PREVALENCE OF MULTIPLY CONTROLLED PROBLEM BEHAVIOR

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We examined articles in the *Journal of Applied Behavior Analysis* in which results of functional analyses indicated that problem behavior was maintained by multiple sources of reinforcement. Data for 88 (16.9%) of 521 subjects reported in 168 studies met the criteria for multiple control. Data for 11 subjects (2.1%) involved a single response topography, whereas data for 77 subjects involved multiple, collapsed response topographies (14.8% of the total [521 cases] or 87.5% of the multiple control cases), suggesting that when multiple control is observed, it often may be a by-product of response aggregation during assessment.

Key words: functional analysis, multiple control, multiple response topographies

Problem behavior maintained by more than one source of reinforcement is said to be multiply controlled and typically is identified as such when results of a functional analysis show consistently higher levels of responding in two or more test conditions relative to the control condition. Multiple control represents a challenge to intervention because treatment for one function of problem behavior might be contraindicated for another (Smith, Iwata, Vollmer, & Zarcone, 1993).

The prevalence of multiply controlled problem behavior has been reported as part of more general findings in several studies and reviews. Iwata et al. (1994) presented data from 152 functional analyses of self-injurious behavior (SIB) and found eight cases (5.3%) of multiple control. Kahng, Iwata, and Lewin (2002) reviewed treatment studies on SIB published over a 30-year period and found a similar prevalence for multiple control (6.8%) based on 265 functional analyses. By contrast, Hanley, Iwata, and McCord (2003), whose review was not limited to SIB, reported 75 (14.6%) of 514 cases in which control by multiple reinforcers was identified. Hanley et al. noted that most cases of multiple control listed ''aberrant behavior'' as the target of interest, which often included multiple response topographies. When aberrant was removed from the total number of multiply controlled cases, the prevalence of multiple control decreased from 14.6% to 9.3%, closer to the findings reported by Iwata et al. and Kahng et al.

In a related study, Derby et al. (2000) conducted functional analyses for multiple topographies of problem behavior with 48 individuals. When results graphed as aggregate behavior were compared to those graphed as individual response topographies, matching functions—similar results based on both sets of graphs—were obtained in only 14 cases. It is unknown whether separate topographies of problem behavior, in fact, had different functions because the functional analyses were conducted only on aggregated responses. Nevertheless, graphic analysis indicated that individual response topographies often showed different rather than similar functional characteristics.

Results from the above studies suggest that the prevalence of multiple control may be overestimated when multiple problem behaviors are included as target responses in the same functional analysis. To examine this possibility further, we conducted a review of published functional analysis data to determine the relation between multiple control as an outcome when single versus multiple response topographies were included as target responses in the analysis.

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METHOD

We examined articles published in the *Journal of Applied Behavior Analysis* (*JABA*) that reported functional analysis data. Other journals were not included, because *JABA* publishes the vast majority of research on functional analysis (Hanley et al., 2003). All issues published at the time of this review (through Spring 2010) were examined, and all articles meeting the inclusion criteria were included in the analysis.

Inclusion Criteria

Studies were included if they contained a functional analysis of problem behavior (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) in which (a) antecedent and consequent events were manipulated; (b) tests for social positive reinforcement (Sr+), social negative reinforcement (Sr–), and automatic reinforcement (except when the target behavior was aggression) were included; and (c) a control condition was included as a basis for comparison. We required multiple test conditions because the absence of a test for multiple sources of reinforcement may have resulted in missing one or more functions. Studies in which data were not presented in graphical or tabular form were omitted, and replicate data sets were included only once. If a study presented functional analyses for multiple topographies but also included supplementary graphs for individual topographies (e.g., Richman, Wacker, Asmus, Casey, & Andelman, 1999), only the aggregate graphs were included to avoid adding replicate data sets.

Single Versus Multiple Response Topographies

Functional analyses were categorized based on authors' descriptions of responses included in the assessment. If the authors listed SIB and aggression as target behaviors, this was counted as an instance of a multiple topography. Similarly, hitting, kicking, and biting others was included as an example because responses that appear to be a topographical response class (aggression) might not be members of the same functional response class. The same rule applied for functional analyses of multiple forms of SIB (e.g., face slapping and head banging). Thus, in all studies with multiple control outcomes categorized as a single response topography, authors indicated that one specific form of the behavior (e.g., SIB consisting of hand mouthing) was targeted in the functional analysis.

Evidence of Multiple Control

We analyzed results through visual inspection of the initial functional analysis data and did not consider data from secondary analyses or treatment evaluations, which often included additional test conditions or parametric manipulations. Thus, our interpretation of the initial functional analysis results may not have matched the authors' eventual interpretation in some cases. Functional analysis results were considered to indicate multiple control if higher response rates were observed in two test conditions relative to the control, yielding three combinations: higher responding in test conditions for social Sr+ and social Sr–, higher responding in test conditions for social Sr+ and automatic reinforcement, or higher responding in test conditions for social Sr– and automatic reinforcement. High rates in two social Sr+ conditions (e.g., attention and tangible conditions) were not considered to indicate multiple control because both conditions involve the delivery of social Sr+. High rates in all test conditions (or in all test conditions plus the control) were considered evidence of maintenance by automatic reinforcement. We also recorded the number of response topographies included (single vs. multiple) in the assessment.

Interrater Agreement

A second reader independently examined each functional analysis in 25.5% of articles that included multiple control outcomes, using the criteria described above. The number of agreements between the two readers' evaluations

was divided by the number of agreements plus disagreements, yielding a reliability score of 92.1%.

RESULTS AND DISCUSSION

Table 1 summarizes our results. One hundred and sixty-eight articles published between 1990 and 2009 met the search criteria (a complete list is available from the first author) and contained functional analysis data for 521 subjects. Results for 88 subjects (16.9% of the sample) showed evidence of multiple control. Data for 11 of the 88 subjects (2.1% of the sample or 12.5% of the multiple control cases) involved a single response topography, whereas data for the remaining 77 subjects (14.8% of the total sample [$N = 521$] or 87.5% of the multiple control cases) involved multiple topographies that were collapsed during assessment. To determine whether this finding was representative of functional analysis outcomes in general, we compared our results to a sample of data indicating that problem behavior was maintained by a single source of reinforcement (non-multiple-control cases). We examined the first single-function analysis in each issue of *JABA* from which an article was included in our search. This yielded 66 functional analyses, of which 38 (57.6%) and 28 (42.4%) targeted multiple and single response topographies, respectively. Thus, a majority of single control functional analyses also included multiple response topographies. However, the proportion of multiple control cases with multiple response topographies (87.5%) greatly exceeded both the proportion of multiple control cases with a single response topography (12.5%) and the proportion of single control cases with multiple response topographies (57.6%). Thus, although it is somewhat common practice to include multiple response topographies in the same functional analysis, this practice may increase the likelihood of obtaining outcomes that indicate multiple control.

Table 1
Prevalence of Multiply Controlled Problem Behavior

	Number of cases	Percentage
Total subject sample	521	
Multiple control (all cases)	88	16.9
Single response topography	11	2.1
Multiple response topographies	77	14.8
Combined functions identified[a]		
Social Sr+ and social Sr−	69	78.4
Social Sr+ and automatic Sr	11	12.5
Social Sr− and automatic Sr	8	9.1
Individual functions identified (within combinations)[a]		
Social Sr+	80	90.9
Social Sr−	77	87.5
Automatic Sr	19	21.6

[a] Percentages for combined functions and individual functions are based on the number of cases of multiple control ($n = 88$). The total number of individual-function cases exceeds the total cases of multiple control by a factor of two (176), but the maximum number for each function is 88.

Table 1 also lists a breakdown of the 88 cases of multiple control. Combined social functions (social Sr+ and social Sr–) were observed for 78.4% of the subjects, whereas combined control by social and automatic reinforcement was identified in considerably fewer cases: 12.5% (social Sr+ and automatic) and 9.1% (social Sr– and automatic). Finally, Table 1 shows the proportion of each individual function within the multiple control cases. Social Sr+ or social Sr- was observed in a great majority of the multiple control cases (90.9% and 87.5% of subjects, respectively), whereas automatic reinforcement was observed in relatively few subjects (21.6%).

Although access to tangible items was subsumed under the social Sr+ category, a secondary finding of interest emerged for this source of reinforcement. It was reported as one of the functions in 41 of the 88 cases of multiple control, even though a tangible condition was included in only 49 of the functional analyses. Thus, a tangible function was identified in 83.7% of the functional analyses in which a tangible condition was

conducted. This high proportion may reflect the fact that investigators typically included a tangible condition in a functional analysis based on preliminary information that it was a likely function. Alternatively, results of some research indicate that inclusion of a tangible condition may lead to a false-positive outcome in which behavior not maintained by tangible reinforcement is nevertheless sensitive to it, especially if the tangible items are highly preferred (Galiatsatos & Graff, 2003; Shirley, Iwata, & Kahng, 1999). Of the 41 tangible cases, 24 contributed to the multiple control total because these cases did not also involve maintenance by attention. Given that subjects' problem behavior in these 24 cases was not sensitive to other forms of social Sr+, responding in the tangible condition might not have been indicative of an original maintaining function but, rather, of one that was acquired during assessment. If these 24 cases are subtracted from those that show multiple control, the prevalence of multiply controlled problem behavior decreases from 16.9% to 12.3%. It is possible, however, that attention was not identified as a maintaining reinforcer in these cases because problem behavior was maintained by an idiosyncratic form of attention that was not included in the attention condition (e.g., Kodak, Northup, & Kelley, 2007). Thus, we can only speculate that some cases of multiple control that contained tangible functions may have represented false-positive outcomes.

In summary, results of the present review suggest that inclusion of multiple response topographies and, to a lesser extent, tests for tangible reinforcement in a functional analysis increase the likelihood of outcomes that suggest multiple control. These practices may hinder identification of the functions of individual problem behaviors and perhaps render overall outcomes uninterpretable. As a result, some topographies of problem behavior may not decrease or may even increase when treatment is implemented (Smith et al., 1993). Given the varied treatment strategies used or highly specific treatment questions asked in the studies we reviewed, and the fact that many studies included only assessment data, examination of treatment outcome was beyond the scope of this review. Nevertheless, analysis of treatment data may provide additional information about behavioral function. If combined problem behaviors apparently maintained by multiple control all decrease when treatment aimed at multiple sources of maintenance is implemented, reasonable confirmation of multiple control is provided. By contrast, failure to treat some topographies of problem behavior effectively may generate additional hypotheses about maintaining contingencies to serve as the basis for alternative interventions. More definitive information about the relation between multiple problem behavior and multiple control is needed in the form of within-subject comparisons between assessment outcomes for single versus aggregated response topographies. Until these data are available, limiting inclusion of multiple response topographies under the umbrella of "problem behavior," although perhaps more time consuming because it may require separate functional analyses, seems like a prudent way to minimize spurious, multiple control assessment outcomes. If multiple response topographies must be included for the sake of brevity of assessment, which may be the case in some clinical settings, graphing responses separately (e.g., Derby et al., 2000; Richman et al., 1999) may help to reveal functional differences among individual response topographies.

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