et al., 1994). Another three studies did not operationally define all their target behaviors and instead used terms such as "on-task," "compliance to directions," or "problem behavior" (Houlihan et al., 1991; Russo et al., 1981; Sprague & Horner, 1992). Finally, some studies targeted behaviors to increase (Houlihan et al., 1991; Parrish et al., 1986; Russo et al., 1981; Souter et al., 1994) while the others had behaviors to decrease with the corollary covaried behaviors.

Covaried Behaviors and Interventions

Results of both covaried behaviors and interventions for the dependent variables are presented together in order to provide continuity and the relationship to each other. There were three studies, however, in which interventions were provided both for the dependent variables and covaried

behaviors (Garcia & DeHaven, 1975; Parrish et al., 1986; Russo et al., 1981) which presents a confound for determining whether interventions for the dependent variables actually changed covaried behaviors in isolation. Table 1 also provides a summary of the interaction between dependent variables, covaried behaviors, and interventions.

Two studies found that when stereotypy and deviant behaviors were eliminated participants engaged in much more toy-playing and positive interactions with family members (Bierly & Billingsley, 1983; Garcia & DeHaven, 1975). One study used a direct instruction intervention to improve participants' spelling scores which reduced aggressive behaviors (e.g., hitting, kicking, biting, throwing objects) which the researchers believed were initially performed as a way to escape spelling tasks for which they did not possess the requisite skills (Lalli et al., 1999). Coincidentally, the Lalli and colleagues' study was the only one to conduct a functional behavioral assessment to determine the purpose targeted behaviors served. Maag et al. (1986) used a more novel intervention, sensory extinction, to eliminate two self-stimulatory behaviors—hand clapping and repetitive up and down motions with a piece of string (i.e., “stringing”). Their hypothesis was that kinesthetic sense modality provided reinforcement for those two behaviors and when that reinforcement was eliminated, the behaviors were extinguished. Interestingly, two covaried behaviors also decreased—hand gazing and object mouthing. Hand clapping and hand gazing shared the same topography but not the same sensory reinforcement function.

Discussion

Symptom substitution, the psychodynamic term, and response covariation, the operant somewhat equivalent idiom were highly debated and researched during the last three decades of the 20th century. The debate was initially framed, at least by behaviorists, as one between objectivity and subjectivity. Operant theorists and behavior therapists believed that “symptom substitution” was too vague an expression to be researched empirically (Cahoon, 1968). A more detailed and historical description of this debate was provided in the introduction of this article. A modicum of research was conducted on response covariation, the more commonly accepted term, during and up until the early part of the 21st century. Then that phenomenon gradually faded from both research and theory. The purpose of the current article was to review the empirical literature on response covariation and by doing so draw conclusions regarding it as a behavioral phenomenon, suggest why it occurs, and how to prevent it. This task proved to be daunting considering only 13 studies were found to be eligible for review with the most recent (e.g., Rosenberg et al., 2007) being 15 years old. Further, it was surprising that no systematic review had previously been conducted on this topic—excluding one dated selective, literature review (e.g., Nurnberger & Hingtgen, 1973). Response covariation as a topic of study seemingly vanished. Therefore, the remainder of this article will first review the results and provide a detailed account of why response covariation occurs and how to prevent it.

Results of the 13 studies reviewed can be summarized as follows. First, only two group design studies have been conducted on response covariation (e.g., Baker, 1969; Rosenberg et al., 2007). The remaining 11 studies all used single case research designs (SCRDs), which should not come as a surprise since the term response covariation comes from an operant orientation. Second, results need to be interpreted cautiously since several studies reviewed not only provided intervention to change dependent variables but also addressed the covaried behaviors, treating them more as a separate dependent variable than arising from the initial

intervention. Third, there were some peculiarities regarding the suppression of some inappropriate behaviors and the unintended suppression of other non-treated behaviors. For example, Maag et al. (1986) found that when hand clapping was suppressed, the covaried non-targeted behavior of hand gazing also decreased. One explanation could be the generalized suppression was due to both behaviors being members of the same response class in terms of topography. However, they did not appear to serve the same purpose even though a formal functional behavioral assessment (FBA) was not conducted. Specifically, hand clapping seemed to be maintained by the kinesthetic sensory reinforcement that was extinguished whereas hand gazing, that did not involve any motion nor generate any tactile stimulation, also decreased. The reason for this seemingly unrelated behavior remains speculative and unconvincing.

Reasons for Response Covariation

The reason for response covariation, or at least the phenomenon of when one inappropriate behavior is suppressed another inappropriate behavior is displayed, can be explained through a series of heuristic approaches for determining the function individuals challenging behaviors serve—that is, by conducting a functional behavioral assessment (FBA). The focus on FBAs began in the early 1980s and literally hundreds if not over a thousand studies have been conducted on various aspects and populations using FBAs. There have also been approximately 17 systematic reviews—both meta-analytic and narrative—that have appeared in the literature from the 1980s through the present (e.g., Maag, 2019). The previous discussion of negative side effects of punishment, such as response substitution and punishment contrast, demonstrates the problem created when the function a target behavior to decrease is not directly addressed prior to a suppressive technique being applied (Maag, 2018).

A study conducted by Ayllon (1963) almost 60 years ago illustrates this point. He used a behavioral technique called stimulus satiation to treat a hospitalized female psychiatric patient who hoarded and stored large numbers of towels in her room. Stimulus satiation is similar to negative practice or “ordeal therapy” but instead of repeatedly performing the negative behavior, the focus is on exposing an individual to the antecedents of their behavior—in this specific case, hoarding towels. The treatment consisted of having the nurses go into the patient's room and, without comment, hand her an ever-increasing number of towels. The first week nurses handed her an average of seven towels, and the number was increased to 60 towels by the third week. After accumulating over 600 towels, the patient began taking a few out of her room. At that point, no more towels were handed to her.

Ayllon (1963) was able to decrease towel hoarding. However, what he did not address was that the behavior of hoarding towels served some purpose for the patient—such as obtaining attention or being empowered by refusing to follow hospital protocol. Therefore, because the function of towel hoarding was not addressed, it was likely that another inappropriate behavior that served the same purpose would subsequently be displayed. The operant technique stimulus satiation has other names depending on a therapist's theoretical orientation—pattern reversal, inconvenience, or paradoxical directives. The point is that without assessing and addressing the function any inappropriate behavior serves response covariation will likely occur so that the individual can continue to obtain a desired outcome.

Not every study reviewed resulted in another negative behavior being performed when the target inappropriate behavior was decreased. Bierly and Billingsley (1983) found that when stereotypy was decreased,

appropriate play with toys increased. Houlihan et al. (1991) increased on-task behaviors and following instructions and observed decreases in disruptive and noncompliant behaviors. Two other studies that increased participants compliance with directions found, in one case, that aggression and self-injurious behaviors decreased (Russo et al., 1981) while Souter et al. (1994) found covaried increases in on-task behaviors and appropriate verbalizations. These positive changes in covaried behaviors that did not receive intervention is easy to explain. For example, increases in the covaried behavior of playing with toys occurred because participants were no longer spending time engaging in self-stimulatory behaviors. The same can be said when on-task behaviors and following directions increased, the covaried behaviors of disruption and opposition decreased. The reason is that if students were engaging in the inappropriate covaried behaviors, then an increase in compliance to stop performing them would occur. By reinforcing compliance to directions that involved stopping inappropriate behavior also resulted in both targeted and covaried behaviors being reinforced.

Ways to Eliminate Covariation of Inappropriate Behaviors

Covariation can sometimes result in a positive side effect of certain behaviors receiving intervention (e.g., increases in appropriate behavior resulting from decreases in inappropriate behavior). The reasons for those positive changes were discussed previously. However, a more problematic effect is when decreases in certain targeted inappropriate behaviors result in increases in other non-targeted inappropriate behaviors. The reason for this occurrence was due to the covaried behavior being performed in order for an individual to achieve the same goal (i.e., purpose) as the eliminated inappropriate target behavior. The solution to this problem is to identify and teach individuals replacement behaviors as part of any intervention to eliminate negative behaviors.

A replacement behavior refers to an appropriate behavior that serves the same purpose as the inappropriate behavior. Maag and Kemp (2003) described how generating replacement behaviors begins with identifying a response class. A response class is a group of behaviors that either share the same topography, effects of reinforcement and punishment, or serve the same function (Malott et al., 2000). For example, a child with a developmental disability who bangs her head into peers as a way to escape close physical proximity may be taught the replacement behavior of extending her arm with palm up in a manner similar to a police officer directing traffic to stop. The inappropriate behavior and replacement behavior share the same topography: body part (head vs. arm and hand), movement (forward), and function (escape). Maag and Kemp indicated that replacement behaviors that share the same topography as the inappropriate behavior are more likely to be accepted and used by a child.

A list of replacement behaviors are next generated in a way similar to identifying effective reinforcers: high status youngsters are observed to determine what behaviors they use to obtain desired outcomes, youngsters themselves are asked what they would like to try, and significant adults (e.g., teachers, coaches, parents) are asked to list behaviors they have observed youngsters use to get what they want, if not appropriately, then at least without resulting in disciplinary action. A list is created from each source and the target youngster rank orders them to determine the most desirable. Next, individual-specific deficiencies are assessed to determine what training, if any, is required—behavioral, cognitive, or self-control. Finally, a reinforcement program is developed to motivate the target child to use the replacement behaviors. Eventually, the repeated use of the replacement behavior will become self-reinforcing—because it gets the

child what she wants—and the external reinforcement program can then be faded.

Limitations to the Current Review

There are two limitations to the current review that need to be acknowledged and addressed. First, most of the studies reviewed were quite dated. Therefore, they may not represent more current studies that would use terms other than those related to response covariation. Although it is possible that some studies exist in dissertations or those appearing in book chapters, the likelihood seems quite low. The reason is because nomenclature has not changed during the last decade from response covariation to some other novel term. Second, no effect sizes were calculated. There are effect size formulas for SCRD studies, the most common being nonoverlap methods (Maag, 2022). However, most SCRD effect size calculations can demonstrate an intervention's effectiveness but not the magnitude of such changes. Further, many studies reviewed did not use covaried behaviors as a dependent variable. Consequently, there were few graphs having a baseline and covaried behavior phase adjacent to each other which is required to compute SCRD effect sizes.

Conclusion

A systematic review of the literature on response covariation reveals, at least implicitly, how it occurs and how to avoid it. It occurs when the function of any dependent variable, or target behavior, is not first determined through FBAs. In the current review only one study explicitly determined the function of target behaviors (Lalli et al., 1999) while another informally determined the function by hypothesizing what sensory modality was reinforcing their occurrence (Maag et al., 1986). The solution to preventing response covariation—at least when one negative behavior appears when another is suppressed—is to teach individuals and reinforce their use of an appropriate behavior that serves the same purpose. The idea of teaching replacement behaviors was hinted at indirectly very early in the literature on response covariation when Paul (1969) stated how many individuals do not possess the necessary skills in their repertoire to perform appropriate behaviors when an inappropriate behavior is suppressed. Wolpe (1969) suggested teaching individuals prosocial behaviors through shaping and reinforcement while Bandura (1968) advised using modeling and systematic desensitization to avoid the emergence of other non-targeted inappropriate behaviors. Yet, it took another 20 years before the process was formalized and empirically validated for using FBAs to determine replacement behaviors. However, the techniques described by Wolpe and Bandura decades ago are nevertheless foundational today for teaching replacement behaviors. Finally, two limitations to the current review were presented—outdated studies and lack of calculating effect sizes. Nevertheless, it appears that interest in the parameters and impact surrounding response covariation has waned throughout the last decade. Yet it remains quite germane for clinicians who conduct psychotherapy using various modalities.

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