

*SEQUENTIAL AND MATCHING ANALYSES OF  
SELF-INJURIOUS BEHAVIOR: A CASE OF OVERMATCHING IN  
THE NATURAL ENVIRONMENT*

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In this study, we examined the relation between naturally occurring rates of self-injurious behavior and appropriate communicative behavior using prospective sequential and matching analyses of descriptive data. Results from both analyses suggested reliable covariation between both forms of behavior and staff attention. Findings are discussed in terms of the applicability of quantitative descriptive analyses to characterize behavior–environment relations in natural contexts.

DESCRIPTORS: destructive behavior, descriptive analysis, sequential analysis, matching law

There have been few direct demonstrations of the application of the proportion-based generalized matching law to socially significant behavior in natural settings in the absence of experimentation (McDowell, 1989). Most descriptive demonstrations of the application of the matching law rely on the hyperbolic equation for the quantitative law of effect rather than the formula for the generalized matching law (e.g., Martens & Houk, 1989). Oliver, Hall, and Nixon (1999) demonstrated that the generalized matching equation could be successfully used for time allocation between appropriate and problem behavior under natural conditions. More recently, Borrero and Vollmer (2002) reported a retrospective matching analysis based on empirically identified reinforcers from a priori experimental analyses of severe problem behavior. In this preliminary prospective study, we used sequential

analyses (Bakeman, McArthur, & Quera, 1996) to identify sequentially dependent behavior–environment relations; these were followed by a matching analysis to evaluate the relative relation between participant and staff behavior under naturally occurring conditions in the absence of experimental manipulation.

## METHOD

### *Participant, Target Behaviors, and Setting*

Robert was a 36-year-old man who had been diagnosed with autism and functioned within the profound level of mental retardation. Robert's appropriate communicative behavior included vocalizations and initiations, defined as audible sounds or single-word utterances or appropriately approaching and reaching for an individual. Robert's self-injurious behavior (SIB) consisted of head and leg hitting, defined as forceful contact of any part of the head or leg with a closed or open hand. Staff interaction included prompts, reprimands, praise statements, and physical contact. All observational data were collected in the context of Robert's naturally occurring routines (i.e., activ-

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ities of daily living and recreation and leisure times) that involved a range of naturally occurring social contexts (e.g., alone, demands, attention, etc.) in the living and dining room areas of his group home.

#### *Data Collection and Analysis*

*Procedure.* First, 29 observation sessions (10 min each) were conducted. Observers did not interact with Robert or staff. Data were collected on the occurrence of SIB, appropriate communicative behavior, and staff interaction with Robert. Direct observation data were collected in real time by trained observers using handheld computers (Jordan 720). The multiple-option observation system for experimental studies (MOOSES; Tapp, Wehby, & Ellis, 1995) software package was used for downloading and data analysis. Participant and staff behavior data were analyzed for frequency, duration, interobserver agreement, and sequential dependencies. Following data transformation, 15 sessions were retained for subsequent matching analysis (sessions with no instances of SIB and appropriate communicative behavior were dropped). Exact interobserver agreement was calculated for 25% of the observed sessions and averaged 78% (range, 50% to 97%) and 83% (range, 50% to 100%) for SIB and appropriate communication, respectively. Kappa coefficients calculated to control for chance agreement for staff attention averaged 73% (range, 53% to 86%).

*Sequential analysis.* Time-based sequential dependencies were calculated and analyzed. The occurrence of staff interaction was tallied in 5-s time windows preceding and following occurrences of SIB and appropriate communicative behavior. In general, this procedure determined whether the transitional probability that one event or behavior leading to another was significantly different from what would be expected by chance (using Allison-Liker *Z* scores and Yule's *Q*; Bakeman *et al.*, 1996).

*Matching analysis.* The proportion-based generalized matching formula was used to calculate the relative proportion of rate of SIB and appropriate communicative behavior and the relative proportion of staff attention provided contingent on SIB and appropriate communicative behavior. To test for asymmetry (bias) and indifference (over- or undermatching), the data were transformed logarithmically and analyzed through least squares regression.

## RESULTS AND DISCUSSION

Robert's overall rates of SIB and appropriate communicative behavior were 2.7 and 1.9 per minute, respectively. SIB and appropriate communicative behavior were both significantly sequentially dependent with staff attention ( $p < .05$ ). In other words, the likelihood that staff attention followed some form of SIB or adaptive behavior was greater than expected by chance. The sequential dependencies associated with staff interaction (e.g., prompts) preceding SIB and appropriate communicative behavior were not significant. The results of the matching analysis indicated that the rate of SIB relative to appropriate communicative behavior matched the amount of staff attention for SIB relative to appropriate communicative behavior (84% variance accounted for; see bottom panel of Figure 1). The intercept did not differ significantly from zero, suggesting no bias in the data. The slope differed significantly from unity,  $t(14) = 8.4$ ,  $p < .05$ , indicating some degree of overmatching (McDowell, 1989). To explore the overmatching finding further, a post hoc latency analysis was conducted in which the number of seconds that elapsed between a target behavior (SIB or appropriate communicative behavior) and staff interaction was calculated by reviewing the raw data and counting the time difference from the onset of a target behavior to the onset of staff attention. La-

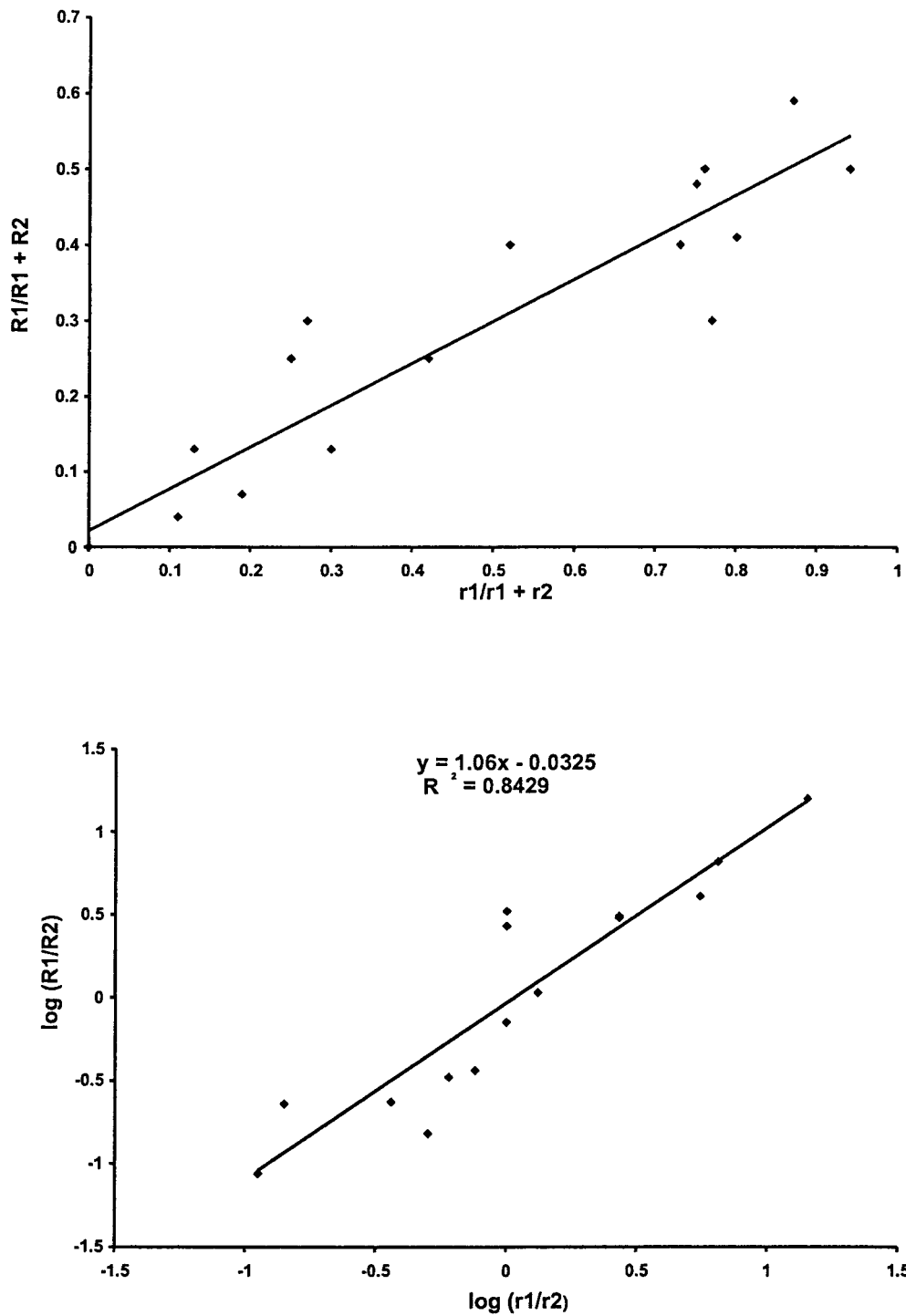


Figure 1. The top panel depicts the relative proportion of self-injurious behavior (SIB) and adaptive behavior (horizontal axis) plotted against the relative proportion of contingent staff attention for SIB and appropriate communicative behavior (vertical axis) for each observation session in which they occurred. The bottom panel depicts logarithms of SIB and appropriate communicative behavior ratios (horizontal axis) plotted against logarithms of SIB and appropriate communicative behavior reinforcement ratios (vertical axis) for each observation session.

tencies were summed and averaged for SIB and appropriate communicative behavior. This analysis indicated that the average amount of time that elapsed from a first occurrence of SIB to staff attention was approximately 4.1 s, whereas it was 20.5 s for appropriate communicative behavior. This difference in latencies may account for the observed overmatching.

An important limitation of this study was the absence of an experimental manipulation confirming staff attention as a reinforcer for SIB or appropriate communicative behavior. Thus, these findings should be considered preliminary. Because of the correlational nature of matching analyses, it is impossible to infer the direction of causation; therefore, the role of attention as a reinforcer should be tested empirically via treatment (McDowell, 1989) or functional analysis (Borrero & Vollmer, 2002). As suggested by Borrero and Vollmer, future work should directly and systematically replicate matching analyses of destructive behavior in the environments in which it occurs. The current study presents a method for including sequential analysis as an adjunct to matching analysis and adds to the growing evidence from studies that have

examined the naturally occurring order between SIB and attention in human interaction.

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