Matching Analyses as an Evaluative Tool:
Characterizing Behavior in Juvenile Residential Settings

by

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Abstract

These studies aimed to use the generalized matching equation, a quantitative model of choice-making behavior, to interpret the interactions between adjudicated adolescents and direct-line staff members. In Experiment 1, the researcher and data collectors recorded the frequency in which staff members delivered attention to adjudicated adolescents (residents) and the frequency in which residents engaged in disruptive and appropriate behavior in a juvenile residential center. One factor that may influence the residents' allocation to either disruptive and appropriate behavior may be the extent to which staff members deliver positive interactions such as praise. Therefore, in Experiment 2, the researcher conducted a series of staff trainings that aimed to increase staff members' delivery of positive social interactions with residents. Following the completion of the staff trainings, the generalized matching equation was again used to evaluate any changes in the residents' allocation of behavior to disruptive and appropriate behavior. The generalized matching equation revealed resident behavior allocation slightly favored disruptive behavior. In general, pre and post-staff training in two dormitories, residents' behavior allocation revealed a pattern of behavior allocation in which residents engaged in more instances of behavior based on the reinforcers (staff attention delivery) available. Staff training had slight effects on increasing staff members' delivery of praise and altering resident allocation of behavior. These data from the generalized matching equation suggest a staff training intervention may indirectly influence resident behavior allocation in juvenile residential settings.

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Chapter 1

Literature Review

Adjudicated Adolescents

In the United States, there are approximately 50,000 adjudicated adolescents in juvenile residential placement (Hackenberry, 2018; Sickmund, 2010). One goal of a juvenile residential treatment center is to provide treatment programs for youth to treat a range of mental health concerns (clinical diagnoses, substance abuse, deviant sexual behavior) in conjunction with residential care. Within these settings, organizations rely on staff members to occupy many roles from being surrogate guardians, promoting rehabilitation, and serving the best interests of these adjudicated adolescents while they reside in a stressful setting (Liou, 1995).

Adjudicated adolescents are likely to be diagnosed with mental health disorders (Shufelt & Cocozz, 2006). It is not clear if adjudicated adolescents enter facilities with diagnoses, facilities engender the diagnoses, or some combination of both. Additionally, Sedlak and McPherson (2010) found that 70% of the adjudicated youth have experienced a trauma, 60% reported anger management issues, and up to 51% stated issues with anxiety. Most respondents (52%) stated they felt lonely much of the time, and 26% of the participants reported they "felt life was not worth living." When adjudicated adolescents *do not have* access to quality mental health services in juvenile placement, recidivism, the tendency of an adjudicated adolescent to reoffend, can be up to 50% (Lipsey, 2009). It is crucial that juvenile residential centers deliver quality services to these adolescents to prevent and treat any consequences, such as "externalizing behaviors," associated with these diagnoses. Staff members in these facilities, change agents[1],

often control many of the reinforcing events for adolescents in these settings. Understanding the relationship between the staff members and adjudicated adolescents may assist in the development and evaluation of interventions to better treat behavioral concerns of this vulnerable population.

One such tactic to characterize staff member and adjudicated adolescent interactions may be through the use of extensively tested quantitative models of behavior. Quantitative models of behavior describe behavioral relationships. They can often precisely capture and explain why nonhuman animals and humans engage in particular responses (Critchfield & Reed, 2009). One such mathematical relationship, which may be particularly useful, is the matching law. The matching law characterizes "choice-making behavior" (response allocation to different behaviors) as a function of the relative rate of reinforcement. (Findley, 1958; Herrnstein, 1961). For example, residents living in a juvenile residential facility can either engage in appropriate communication or disruptive behavior. Based on the matching law, the rate of both behaviors would be proportional to the relative rate at which change agents[1] (e.g., staff members) deliver access to socially mediated reinforcers like attention. A number of investigations have used different mathematical derivations of the matching law to evaluate behavior allocation to response alternatives in non-humans and humans (see Davison, & McCarthy, 1988 for a full review; Jacobs, Borrero, & Vollmer, 2013). Across six decades, experimental, translational, and applied investigations have provided informative analyses of operant behavior as a function of reinforcement.

Historical Overview of the Matching Law

In early arrangements of evaluating choice-making behavior, researchers utilized

[1]The term "change agents" will be used to refer to persons who control access to putative reinforcing events.

concurrent schedules of reinforcement with nonhuman animals. Herrnstein (1961) described a procedure in which two variable-interval (VI) schedules of reinforcement were simultaneously available to pigeons. After a variable interval of time had passed, left or right key pecking was reinforced. He utilized four different VI schedules of reinforcement (VI 3 min VI 3 min, VI 2.25 min VI 4.5 min, VI 1.8 min VI 9 min, and VI 1.5 min extinction). In most conditions, he programmed a changeover delay (COD), such that a reinforcer on one key could not be obtained even if arranged by the schedule until 1.5 s had elapsed since the first peck on that key. Herrnstein (1961) reported the proportion of responses pigeons emitted on one key approximately equaled the proportion of reinforcers obtained from that key. Pigeons' relative rate of responding corresponded in a linear manner to the relative rate of reinforcement, described algebraically by the first mathematical model of choice-making behavior, the proportional matching equation (Equation 1):

$$\frac{B_1}{B_1 + B_2} = \frac{R_1}{R_1 + R_2}$$

(Equation 1)

In this relationship, *B* is to the rate of behavior and *R* is the obtained reinforcer rate. The subscripts refer to the two choices. Subsequent experimental research replicated Herrnstein's findings of proportional matching when using concurrent VI VI schedules with COD (Catania, 1963a; Catania, 1963b; Shull & Pliskoff, 1967).

An expansion of the proportional matching equation was extended to another dimension of behavior, time allocation, or the duration spent on certain alternative. Baum and Rachlin(1969) assessed pigeons' duration of time standing in a divided operant chamber when food reinforcers where delivered on concurrent VI schedules. Pigeons' ratio of time standing on one or the other side was directly proportional to the level of reinforcement produced by standing

on either the left and right side. Though pigeons demonstrated a bias for the right side, authors concluded these data were comparable to matching produced with key pecks. This led to the development of the time allocation model (Equation 2):

$$\frac{T_1}{T_1 + T_2} = \frac{R_1}{R_1 + R_2}$$

(Equation 2)

In this equation, *T* refers to the duration of time spent responding on the two choices. The time allocation model tends to be an accurate and precise way to describe behavior that does not occur in discrete units (Martens & Houk, 1989; McDowell, 1988; Neef, Mace, Shea, & Shade, 1992).

Inevitably, it is the case that sources of reinforcement in "real world" scenarios or even in controlled, lab studies may not be dichotomous. Herrnstein (1970) argued, all behavior is a choice, and there are never solely *two* behavioral options. Even in operant chamber preparations, animals can either engage in programmed defined behaviors measured by experimenters or allocate responding to unprogrammed behavior like foraging, scratching, and licking. As such, conceptualizing behavior as dichotomous (either left or right key) may be inaccurate or misleading. Thus, Equation 3, an algebraic rearrangement of the proportional matching equation, was needed to account for all possible responses and sources of reinforcement:

$$B_1 = \frac{kR_1}{R_1 + R_e}$$

(Equation 3)

Equation 3, frequently called the single-rate equation, quantifies responding on a single device, accounts for the role of extraneous reinforcers(R_e) unprogrammed by the researchers. The constant *k* is the total sum of the target behavior (B_1) and extraneous behavior that may occur (B_e) This function produces a hyperbola, a negative accelerated curve, with an upper asymptote that

represents the maximum response rate that can be produced on a particular response device. Herrnstein (1970) called this the quantitative law of effect, which could account for environmental and physical constraints of the individual. This quantitative model predicts that extraneous reinforcement reduces the sensitivity of target behavior to the programmed reinforcement. For example, in a rich environment characterized by high levels of reinforcers (access to staff member attention and preferred activities), sensitivity to reinforcement may be relatively low. Alternatively, in impoverished environments, characterized by low levels of reinforcers (deprivation of staff attention and activities), sensitivity to reinforcers may be quite high. In sum, as reinforcement rates increase, rates of the target behavior will ultimately stop increasing as it reaches its maximum potential. The quantitative law of effect documents this relationship between observed and extraneous reinforcers on the occurrence of behavior and supports the notion *all* behavior is choice (Herrnstein, 1970).

Further refinement of the strict matching equation occurred with the derivation of the generalized matching equation (GME; Baum, 1974a). The GME allowed for the use of data that did not conform to the proportional matching equation. For example, if the data revealed bias or relative responding on alternatives did not conform linearly to the relative rate of reinforcement, the GME would allow for interpretation by transforming the data (Baum, 1974a), as shown in Equation 4:

$$\log\left(\frac{B_1}{B_2}\right) = a\ log\left(\frac{R_1}{R_2}\right) + \log k$$

(Equation 4)

The GME is algebraically equivalent to Equation 1 if there is no bias and if the proportion of responses on an alternative is linearly related to the proportion of reinforcers, a situation that

rarely occurs even in experimental settings. Equation 4 is a logarithmic transformation of a power-law formulation (see Baum, 1974a). In Equation 4, the parameters k and R_e are dropped from the model and provide a method to describe multiple behaviors and multiple reinforcers in the environment (Jensen & Neuringer, 2009). Bias, indicated by log k, represents the magnitude of preference for either behavior that cannot be explained by the schedule of reinforcement alone. When bias (due to characteristics of the individual or environment like handedness, color preference, or quality of reinforcers; Baum 1974a) occurs, log k will differ from one. For example, if log k is less than one, the response alternative in the denominator is favored. If log k is greater than 1, the response alternative in the numerator is favored (Baum, 1974a).

The other parameter, a, represents sensitivity to reinforcer frequency and quantifies the amount of change in behavior associated with a change in reinforcement. Baum (1974b) proposed several factors contributing to changes in sensitivity, including poor discrimination of the two schedules of reinforcement, absence of a COD, and states of deprivation. A value of a less than 1.0, termed "undermatching," represents behavior allocation deviating in the direction of indifference or insensitivity (Baum, 1979). Thus, as relative rates of reinforcement increase, the increase in relative rates of behaviors are less than predicted by strict matching. If sensitivity is greater than 1.0, the phenomenon of the "overmatching" occurs. Here, small increases in reinforcer ratios result in relatively large increases in response ratios. As relative rates of reinforcement increase, the increase in behavior is more than predicted by strict matching. Equation 4 allows for a linear regression analysis, which provides quantitative estimates of the two parameters, as well as information to describe how well the GME accounts for the data pattern obtained. "Variance accounted for," usually notated as R^2, displays the percentage or proportion of variance in the data that can be explained by the GME. For example, if the GME

describes the data perfectly, one could predict every data point with 100% accuracy ($R^2 = 1.0$).

The matching law, and its mathematical derivations, have been incredibly significant in describing choice-making behavior (Davison & McCarthy, 1988; Grace & Hucks, 2013; Jacobs et al., 2013). It provides a simple quantification of response allocation for both nonhuman animals and humans that can be useful in a range of settings. The matching law presumes that behavior is predictable and is *not* the result of the nonhuman animal or human "deciding" to behave in one manner over another (Skinner, 1971). Rather, the matching law states responding on alternatives is influenced by the relative rates of reinforcement, an environmental determinant.

Clinical Applications of the Matching Law

As a result of the extensive experimental work conducted with nonhumans, the matching law and its derivations have expanded knowledge of operant behaviors within populations with and without clinical concerns or diagnoses. For example, several studies have evaluated social interaction (eye contact, body orientation, and verbal statements) as a function of confederate approval statements (Borrero et al., 2007; Conger & Killeen, 1974; Pierce, Epling, & Greer, 1981; Simon & Baum, 2017). Conger and Killeen (1974) first assessed the generality of the matching law when studying human, social behavior. Five college students conversed with confederates, who were signaled by lights to respond to participants' statements on VI VI schedules of reinforcement. Confederates delivered verbal approval ("That's a good point") on a dense schedule of reinforcement (70%) or a lean schedule of reinforcement (30%) following participant statements on a facilitated discussion on drug abuse. Participants' allocation of time spent talking was proportionally related to the confederate's relative rate of social approval. Through a controlled manipulation of reinforcement schedules, allocation of participant verbal behavior was influenced by the consequences delivered by the conversational partner. Together

this study and the aforementioned studies have shown the conditions under which social, verbal behavior is supported by environmental conditions.

Matching equations have also described the behavior-environment relationships of the problem and appropriate behavior of individuals from clinical populations. Two populations of interest are people with intellectual and developmental disabilities (Borrero & Vollmer, 2002; Carr & McDowell, 1980; Hoch & Symons, 2007; Martens & Houk, 1989; Oliver, Hall, & Nixon, 1999; St Peter et al., 2005) and juveniles at risk for offending (McDowell & Caron, 2010a, 2010b). Martens and Houk (1989) used the quantitative law of effect (Eq. 3) to describe the on-task and disruptive behavior of an adult with a disability. Equation 3 accounted for 83% of the variance for disruptive behavior and 44% of the behavior for on-task behavior. In a related study, St. Peter et al. (2005) used both the proportional (Eq. 1) and GME (Eq. 4) to describe three participants engagement in problem behavior in classrooms. The outcomes of their matching analyses demonstrated a relationship between the occurrence of problem behavior and adult attention. Specifically, the relative rate of problem behavior corresponded to the relative rate of adult attention delivery, despite confirming the problem behavior was *not* maintained by adult attention (see Borrero & Borrero, 2008; Borrero et al., 2010 for studies using functional reinforcers). St. Peter et al. concluded outcomes from matching equations may be misleading if functional reinforcers are not used. However, the authors note the occurrence of problem behavior may serve as an evocative event for inappropriate adult, staff, or caregiver behavior. Thus, matching analyses may be a useful tool to identify staff training needs to ensure the environments for clinical populations are therapeutic.

Matching analyses have also been used to characterize verbal behavior patterns for adolescents at risk for juvenile delinquency. With possible contributing factors and history of

abuse, neglect, and trauma, it is important to understand if matching equations may explain response allocation in this vulnerable population. Notably, McDowell and Caron (2010) examined the verbal behavior of 210 adolescents at risk for juvenile delinquency when they conversed with similar-aged peers. They videotaped 25-min sessions in which participant-peer dyads interacted. They coded the duration and rate of rule break and normative talk as well as peer's positive social and non-positive social responses. Participants' families and teachers also completed a child deviance measure. Participant rule-break talk and normative talk was proportionally related to peers' positive or nonpositive social statements using the GME. The GME provided an excellent description of the time and rate of at-risk youth's verbal behavior. In general, participants allocated more responding to normative talk than rule-break talk. However, those with higher reported levels of deviance were more likely to engage in rule-break talk. Authors speculate different histories could have contributed to participants' rule break and normative talk, hypothesizing participants with increased deviance may find positive social responses less reinforcing.

Matching Analyses as an Evaluative Tool

Rather than using matching equations to solely describe behavioral-environment interactions, matching equations may be a useful *evaluative* tool in quantifying *the change* of variance accounted for (R^2) by the quantitative model, change in behaviors' sensitivity to reinforcement and bias, pre-and post-treatment (Murray & Kollins, 2000; Rivard, Forget, Kerr, & Bégin, 2014). For example, if an individual's sensitivity to reinforcement is 0.0 prior to intervention, suggesting an indifference to programmed reinforcers, application of the GME post-intervention may reveal improvements in sensitivity (values closer to 1.0). These data would indicate that response allocation is corresponding more closely to the relative rates of

reinforcement post-intervention. This may suggest that environmental variables (intervention) influenced behavior allocation that optimizes access to reinforcers and that behavior is making better contact with its consequences.

In fact, for children diagnosed with autism spectrum disorder (ASD), researchers have evaluated how participants' sensitivity to reinforcement changes following an independent variable (Rivard et al., 2014). Researchers observed 14 French children with ASD pre-and post-early intensive behavioral intervention (EIBI) and recorded appropriate behaviors (responding to a demand, maintaining interaction, initiation of interaction) and problem behaviors (aggression and self- injury) as it related to therapist attention and material reinforcers. By using the GME (Eq. 4), researchers analyzed the degree to which children's' behavior allocation matched to therapist attention, while also identifying changes in the parameters of sensitivity and bias. Prior to EIBI, the GME accounted for at least 50% of the variance of the relative rates of behavior and relative rates of adult- mediated reinforcement for seven participants. Post-EIBI, the GME accounted for at least 50% of the variance for an additional three participants' behavior allocation. Though R^2, sensitivity, and bias remained statistically unchanged over time at the group level, there were individual differences in these parameters. As indicated by the sensitivity parameters, three participants' behavior strictly matched (indicated by sensitivity parameters within a 0.90-1.11 range), five participants' behavior overmatched, one participant behavior undermatched, and the remaining participants' behavior did not match pre-EIBI. No participants presented a bias toward inappropriate social behavior at any time during the study. Post-EIBI four participants had no change in sensitivity to reinforcement, five participants showed a marginal decrease in sensitivity in reinforcement (though small), and the remaining showed an slight increase the sensitivity to reinforcement.

Rivard et al. (2014) relied on naturalistic reinforcers (not contrived experimenter-controlled VI schedules). Given this, there was little opportunity for matching to take place for many of the participants, indicated by the restricted range of the values. Though the information derived from the GME could inform current and future strategic intervention for these children, there are hazards to relying on correlations between response-reinforcer relationships rather than experimentally determined response-reinforcer relationships. Notwithstanding, researchers raised the possibility of using matching analyses as an assessment tool that may guide behavioral treatment. Specifically, if the GME failed to account for a large portion of the variance, it may be important to pair social reinforcers with other reinforcers (tangibles, edibles, specific activities). Contrastingly, if the GME accounted for large portion of the variance, it may be an indicator to continue using social reinforcers.

In another illustration of matching analyses being analytical tools for intervention, Murray and Kollins (2000) delivered a placebo or methylphenidate to children diagnosed with attention-deficit hyperactivity disorder to determine the extent to which the drug altered the task completion under different VI schedules. The single-rate equation (Eq. 3) accounted for more variance under *medicated* conditions for both participants. Also, when medicated, both participants had higher *k* values. These values indicate participants engaged in higher levels of academic behavior under medicated conditions when compared to the placebo condition. Though this investigation was conducted with two participants, it provides a framework in understanding how a psychotropic medication may interact with environmental events to influence behavior allocation in a clinical population. In sum, both Rivard et al. (2004) and Murray and Collins (2000) are examples of the application of matching law analyses with clinical populations that may inform treatment and intervention.

If concerns are how to best describe the behavior of a "unit," (behavior of multiple individuals; Fox, Hopkins, & Anger, 1987), matching analyses have also been shown beneficial in this domain. Researchers have used matching equations to characterize team "behavior," or the collective sum of behaviors of individual team members, in baseball, basketball, and football teams (Alferink, Critchfield, Hitt, & Higgins, 2009; Reed, Critchfield, & Martens, 2006; Vollmer & Bourret, 2000). Team behaviors are ideal situations to use matching equations. Presumably, all team members are attempting to reach the same goals. Reinforcers (points, scores, or success) are easy to assume and calculate even in the absence of experimenter controlled VI reinforcement schedules. For instance, Reed et al. (2006) conducted a series of studies in which they used the GME to investigate relative rates of play calling (passing and rushing) as a function of the relative rate of reinforcement (yards gains) in 32 National Football League teams for the 2004 season. In Study 1, GME accounted for 75.7% of the variance in play calling. Specifically, teams who were successful at passing plays, tended to call more passing plays per opportunity, and teams better at rushing plays called more rushing plays per opportunity. In Study 2, authors examined each NFL teams' behavior during pre-, regular, and post-season. As the season progressed, the GME accounted for more variance, suggesting the teams' "behavior" was becoming more sensitive to rates of reinforcement as time and contact with the contingences occurred. It is unclear if the matching shown is truly team behavior or matching behavior of the quarterback or coach. Regardless, it is the collective behavior of the team that allows for the contact of reinforcement or points.

In a related investigation evaluating team behavior, Alferink et al. (2009) used matching analyses to describe college and professional basketball teams' shot selection (behavior allocation to either 2- or 3-point shots). The matching law accounted for large portions of the

variance for both college and professional basketball teams' shot selection. The GME also revealed the teams' shot allocation undermatched relative rates of reinforcement. There was also a bias for team members to engage in more 3-point shot selection than what would be predicted by the relative rates of reinforcement. When the teams' sensitivity parameters were compared to sensitivity parameters from operant laboratory studies, the variability of the parameters were similar. These data suggest that aggregate (team behavior) *and* behavior allocation evaluated at the individual level are similarly characterized by the matching law.

The aforementioned studies and more (Borrero, Vollmer, Borrero, & Bourret, 2004; Neef et al., 2005; Reed & Martens, 2008; Seniuk, Williams, Reed, & Wright, 2015) have shown the utility of matching analyses when evaluating behavior allocation for individuals or groups of individuals (teams). One such setting and population where such an analysis may be of importance is in juvenile residential placement for detained adolescents. Like team behavior, staff behavior in these juvenile residential settings is consistently a collaborative effort to ensure their group of residents are safe and well-behaved. One way administrators in juvenile residential settings ensure residents are well-behaved are to deliver empirically supported mental and behavioral interventions.

Traditional Interventions for Adjudicated Adolescents

One common intervention employed when treating adjudicated adolescents' mental health is individual counseling (Lipsey, 2009). Individual counseling or therapy can be defined as a qualified provider meeting with the adolescent in a one-on-one setting to provide guidance and support. In a national sample of clinical staff from juvenile correctional facilities in the United States, approximately 50% of the reported facilities had mandatory individual counseling for their youth, with most institutions employing cognitive-behavioral therapy (Swank & Gagnon, 2016).

Another common intervention used with adjudicated adolescents is group therapy (Greenwood, 2008; Jewell, Malone, Rose, Sturgeon, & Owens, 2015; Lipsey, 2009). During these group therapy sessions with mental health professionals, at least two adolescents are present. Together the adolescents and mental health professional discuss what events make them angry, life skills, social skills, substance abuse, and traumatic experiences (Lipsey, 2009). Group members may also practice targeted skills while receiving feedback from the trained mental health provider (Underwood & Knight, 2006). In this group format, mental health professionals can serve multiple individuals simultaneously while also establishing positive interactions between peers. Approximately 79% of reporting juvenile facilities reported serving adjudicated youth through group counseling and therapy (Swank & Gargon, 2016).

For both individual and group therapy approaches, highly qualified individuals such as case managers, social workers, and psychologists are likely to deliver services (Lipsey, 2009). These individual and group therapy interventions may be limited in their utility due to the complex interactions adjudicated youth may face outside of the therapy session with peers or staff members in their dormitories. It is unknown the extent to which skills taught in therapy sessions generalize to the natural setting or the extent to which direct line staff encourage, reinforce, or acknowledge skills learned through therapy. Though higher quality services are associated with less recidivism (Lipsey, 2009; Lipsey, Howell, Kelly, Chapman, & Carver, 2010), direct line staff may be less utilized for these services given their lack of formal educational training. It may be worthwhile to investigate how training frontline staff to implement interventions can influence appropriate and disruptive behavior of adjudicated adolescents. In fact, among skill building approaches, behavioral and cognitive-behavioral interventions appear especially effective when looking at recidivism, even more so than strategies based on control or coercion (Lipsey, 2009).

Behavior-Analytic Interventions in Juvenile Residential Settings

Adjudicated adolescents may engage in disruptive behavior (excessive horseplay, inappropriate language, interrupting) that may present challenges in therapy sessions, the classroom, and the dormitory. Behavioral reduction interventions (targeting the reduction of overt, disruptive behavior) may assist in adjudicated adolescents being successful in these settings, assuming relevant change agents have proper training. Early behavior-analytic work in residential settings for adjudicated youth and adults assessed the effectiveness of token-reinforcement, response cost, and supervision in reducing disruptive behavior (Bassett & Blanchard, 1977; Hobbs & Halt, 1976; Milan & McKee, 1976; Phillips, Phillips, Wolf, & Fixen, 1973). Within the token economy approach, change agents delivered points for appropriate behavior (chores) and either ignored or penalized disruptive behavior by removing points. Participants would accumulate earned points and exchange points for preferred items and privileges such as phone calls, longer TV time, and candy. Token economies (and their derivatives like point and level systems) account for 17% of published research in reducing disruptive behavior in juvenile justice settings (see Lipsey, 2009). Despite their prevalence, these interventions are cited to be difficult to train and implement, requiring a substantial amount of time for staff training (Mohr et. al, 2009; Mohr & Pumariega, 2004; Tompkins-Rosenblatt & VanderVen, 2005).

A more apt approach for behavior-reduction interventions may be to design the treatment to meet the goals and needs of the *target setting* (Brogan, Falligant, & Rapp, 2017; Chinnippan, Rapp, & Burkhart, 2019; McDougale et al., 2018). For example, clinical therapists may not be able to address the adjudicated adolescent calling out, interrupting, excessive horseplay, and inappropriate language that may occur in group therapy sessions. The occurrence of these

disruptive behaviors, which are not only frustrating and difficult for the clinical therapist, potentially negate their intended effect of their therapy. In an application of measuring and treating a behaving unit of adjudicated adolescents, Brogan et al. (2017) applied an interdependent group contingency for decreasing disruptive behavior during clinical group therapy sessions. Delivering preferred items based on the group's appropriate performance (not the individual), decreased disruptive behavior across two therapy groups. Additionally, both clinical therapists endorsed the intervention as acceptable. This highlights the applicability and success of behavioral interventions to influence the collective group of behaving individuals in a juvenile facility in collaboration with mental health professionals.

McDougale et al. (2018) extended and replicated Brogan et al. (2017) in a series of studies aimed to decrease problem behavior using group procedures with individuals adjudicated for sexual offenses within the residential setting. In their first study, McDougale et al. trained staff members to deliver time-based delivery of attention during leisure periods in their dorm. As a result of this training, disruptive behavior displayed by the group of detained adolescents decreased. In Study 2, adjudicated youth's appropriate line walking increased as a result of rules and programmed consequences such as edibles and feedback. When reinforcers (edibles) were thinned (reduced), staff members needed direct training to promote generalization to novel transitions. Both studies demonstrate that behavioral interventions delivered for the "group" can be successful when decreasing problem behavior. Brogan et al. (2017) and McDougale et al. (2018) also highlight the impact of "simple" behavioral interventions when delivered by clinical therapists or residential dormitory staff following training.

It is a concerted endeavor between multiple professionals to ensure that juvenile residential environments are therapeutic and safe. Ultimately, much of the responsibility for

implementation falls onto frontline staff members (Liou, 1995). It is reasonable to assume that if staff members are not instructed or trained to create a therapeutic environment using behavioral interventions, these behaviors will not occur. Notably, McDougale et al. (2018) indirectly changed the group of adjudicated adolescents' behavior by directly changing staff group behavior, perhaps creating an interlocking behavioral contingency. Interlocking behavioral contingencies are contingencies in which the behavior or behavioral product of one individual acts as the antecedent for another individual's behavior and the consequences for both individuals are shared (Glenn & Malott, 2004). Staff members delivery of time-based attention may have served as an antecedent for residents' appropriate behavior in the dormitory. Both staff members and residents shared the putative consequence of a calm and positive dormitory setting. Further exploration of this process, the influence of staff training, and its indirect effects on adjudicated adolescent behavior is warranted.

Juvenile Staff Members in Residential Settings

There are approximately 300,000 juvenile justice workers in the nation (Howe, Clawson, & Laviee, 2007). When working in these settings, staff members encounter long work hours, staffing shortages, perceived lack of administrative support, low pay, and limited prospects for job advancements (Howe et al., 2007). For the past two decades, staff turnover rates in corrections have averaged around 20%, ranging from 15% to 25% (Lambert, 2001; Lambert & Hogan, 2009; Minor, Wells, Angel, & Matz; 2011). In terms of time and resources, staff turnover rates may have a substantial effect on training, particularly if the modality adopted is a one trainer-to-one staff member. That is, one-to-one training is likely to be cost inefficient given the likelihood of staff turnover in these settings.

Staff members often enter and remain in juvenile justice due to their desire to help

children overcome problems (Minor, Wells, & Jones, 2004; Wells, Minor, Angel, Matz, & Amato, 2009). If staff members self-report high levels of personal efficacy (the degree they report believing they are accomplishing something beneficial to youth in their charge), they are less likely to report experiencing stress on the job. Though not studied empirically, quality training in which staff members experience minimal disruptive behavior (due to high integrity of behavioral interventions) could result in staff members reporting less stress at their job. Training juvenile direct-line staff members may have several advantages. Not only does training have the potential to increase staff members' skill sets and reduce the likelihood of stressful situations, it may have positive effects for the residents at these juvenile facilities.

It is known that the quality of youth services, positive institutional experience, and institutional care are associated with adjudicated youth less likely to be rearrested and return to the facility (Lipsey, 2009). As such, staff members within these settings should be trained to cultivate an encouraging environment, which may entail additional monitoring of staff members' behavior. Some reported outcomes of appropriate staff-detainee interactions include decreased likelihood of adjudicated adolescents to report anxiety and helplessness (Biggam & Power, 1997), increased likelihood of successful adaptation to rehabilitation environments (Liebling, 2004), increased detainees' report of the institution of being fair and safe, and decreased reported level of fear (Van der Laan & Eichelsteim, 2013). Of note, if staff members are not appropriately trained to decrease the likelihood of resident disruptive behavior, staff members may resort to using coercive tactics without cause (Coyle & Fair, 2018). Given that appropriate staff-resident interactions are associated with residents less likely to report feeling anxious and less likely to contact restrictive procedures, further evaluation is needed to investigate how to effectively train staff members to deliver frequent positive interactions.

Training Staff Members to Implement Behavioral Interventions

Much of what is known about evidence-based training has been conducted when instructing change agents (e.g., parents, teachers, paraprofessionals) to implement interventions with individuals with disabilities (Karsten, Axe, & Mann, 2015; Maffei-Almodovar & Sturmey, 2018; Rispoli, Neely, Lang, & Ganz, 2011; Shapiro & Kazemi, 2017). There is a dearth of recent behavior-analytic training research in residential centers for adjudicated youth. Direct measurement of the staff behaviors in the context in which it is needed is an objective method in determining if a training is effective. However, published accounts of training workers in juvenile residential centers often lack procedural details, fail to directly observe and measure overt behavior prior to and following the trainings, and opt for narrative reports of success (James, 2011; Lott, 2018; Pazaratz, 2000). Additionally, researchers conducting training in correctional settings may determine the training's effectiveness based on improvements on quiz scores (Doran, Hohman, & Koutsenok, 2013; Masters, Magnuson, Bayer, Potter, & Falkowski, 2016) rather than behavioral observation.

One such approach that does not rely on the notion of "train and hope" (Stokes & Baer, 1977) is behavioral skills training (BST). BST is a teaching strategy that produces high procedural integrity with behavioral interventions. In this training modality, the trainer provides instruction, models the procedures, allows for opportunities for change agents to practice, and delivers positive and corrective feedback on their performance (Parsons, Rollyson, & Reid, 2012). BST has been widely used for increasing change-agent integrity with behavior-analytic assessments, skill acquisition procedures, and behavioral reduction programming (DiGennaro Reed, Blackman, Erath, Brand, & Novak, 2018; Leaf et al., 2018). However, more investigation is needed in how a client's behavior is altered as a direct result of change agent training, particularly outside of the intellectual and neurodevelopmental disorders population.

Also, much of the BST research involves instruction on procedures that contain specific sequences of discrete responses for which completion of a step sets the occasion for the subsequent step (see Shaprio & Kazemi, 2017 for a recent review). To illustrate, there are seven steps for setting up and conducting a multiple-stimulus preference assessment and a student's behavior will dictate if the change agent conducts four out of seven steps (Weldy, Rapp, & Capocasa, 2014). However, behavioral reduction procedures such as differential reinforcement of alternative behavior may be more complicated given that all steps in the procedure are dependent on a student's behaviors. Nevertheless, researchers have successfully trained behavioral therapists, school personnel, and parents to implement behavioral reduction interventions using BST (Hogan, Knex, & Kahng, 2015; Seligson-Petscher & Bailey, 2006). As a whole, BST is a resource-intensive package that can increase change agents' accurate implementation of behavior-analytic interventions. As a result of the costs associated with BST (DiGennaro-Reed & Henley, 2015), researchers have examined which components are necessary for change-agent acquisition (see Ward-Horner & Sturmey, 2012) in an attempt to optimize training efficiency.

One such way to decrease costs and increase the number of staff participants may be the use of antecedent-based teaching strategies. Antecedent-based training strategies have been successful in increasing skill sets such as respite care (Neef, Parish, Egel, & Sloan, 1986), discrete-trial instruction (Vladescu Carroll, Paden, & Kodak, 2012), preference assessments (Deliperi, Vladescu, Reeve, Reeve, & DeBar , 2015; Weldy et al., 2014), and behavior-reduction interventions (Luna, Nuhu, Palmier, Brestan-Knight, Rapp, & 2019; Spiegel, Kisamore, Vladescu & Karsten, 2016). This training approach does not require an expert trainer to deliver feedback and may be optimal in settings with low trainer-to-staff ratios. For example, both Luna et al. (2019) and Spiegel et al. (2016) evaluated the extent to which a antecedent-based package

(including video modeling, voiceover instructions, and audio) would increase school staff members and caregivers, respectively, level of correct responding when implementing behavioral reduction procedures. In general, these antecedent-based practices improved participants' performance when compared to baseline and suggested this may be a more time-efficient training packages when compared to BST.

Despite advancements in creating effective training packages, behavior-analytic training research is almost exclusively conducted in schools, clinics, and homes with a homogenous sample of participants (educated females) when implementing prescribed procedures for children with disabilities (Leaf et al., 2018; Love, Carr, LeBlanc, & Kisamore, 2013). Thus, the efficacy of these strategies remains unknown in populations in which both change agents and individuals targeted for intervention represent diverse participants in terms of gender, race, ethnicity, and educational background. One method in combating this gap in the literature is to evaluate interventions in novel settings like juvenile residential placement for adjudicated adolescents.

The Present Study

The current experiments aimed to extend the utility and generality of matching equations when describing staff member and residents' behaviors in a juvenile residential setting, while also determining the degree to which training packages can alter staff behavior and its relationship to resident behavior. In Experiment 1, the generalized matching equation (Eq. 4) was employed to interpret resident appropriate and disruptive behavior as function of staff member attention delivery. Bias (*log k*), sensitivity (*a*), and variance accounted for (R^2) were assessed following observations in three target dormitories and one comparison dormitory at a juvenile residential center. Training staff members to deliver contingent and noncontingent interaction to multiple behaving individuals may reduce the occurrence of disruptive behavior (McDougale et

al., 2018; Shore, Iwata, Vollmer, Lerman, & Zarcone, 1995). In Experiment 2, the extent to which staff training, using a single-case experimental design, altered the frequency of staff members' delivering positive interactions to residents and the extent to which parameters of the GME were altered post-staff training were also assessed. Additional quantitative approaches to analyzing resident and staff member behavior were employed, including comparisons to a dormitory with senior staff members on the same campus and under the same administration.

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Chapter 2

Experiment 1 Methods

Staff Members and Residents

The researcher approached staff members from a local juvenile residential treatment center that served adolescents and young adults who have been adjudicated for sexual or criminal offenses. Prior to the start of the study, she explained the purpose of the study and invited them to participate. The researcher explained that the research team would be collecting group data on resident-staff interactions. Specifically, the researcher informed the staff member individual data on one staff member *would not* be collected. Staff members, as part of the informed consent process, were able to opt-out of being part of the data collection for this study. However, the conditions of their employment require them to be trained to interact appropriately with the residents. The researcher recruited all second-shift staff members from each of the targeted dormitories: eight from Dormitory 01, seven from Dormitory 02, and ten from Dormitory 03. Most staff members (62%, 57%, and 60% of staff members, respectively) had been employed less than one year at the juvenile residential facility. Staff members from Dormitories 01, 02, and 03 interacted with and monitored residents adjudicated for criminal offenses such as drugs, property, and assault charges. Dormitory 04 staff members worked with and monitored residents adjudicated for sexual offenses. Based on their tenure, Dormitory 04 staff members were more seasoned staff members in this juvenile residential treatment facility, working at the institution for at least one year. These staff members also engaged in ongoing training that encouraged therapeutic interactions with the adjudicated adolescents.

All staff members were at least 21 years old and had minimum of a high school diploma or high school degree equivalency (General Equivalency Diploma), as required by their employment at the juvenile residential treatment center. Staff members worked 6-12-hr shifts in their designated resident dormitory on Mondays-Fridays between the hours of 12 p.m. to 12 a.m. During the course of the study, staff members were not seen in an unassigned dormitory. Residents were adolescent and young adult males ranging in age from 16-to-21-years and who have been adjudicated for illegal behavior and have been ordered to complete their sentence in a residential facility.

Dormitories

To ensure that we captured an adequate representation of staff member-resident interactions in the juvenile residential facility, observers recorded data in four different dormitories. Dormitory 01, 02, and 03 were targeted dormitories for staff training (see Experiment 2), and Dormitory 04 was a comparison group. Dormitory 01 could house 20 residents. During the course of the study, no more than 15 residents were assigned to this dormitory. The dormitory supervisor assigned each resident their own cell which contained a mattress, a toilet, and minimal personal materials such as notebooks and clothing. Ten of these cells were on a second floor, and the other ten cells were on the first floor. In addition to resident cells, there were two seclusion cells of the first floor that could be occupied by any resident in the juvenile residential institution and were reserved for residents that met "time-out" criteria (residents who engaged in aggression, noncompliance, sexual acts, or the possession of contraband). On the first floor, there was a public space containing two televisions, an electronic gaming system, one to four tables, twenty plastic chairs, and a bookshelf with books. In the middle of the dormitory, there was a control center that was surrounded by clear Plexiglass. In

the control center, staff members would sit or stand to monitor the residents, answer the phone, and electronically unlock the residents' cells or entrances/exits. There were two entrances/exits in the dormitory. Each entrance/exit had two locked doors before reaching outside of the dormitory. One side of the dormitory had three showers for the residents to use at designated times.

Dormitory 02 and 03, characterized as "open-bay" dormitories, were residential settings in which residents share sleeping quarters in a large space. Each resident had a bed and a large plastic container with their personal materials. There was a public space in which there was one or two televisions, an electronic gaming system, one to four tables, two-ten plastic chairs, and a bookshelf with books. In these dorms, staff members would sit tables on the left and right side of the dormitory to monitor the residents. There were three entrances/exits in these dormitories that are locked at all times. To enter or exit the dormitory, one must ask a staff member to unlock the door using a key. There were bathrooms adjacent to the public space which contained a row of urinals, row of toilets, a row of sinks, and row of showerheads each separated by half-walls.

Dormitory 04 housed 12 residents adjudicated for sexual offenses who have been sentenced to longer durations at the facility than those residents from the other dormitories. To reside in Dormitory 04, these residents would have to meet specific criteria such as meeting academic, clinical, and behavioral goals. Each resident had a private sleeping space separated by two shared walls, one wall with a window, and wall with a door that led to one public space. Each resident had bed and personal materials in their room. There was a public space in which there was one television, one to four tables, two to 10 plastic chairs, a bookshelf with books, and a variety of leisure materials at the staff member tables. In this dormitory, staff members would sit at tables in the center of dormitory to monitor the residents. There were three entrances/exits

in these dormitories that are locked at all times. To enter or exit the dormitory, one must ask a staff member to unlock the door using a key. There were bathrooms adjacent to the public space which contained a row of urinals, row of toilets, a row of sinks, and row of showerheads each separated by half-walls. In addition to the main public space, there was a large public space available in this dormitory that was used for special activities such as movie nights.

Electronic Data Collection System and Response Measurement

Observers recorded frequency data using an electronic data collection program, BDataPro, on five topographies of staff member attention delivery and resident appropriate and disruptive behavior (Bullock, Fisher, & Hagopian, 2017). BDataPro is a freely accessible computer program that allows for real time data collection for multiple behaviors and calculates reliability coefficients (described below in the interobserver agreement section). Response topographies of attention delivery included: general attention delivery, negative attention delivery, instruction delivery, reprimand delivery, and praise delivery.

Observers recorded *general attention delivery* when staff members vocalized to a student that did not meet the operational definitions below (e.g., "Hey." "Jones!" "You straight?"). Observers recorded *negative attention delivery* when a staff member used inappropriate language (e.g., "What the f*** you think you doing?") or engaged in horseplay behavior (neck hold, punching, tripping) toward a resident. As stated on posted rules and by dormitory supervisors in this juvenile residential facility, physical contact, such as horseplay was prohibited between residents and staff members. Observers would record *instruction delivery* when any staff provided a vocal prompt to a student or group of students to engage in a behavior (e.g., "Tuck in your shirt," "Take a seat," "Line up."). Observers would record *reprimand delivery* any instance in which a staff member provided a vocal prompt to a student or group of students to refrain

from a behavior (e.g., “Stop doing that,” “Quit it,” “Don’t do that,” “Stop cussing.”). Finally, observers also recorded *praise delivery* when any staff member vocalized an encouraging or affirming statement about a task or behavior the resident is currently doing or has done in the past or thanking them for current or past behavior (e.g., “Great job,” “Thank you,” “I appreciate that.”).

Observers scored *appropriate behavior* when a resident approached and vocalized to a staff member in the absence of disruptive behavior. Observers scored *disruptive behavior* as any instance in which a resident hit, tripped, or pushed another resident or staff that did not include a handshake, high five, or fist bump; any instance of breaking, ripping, tearing, or contacting objects that produced an audible sound like banging on cell door; and any instance in which residents engaged in vocalizations that referenced drugs, sex, or contained curse words. Given the policies at this juvenile residential treatment facility, observers scored all instances of behavior that met this definition, regardless if it occurred in the presence or absence of indices of happiness (smiling and laughing; Green & Reid, 1996).

Interobserver agreement (IOA)

Prior to collecting data in the dormitories, the first author conducted a 10-hr data collection training with research assistants. Research assistants demonstrated at least 90% accuracy on quizzes defining each of the response topographies for staff members and residents. In addition, research assistants demonstrated 90% reliability when using both electronic and paper data collection for identifying antecedents-behaviors-consequences (Luna, Petri, Palmier, & Rapp, 2018) from videos. Finally, the first author conducted a minimum of three observations with the research assistants while at the juvenile residential treatment facility to ensure research assistants achieved a minimum of 90% reliability across all dependent measures. If research

assistants did not achieve these scores, the researcher outlined the operational definitions again, prompted the research assistants to ask questions, and further clarified the definitions. The researcher conducted reliability checks the first week research assistants were scheduled in the dormitories and, subsequently, once a month.

Two trained, independent observers recorded staff members and resident behaviors for 90%, 74% , 41%, and 47% of the observations across the four dormitories, respectively. Using BDataPro, the researcher obtained partial-interval agreement scores across the staff member and resident behaviors. Observations were divided into 10-s bins, and the number of observed responses were scored for each bin. The smaller number of the observed responses from one observer within each bin was divided by the larger number of observed responses. These proportions were summed and converted to agreement percentages for each observation (Cooper, Heron, & Heward, 2007; Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990; Mudford, Martin, Hui, & Taylor, 2009). Table 1 depicts the mean IOA scores for each response topography for staff members and residents during Experiment 1.

Observation Procedures

Observations for each dormitory occurred one-three days a week between the hours of 3:15 p.m.-6:45 p.m., Monday-Friday for nine months for Dormitory 01 and 02, 8 months for Dormitory 03, and two months for Dormitory 04. Upon arrival, observers asked staff members if it was an acceptable time to observe. If staff members indicated observers could not record data at this time, observers asked when they could return and proceeded to a different dorm. This occurred on a weekly basis in Dormitory 01 (because residents were showering), and it never occurred in Dormitory 02, 03, and 04.

Both primary and reliability observers had laptops with the electronic data collection software, BDataPro (Bullock et al., 2017). Observers would locate chairs in the dormitories and sit in the dormitories' public space, aiming to sit approximately 0.5 m away from each other and at least 1 m from staff members and residents. If approached by residents about the purpose of their observations, observers would state the following phrase or something similar:

> We are taking data, kind of like notes, on the interactions residents and staff engage in while in the dorm. We do not record anyone's name to protect your privacy. We know it may be weird, but try to act like your normally act.

Before recording data, the primary data collector ensured there was one staff member and five residents present in the public space. If these criteria were not met, observers did not record data on staff-resident interactions until the criteria were met. Once these criteria were met, the primary observer recorded the number of staff members and the number of students. Both observers would begin recording the staff member and resident behaviors once the primary observer stated "Begin session in 3, 2, 1, NOW." Observers refrained from interaction with residents, staff members, or the other observer at any point during the observation. Observers refrained from laughing, smiling, rolling eyes or other verbal and non-verbal behaviors in response to either staff member or resident behavior. Every 10 min the data collection software would automatically stop. The primary observer would record the number of staff and residents that were currently in the dormitory. Both observers would begin another observation if these criteria were met.

Researchers observed each dormitory a minimum of 10 different days or until observers recorded a minimum of 400 instances of resident disruptive behavior (St Peter et al., 2005).

These criteria were set to allow for a minimum number of data points to fit into the generalized matching analyses and allow for a representative sample of behavior across the dormitories.

Generalized Matching Equation Analyses (Simple Linear Regression)

The researcher portioned the observational data into 10-min blocks for the GME analyses (St. Peter et al., 2005). The GME (Eq. 4) allows for the determination if relative rates of resident appropriate and disruptive behavior approximate the relative rates of attention delivered by staff members. The researcher considered attention contiguous if it occurred within 10 s after the resident behavior (Borrero & Vollmer, 2002) by examining raw .txt files produced by BDataPro. For example, if disruptive behavior occurred 5 s before staff delivered attention, and appropriate behavior occurred immediately before the staff delivery of attention, the researcher would consider both responses reinforced. Figures were also examined to confirm that the relations were linear.

To avoid taking a log of zero, which is undefined, so that all data could be used in the GME analysis, a Goodman-style correction of adding a constant (0.5) was applied to all observations so sessions with zero response rates could still be accommodated (Brown & White, 2005). Following the calculation of resident appropriate and disruptive behavior rates and contiguous attention rates, the data points were plotted and examined, least squares regression line was applied, and bias, sensitivity, and variance accounted were determined from this analysis. Data were analyzed using Microsoft Excel for the GME as described by Reed (2009).

Supplemental Analyses

Additional supplemental statistical analyses were conducted utilizing SPSS version 25.0 and critical values of $p \leq .05$ for significance. A one-way analysis of variance (ANOVA) was conducted to detect if there were any between-group differences existed between the dormitories in the five staff member response topographies, staff member and resident presence at the beginning and end of observations, and resident behaviors. Given the data were analyzed repeatedly, Bonferroni's *post hoc* correction was used to detect significant differences between the dormitories. The Bonferroni correction was applied to ensure that statistical differences reported between dormitories on different response topographies were not a result of chance (Cabin & Mitchell, 2000; Streiner & Norman, 2011).

Results

Generalized Matching Equation Analyses

As depicted in Figure 1, the GME (log ratio of appropriate behavior to disruptive behavior against the log ratio of contiguous attention provided for these behaviors) was applied for Dormitory 01, 02, 03, and 04. Each single data point represents a 10-min observation. The dashed line indicates strict matching as predicted by the GME. The solid line indicates the best-fitting line through the data points and the lines were not extended beyond the data. The linear regression equation is depicted at the top of each panel. For Dormitory 01, 02, and 03 the GME accounted for 72%, 72%, and 39%, respectively, of the variance in the relative rate of responding by relating it to rate of attention delivery following behavior. For Dormitory 04, the GME accounted 85% of the variance in the rate of responding by relating it to the rate of contiguous staff attention delivery. The y-intercepts (the bias term in the GME) in the linear regression models were less than 0.0 for Dormitories 01, 02, and 03, indicating a bias for disruptive behavior. For Dormitory 04, there was a tiny slight bias for appropriate behavior, indicated by a

value greater than 0. The sensitivity parameter (indicated by the slope term) for Dormitories 01 and 02 were values greater than 1.0. This pattern of resident behavior allocation, overmatching, indicates residents engaged in more instances of behavior based on the reinforcers (staff member attention) available or were especially sensitive to the consequential acts produced by the staff. Dormitory 03 resident behavior allocation revealed the lowest sensitivity to reinforcement, as indicated by a slope of 0.79. Dormitory 04 resident behavior allocated demonstrated stricter matching with a slope of 1.06, and a slight bias toward appropriate behavior.

Supplemental Analyses

An analysis of variance (ANOVA) showed that significant, statistical differences across dormitories in general attention delivery, ($F(3, 156) = 32.3$, $p < .0001$), negative attention delivery ($F(3, 156) = 4.5$, $p = .005$), instruction delivery ($F(3, 156) = 6.5$ $p < .0001$), reprimand delivery ($F(3, 156) = 3.4$, $p < .011$), and praise delivery ($F(3, 156) = 9.8$, $p < .0001$). Significant differences were also detected across the dormitories for staff members present at the beginning and end of the observations (respectively, $F(3, 152) = 24.8$, $p < .0001$; ($F(3, 152) = 24.3$, $p < .0001$). Finally, there were significant differences across dormitories in the frequency of resident appropriate and disruptive behavior (respectively, $F(3, 156) = 9.0$, $p < .0001$; ($F(3, 156) = 7.7$, $p < .0001$). Table 2 depicts the number of observations conducted, averages, and standard deviations for variables compared across the four dormitories.

Given the significant omnibus ANOVAs, multiple post-hoc comparisons using the Bonferroni correction were also conducted as indicated in Table 3. General attention delivery from staff members was significantly lower in the Dormitory 01, 02, and 03 when compared to staff members in Dormitory 04. The average rate of negative attention delivery from staff members was significantly higher in the Dormitory 01 when compared to Dormitory 03 and 04.

Staff members' delivery of instructions was significantly higher in the Dormitory 03 and 04 when compared to Dormitory 01 and 02. Dormitory 01 staff members engaged in significantly higher levels of reprimand delivery when compared to staff members in Dormitory 04. Staff members in Dormitory 01, 02, and 03 delivered praise, on average, at significantly lower levels than staff members in Dormitory 04. When observations occurred in Dormitory 04, on average, there were significantly more staff members present at both the beginning and end of observations when compared to the other three dormitories. The average rate of resident appropriate behavior was significantly lower in Dormitory 01 and Dormitory 02 when compared to Dormitory 03. In addition, Dormitory 02 had significant lower rates of resident appropriate behavior when compared to Dormitory 04. Finally, Dormitory 01 had significantly, on average, higher levels of disruptive behavior, when compared to Dormitory 03 and Dormitory 04.

Discussion

Three of the four dormitories (Dormitory 01, 02, and 04) had a great deal of variance accounted for when applying the GME to describe resident behavior allocation and staff member attention delivery. As indicated by the negative bias parameters for each of the linear regressions (y-intercepts), residents had a preference for engaging in disruptive behavior in Dormitories 01, 02, and 03. For Dormitories 01 and 02, residents' relative ratios of behaviors overmatched the relative ratios of staff members' comments. Overmatching, which is relatively uncommon in the experimental and applied literature (Kollins, Critchfield, & Newland, 1997), indicates response distribution more extreme than the reinforcer distribution. When overmatching is observed, experimenters introduced specific independent variables such as response barriers (Aparicio, 2001) or exposure to drugs (Borre, Chandrashekar, Dougan, Heidenreich & Farmer-Dougan, 2007). It is unknown why residents in Dormitory 01 and 02 engaged in overmatching behavior

allocation. Specifically, overmatching response allocation suggests behavior is sensitive to changeover costs (Findley, 1958; MacDonall, 2003), yet this study did not have a COD programmed, common practice in experimental studies using matching analyses. Yet, with this pattern coupled with a bias toward disruptive behavior and staff delivering attention surrounding disruptive behavior it suggests a need for staff training intervention.

Unlike Dormitory 01 and 02, Dormitory 03 residents engaged in an undermatching pattern of behavior allocation. This response allocation pattern is often demonstrated in both human and non-human experiments (Kollins et al., 1997). For example, McDowell & Caron (2010b) found undermatching behavior allocation with male teenagers at-risk for delinquency. Authors note that undermatching may occur to a greater degree if the reinforcers delivered for the two response alternatives are less valued. In the current study, staff members' attention delivery was qualitatively similar following both appropriate and disruptive behavior. Presumably, if staff members can be trained to increase attention delivery, specifically praise delivery (a qualitatively different reinforcer), this may influence how residents allocate their behavior. Though Dormitory 03 resident allocation ratios were primarily positive (indicating higher relative rates of appropriate behavior), staff members did delivery attention following disruptive behavior at times more than surrounding appropriate behavior. These data would suggest that these staff members may benefit from additional training and development to address this skill set.

The GME was a better fit for resident behavior allocation in Dormitory 04. Resident behavior ratios were mostly positive, indicating higher relative rates of appropriate behavior when compared to disruptive behavior. Also, Dormitory 04 staff members almost exclusively attending to appropriate behavior. In fact, the multiple comparisons revealed that these staff

members engaged in higher levels of "therapeutic" interactions (general attention, instructions, and praise) than "non-therapeutic" interactions (negative attention and reprimands) when compared to the other three dormitories. It is unclear if these staff members entered this profession with the skill sets to attend to resident behavior strategically, if the facility prioritized the training and development of these skill sets, or some combination of both. Regardless, for Dormitory 04, it appears that staff member behavior is highly related to how residents allocate responding. It may be a worthwhile endeavor to teach staff members who work in Dormitories 01, 02, and 03 to interact with residents in a similar manner to those staff members working in Dormitory 04.

Training staff members in frequent positive attention delivery may promote higher ratios of resident behavior allocation (higher levels of appropriate behavior compared to resident disruptive behavior). Evidence-based staff training may also indirectly reduce the extent to which residents deviate from strict matching (over or undermatching), especially if staff members deliver higher quality attention. Thus, the purpose of Experiment 2 was to examine the extent to which training would increase staff members from Dormitories 01, 02, and 03 delivery of positive social interactions (praise). Finally, a post-training GME analysis was conducted to identify if the training influenced (a) staff member attention delivery ratios surrounding appropriate resident behavior and disruptive behavior and (b) resident behavior allocation ratios of appropriate behavior to disruptive behavior.

Experiment 2 Methods

Staff Members, Residents, and Setting

Staff members and residents were individuals observed in Experiment 1 from Dormitories 01, 02, and 03. Observers continued to score data in the dormitories as described above.

Response Measurement

As indicated in Experiment 1, observers recorded five topographies of staff member attention delivery and two resident behaviors using BDataPro. IOA was assessed across 37.8%, 49.3%, and 44.2% of observations for Dormitory 01, 02, and 03, respectively. Mean IOA for each of the response topographies are depicted in the Table 4.

Treatment Integrity

Data collectors recorded treatment integrity data across 87.5% (14 of 16) staff trainings. The researcher engaged in 100% of integrity in all the trainings conducted. Treatment integrity data indicates the percentage of components the researcher accurately implemented when instructing staff members. Components included the researcher: (a) describing the purpose of training; (b) outlining the target skill; (c) reviewing steps within the skill; (d) providing a minimum of three examples of targeted skill; (e) recruiting members to vocally contribute; (f) acknowledging members' vocal input; (g) recapping the skill taught; and (h) asking members' for their impressions of the training.

Experimental Design

The researcher evaluated the effects of staff training in increasing the staff members' praise delivery using a nonconcurrent multiple baseline design (Carr, 2005; Coon & Rapp, 2018) across the three target dormitories. However, in this hybrid, nonconcurrent multiple baseline

design, the researcher intervened on the group of staff members' behaviors. That is, each member of the group contributed to the total occurrence of behaviors for the session. The decisions within this design were made based on the total sum of the group's responses of praise delivery. The researchers also delivered the independent variable in a group (rather than individual) format. In sum, the dependent variable, praise delivery, is the totality of events from multiple behaving individuals (for examples, see Brogan et al., 2017; Chinnappan et al., 2019; Jason, Pokorny, Sanem, & Adams, 2006; McDougale et al., 2018).

Procedures

Baseline. During baseline (BL) observations, data collectors followed the observation procedures as detailed in Experiment 1. Data collectors did not provide any instructions or feedback during baseline. In addition, observers avoided reacting to staff member or resident behavior during data collection.

Positive Monitoring (Training One). This training (TR 1) outlined three ways to provide positive interactions to residents in the dormitories while monitoring. The researcher delivered this training to the staff members during scheduled working hours when staff members did not have to monitor residents. The researcher used a Microsoft PowerPoint (see Appendix A), consisting of 13 slides. The training was approximately 20 min in duration, and the trainer discussing how increased staff member supervision can influence the level of disruptive behavior (Atkins et al., 1998; Lewis, Colvin, & Sugai, 2000). Below are brief descriptions of each slide:

1. Stating the title of the training
2. Thanking staff for attendance
3. Outlining the goals of the training
4. Introducing the three steps within "Positive Monitoring"

5. Reviewing behaviors to do and avoid for “Frequently Check in”
6. Reviewing behaviors to do and avoid for “Modeling Respect”
7. Reviewing behaviors to do and avoid for “Encouraging Communication”
8. Recruiting staff members to describe what aspects of staff-resident interaction were or were not occurring based on a picture. For example, when shown a picture of residents alone, the researcher would ask staff members, “Are staff members checking in? Modeling respect? Encouraging communication?”
9. Recruiting staff members to describe what aspects of a staff-resident interaction were or were not occurring for a second example
10. Recruiting staff members to describe what aspects of a staff-resident interaction were or were not occurring for a third example
11. Recapping the three targeted steps within positive monitoring
12. Recruiting staff members to express questions, comments, and concerns with the topics discussed.

This training was conducted with 100% of the staff members that are normally scheduled to work shifts between 12 p.m. -12 a.m. Mondays-Fridays for Dormitory 01 and 02. Due to availability constraints of the second-shift staff members, Dormitory 03 staff members did not participate in TR 1.

Strategic Interaction (Training Two). This training (TR 2) outlined a time-based method to provide positive social interactions to residents in the dormitories in a juvenile detention setting (similar to McDougale et al., 2018) for approximately 40-45 min. The training consisted 16 slides (see Appendix B, “Strategic Interaction”):

1. Stating the title of the training

2. Outlining the goals of the training
3. Introducing an recap of the past training
4. Recapping “Positive Monitoring “
5. Introducing and outlining the four steps to strategic interaction
6. Reviewing and modeling behaviors to do and avoid for “Set Timer”
7. Reviewing and modeling behaviors to do and avoid for “Hide Timer”
8. Reviewing and modeling behaviors to do and avoid for “Continue as usual”
9. Reviewing and modeling behaviors to do and avoid for “Provide interaction.”
10. Indicating to staff members that they will watch a series of 30-s videos demonstrating this strategy and will be asked to state what the staff members did well or could improve when implementing this skill
11. Playing the first, 30-s video which consists of simulated interaction between two residents and a staff member and recruiting staff participation to identify which steps were or were not present in the video (set timer, hide timer, continue as usual, and provide interaction)
12. Playing the second, 30-s video and recruiting staff participation to identify which steps were or were not present in the video
13. Playing the third, 30-s video and recruiting staff participation to identify which steps were or were not present in the video
14. Providing an opportunity for staff members to practice delivering a positive social interaction (praise statement) to the researcher
15. Recapping the three targeted steps within “Strategic Interaction”

16. Recruiting staff members to express questions, comments, and concerns with the topics discussed.

Following the completion of the training, the trainer showed staff members where the timers were located in their dormitory and reminded staff members to use the timers during their next shift. This training was completed with 100% of the staff members in Dormitory 01, 02, and 03.

Offering Options (Training Three). This training (TR 3), approximately 45-50 min in duration, described delivering positive social interactions and choices of leisure items to residents (Brenske, Rudrud, Schulze, & Rapp, 2008; Tasky, Rudrud, Schulze, & Rapp, 2008). The training consisted of 22 slides (see Appendix C, "Offering Options"):

1. Stating the title of the training, "Offering Options"
2. Thanking staff for attendance
3. Outlining goals of the training
4. Introducing a recap of the first skill trained (TR 1)
5. Recapping "Positive Monitoring"
6. Introducing a recap of the second skill (TR 2)
7. Recapping "Strategic Interaction"
8. Introducing new skill "Offering Options" and briefly stating each of the steps
9. Reviewing and modeling behaviors to do for "Gather" and showing the relevant materials to staff members (timer, binder, leisure items)
10. Reviewing and modeling behaviors to do for "Announce," providing at least one opportunity for staff members to vocalize how s/he would communicate the availability of leisure materials to residents

11. Reviewing and modeling behaviors to do for “Check out,” providing an opportunity for staff members to look at the check-out/in binder
12. Reviewing and modeling behaviors to do for “Acknowledge,” providing at least one opportunity for staff members to vocalize how s/he would comment on appropriate behavior
13. Reviewing behaviors to do for “Monitor” and presenting the timer to staff members to touch and set
14. Reminding staff members of behaviors to do and avoid when delivering positive interactions
15. Providing a reminder to staff members to monitor safety when introducing leisure items (i.e., avoiding prolonged periods with staff engagement of materials and encouraging “restless” residents to find an activity)
16. Reviewing and modeling behaviors to do for “Announce,” providing one opportunity for staff member to vocalize how s/he would communicate to residents to clean up leisure materials
17. Reviewing and modeling behaviors to do for “Check in,” again allowing staff to look at check-out/in binder
18. Reviewing and modeling behaviors to do for “Acknowledge,” providing at least one opportunity for staff members to vocalize how s/he would comment on appropriate behavior
19. Providing advance notice to staff members that researcher and research assistant will be modeling each step of “Offering Options”

20. Following the modeling of the procedure by researcher and research assistant, providing a blank sheet of slide 2 to staff members, and instructing staff members to write the eight steps of "Offering Options" within 5 min
21. Reviewing and recapping the eight steps of "Offering Options," allowing one opportunity for staff participation at each step
22. Recruiting staff questions, comments, and concerns with the topics discussed.

The trainer instructed and showed the staff members where the leisure items were located in their dormitory and asked staff members to have different materials available during leisure periods. This training was completed with 100% of the staff members. Following the completion of each training, observations continued as scheduled and as indicated by baseline observation procedures. Questions or comments from staff members regarding the implementation of the skills described in the trainings were directed to the researcher.

Visual Inspection and Dual-Criteria Method

The researcher employed visual inspection as one method for analyzing the data collected on staff members' delivery of praise (Kazdin, 2011). Changes in means across the phases were analyzed to identify the extent to which the average frequency of staff member praise delivery was altered following the staff trainings. Changes in level refer to refer to the extent to which staff and resident behavior either shifted up or down. Trend refers to the extent in which the slope of the staff's and resident's graphed data increased or decreased across time when compared to the previous phase.

Given that one dormitory did not yield increases in staff members' delivery of praise, the researcher also employed the dual-criteria method to supplement visual inspection (Fisher, Kelley, & Lomas, 2003; Lanovaz, Huxley, & Dufour, 2017). The dual-criteria method involved

creating two lines when visually inspecting the data: (a) a mean line and (b) trend line. Both lines from the first phase were extended into the subsequent phases. From here, the researcher counted the number of data points that fell above both lines in the training phases. Finally, the number of data points were compared to a cut-off value based on a binomial distribution (see Fisher et al., 2003). To report a statistically significant outcome ($p < .05$), the researcher identified the length of the treatment phase and the number of data points above both the mean line and regression line from baseline.

Generalized Matching Equation Analysis (Simple Linear Regression)

As described in Experiment 1, the researcher applied the GME in the same manner. Microsoft Excel was used to calculate the base 10 logarithms of resident behavior ratios and contiguous attention ratios for observations following the training three after one and two weeks.

Supplemental Descriptive Analyses

Rates of staff member response topographies for each observation were also converted into a percentage. For example, if an observation had 10 instances of general attention delivery, 3 instances of negative attention delivery, 1 instruction delivery, 6 reprimand delivery, and 0 praise delivery, the total amount of attention delivery for that observations would be 20 instances. The percent of staff member allocation to the different types of attention delivery would be 50%, 15%, 5%, 30%, and 0%, respectively. Percentages from each session were then averaged across each phase of the Experiment 1 and 2 for targeted dormitories (Dormitory 01, 02, and 03) and the comparison dormitory, Dormitory 04, from Experiment 1. These data depict how staff members shifted their response allocation to different topographies of attention over the course of the study. Visual comparisons can be made between the staff members who participated in the

trainings (01, 02, and 03) when compared to Dormitory 04 staff members' allocation to response topographies of attention.

Results

Visual Inspection and Dual-Criteria Method

Figure 2 displays the rate (responses per minute, rpm) in which staff members engaged in praise delivery during 10-min observations in Dormitory 01 (top panel), Dormitory 02 (middle panel), and Dormitory 03 (bottom panel) following baseline and the three staff trainings: TR 1, TR 2, and TR 3. During baseline, staff members in Dormitory 01 engaged in *zero levels* of praise delivery. Levels of positive social interaction did not increase following TR 1. Levels of praise delivery increased following TR 2 (M = 0.04 rpm) and TR 3 (M = 0.01 rpm). Given the trainings' effect for Dormitory 01, the dual-criteria method was employed to supplement visual inspection (Fisher et al., 2003; Lanovaz et al., 2017). Results from the dual-criteria method indicate the training's influence on staff members increased levels of praise statements is likely significant ($p < .05$) in that 14 data points fell above both the mean and regression lines. These lines are not depicted in Figure 2, a common practice in the use of this method (for a recent example see McDougale et al., 2018).

In Dormitory 02, during baseline, staff members engaged in low levels of praise (M = 0.01 rpm, range = 0.0-0.1 rpm) Following TR 1, levels of praise initially occurred at a higher level for an observation when compared to baseline. As observations continued, praise delivery from staff members decreased to zero levels. After TR 2, staff members continued to engaged in low levels of praise delivery (M = 0.01 rpm). After TR 3, staff members engaged in low levels of praise delivery.

In Dormitory 03, during baseline, staff members' engaged in low levels of praise delivery

(M = 0.01 rpm). Following TR 2, staff members engaged in slightly increased levels of praise delivery when compared to baseline. After TR 3, staff members engaged in marginally higher levels of praise delivery of (M = 0.05 rpm) when compared to the prior phase. Given the trainings' effect for Dormitory 03, the dual-criteria method was once again employed to supplement visual inspection. Results from the dual-criteria method indicate the trainings influence on Dormitory 03 staff members increased levels of praise statements is likely significant ($p < .05$) in that 16 data points fell above both the mean and regression lines.

Generalized Matching Equation Analyses (Simple Linear Regression)

As depicted in Figure 3, the GME (log ratio of resident appropriate behavior to disruptive behavior against the log ratio of contiguous attention provided for these behaviors) was applied for each of targeted dormitories one and two weeks following TR 3. Each single data point represents a 10-min observation. The dashed line indicates strict matching. The solid line indicates the best-fitting line through the data points. Data points were fitted using simple linear regression, as described by Reed (2009), and the regression is depicted at the top of each panel. Following the three staff trainings for Dormitory 01, the GME accounted for 1% of the variance, bias = -0.31, and sensitivity = 0.21. For Dormitory 02, the GME accounted for 47% of the variance, bias = -0.18, and sensitivity = 1.40. Following the staff trainings for Dormitory 03, the GME accounted for 53% of the variance, bias = -0.18, and sensitivity = 1.30. As indicated in Table 5, decreases in variance were seen for Dormitory 01

As indicated in Table 5, Dormitory 01 residents engaged in similar levels of bias following staff training, yet sensitivity to reinforcement decreased from 1.55 pre-staff training to 0.21 following the training. Given this decrease in sensitivity, the GME accounted for far less variance following the training for Dormitory 01. In Dormitory 02, levels of bias were similar

prior to and following the staff training. In addition, residents' sensitivity to reinforcement was consistent (1.37 and 1.40, pre-and post-training, respectively). The GME accounted for less variance following staff training in Dormitory 02. In Dormitory 03, there was a notable change in bias following staff training (from -0.05 to -0.18), sensitivity (0.79 to 1.30), and variance accounted for (38% to 53%).

Data from both Experiments 1 and 2 are also depicted in Figure 4 to visually inspect the effect staff training had on resident behavior allocation pre-and post-training (top and bottom panels, respectively). Data points in the upper left quadrant are indicated by a grey color, upper right quadrant data points are indicated by an orange color, lower right quadrant data points are indicated by a blue color, and lower left quadrant data points are indicated by a yellow color. Purple data points indicate observations in which relative rates of staff member attention delivery corresponded to resident behavior allocation (points through the origin, 0,0).

For Dormitory 01, we saw less extreme resident behavior allocation following the training, indicated by less negative values in the yellow quadrant. However, there was a decrease in the number of observations in which resident behavior allocation favored appropriate behavior, indicated by orange). For Dormitory 02, post-staff training, there were increases in the number of observations in the orange quadrant, indicating a behavior pattern in which residents engaged in more appropriate behavior relative to disruptive behavior. In addition, there were fewer data points in the yellow quadrant post-staff training, indicating less observations in which the relative rate of disruptive behavior exceeding appropriate behavior. For Dormitory 03, most observations pre-and post-staff training revealed patterns of resident behavior allocation in which relative rates of appropriate behavior exceeded relative rates of disruptive behavior. However, post-staff training, there were more observations in which in which the relative rate of resident

disruptive behavior exceeded appropriate behavior in Dormitory 03.

Supplemental Descriptive Analyses

As shown in Figure 5, across all dormitories and all phases, the average percent of attention delivery during observations was primarily general attention delivery (unclassified attention) over other response topographies. For Dormitories 01, 02, and 03, the average percent allocation of general attention delivery increased over the course of Experiment 2. In regards to the average percent of attention delivery that was negative attention, baseline was associated with the highest levels when compared to the other phases of the Experiment 2. Notably, the average percent of attention that was instruction delivery was the highest in baseline for Dormitory 02 and 03 when compared to the other phases of Experiment 2. Dormitory 04 staff members engaged in higher levels of average percent allocation of instructions when compared to other dormitories targeted for staff training. In regards to average percent of praise delivery, this accounted for a smallest percentage of attention delivery from staff members across all dormitories. Praise delivery slightly increased for two of the three dormitories' staff members over the course of Experiment 2.

Discussion

The staff training packages exerted a slight effect on staff member praise delivery. Though past research has shown the direct and indirect effects of a similar staff training intervention (McDougale et al., 2018), this outcome was not replicated in this experiment. Of note, McDougale et al. intervened in a dormitory with staff members and residents with similar profiles and histories as those individuals from Dormitory 04 from Experiment 1. Further investigation is warranted to identify if resident behavior allocation can be more permanently shifted by means of altering change agent (staff member) behavior with staff members with

presumably different training histories and less experience in juvenile residential settings.

In this experiment, the GME described a sizable portion of the variance when describing resident allocation of appropriate and disruptive behavior for Dormitories 02 and 03. The bias parameters across the three dormitories continued to be less than 0, indicating a resident bias toward disruptive behavior. Notably, the sensitivity parameters were much smaller for Dormitory 01, similar for Dormitory 02, and much higher for Dormitory 03. Also, these data suggest the staff training exerted a minimal indirect effect on resident behavior allocation. Of note, Dormitory 01 had fewer observations with extreme resident allocation to disruptive behavior post-staff training, yet there were less sessions with resident allocation with higher relative rates of appropriate behavior post-training.

These data suggest two avenues for future research. First, interventions for this population and setting may benefit from intensive staff instructional methods. This may include highly structured, one-to-one instructional modalities; multiple opportunities to rehearse taught skills; and in-situ trainer modeling and delivery individualized positive and corrective feedback. Second, interventions targeted for residents such as self-control instruction or teaching procedures for appropriate communication may be more apt approaches to changing interactions with their staff members. Future investigations may evaluate the extent to which top-bottom approaches (staff training) or bottom-top interventions (resident programming) alter interactions as quantified by the GME.

Overall Discussion

In Experiment 1, the GME accounted for a great deal of the variance for three of the four dormitories' resident behavior allocation as a function of staff member attention delivery in a juvenile residential setting. Bias parameters were less than 0 for three of the four dormitories,

indicating preference for disruptive behavior. Of note, Dormitory 04 residents' behavior allocation suggested more sensitivity to relative rates of reinforcement when compared to the other dormitories. When targeted dormitories (01, 02, and 03) were compared to a comparison dormitory (04) prior to training, salient differences in staff attention response topographies were also detected. Prior to training, Dormitory 01, 02, and 03 staff members engaged in lower levels of general attention delivery and praise delivery when compared to Dormitory 04 staff members. Using a nonconcurrent multiple baseline design across dormitories in Experiment 2, group-delivered staff trainings had a marginal effect in increasing the staff members' level of praise delivery for two of the three dormitories. Other auxiliary response topographies for staff members and residents were not influenced by the staff training. When the GME was applied after staff training, it accounted for less variance for Dormitory 01 and 02 and more variance for Dormitory 03. For two of the three dormitories, sensitivity parameters remained over 1.0.

The current study extends behavior-analytic research and understanding of adjudicated residents and staff members interactions in these settings. First, group behavior (residents and staff members) was adequately described by the GME. Similar to past investigations in which the GME was used to characterize team behavior (Alferink et al., 2009) and problem behavior (Borrero & Vollmer, 200; St. Peter et al., 2005), the present study applied this analysis to a diverse population in an applied setting with groups of behaving individuals. This study demonstrates the robust nature of this quantitative model of choice-making behavior. The GME described staff member-resident interactions in an imperfect environment and was an analytical tool to identify how training staff members may influence resident behavior allocation. Through the use of the GME, staff training exerted very little influence in how staff members delivered attention surrounding resident and appropriate behavior. Yet, it appeared there was *slight*

resident behavior allocation differences (less occurrences of disruptive behavior) following the staff training for at least one dormitory.

The present study is also consistent with the extant literature in the use of single-case experimental designs to evaluate the extent to which interventions can influence "group" behavior, that is the behavior of a collective unit of individuals (Brogan et al., 2017; Chinnappan et al., 2019; McDougale et al., 2018). Increasingly, practitioners in behavior analysis are being asked to serve diverse populations in settings with low staff-to-client ratios. Given that the majority of behavior-analytic research examines individualized interventions for young children with disabilities and their change agents, there are practice gaps for behavioral strategies for multiple individuals engaging in disruptive behavior or when training large numbers of staff members. The present study demonstrates one way to fulfill this research-to-practice need by conducting investigations in novel settings using hybrid approaches, combining both single case experimental design and group comparisons.

The current study warrants discussion of several limitations. First, it is unclear why the GME accounted for similar levels of variance for both Dormitory 01 and 02 pre-staff training and the variance decreased post-staff training, while the opposite pattern occurred in Dormitory 03. Due to the assumption that staff attention delivery was presumed reinforcer for resident appropriate and disruptive behavior, it is possible spurious matching relationships occurred (St. Peter et al., 2005). Without an experimental functional analyses confirming attention as a social, positive reinforcer for appropriate behavior and disruptive behavior (Borrero & Vollmer, 2002), it is possible the data collected in either or both experiments represent a relationship that does not exist. Nevertheless, a fundamental aim of these current experiments was to evaluate the behavior of a collective unit of residents, *not one* individual resident. Notably, there is an interactive

nature between staff member and resident behavior which makes it difficult to ascertain causation and piece apart the potential reinforcing consequences for either staff members and residents. Presumably, resident behavior drives staff member attention delivery, which may further influence resident behavior. The current intervention sought to intervene on this interaction. Specifically, staff members were trained to deliver more frequent positive social interactions in an attempt to increase the relative rates of attention following appropriate behavior. Though the effects of the training were slight, it does suggest the need for further research in which both change agent (staff) and client (resident) behaviors are simultaneously measured following a training intervention.

Second, a number of variables may account for the differences seen between the targeted dormitories (01, 02, and 03) and Dormitory 04. Staff members in Dormitory 04 had longer work histories in the juvenile residential facility and likely were exposed to more professional development. The dormitory supervisor also had past, regular contact with a clinical psychologist with expertise in the assessment and treatment of adjudicated adolescents (Burkhart, Behles, & Stumphuazer, 1976; Everhart Newman, Falligant, Thompson, Gomez, & Burkhart, 2018). Furthermore, staff members in this dormitory participated and endorsed the practices from the Children and Residential Experiences program (CARE; Holden, 2009). In this approach, staff members are encouraged to engage with the residents as they would a family member, attempting to have every interaction with the adolescent as a positive experience. These themes are similar to what the current study's training packages sought to train staff members in Dormitory 01, 02, and 03. Anecdotally, the Dormitory 04 leadership endorsed the CARE strategies and provided the appropriate monitoring, supervision, and feedback to their staff members to ensure it was consisntely implemented. This type of supervisory support of the

present study's trainings and strategies was not witnessed in Experiment 2 in Dormitories 01, 02, and 03. Thus, the impact of the training intervention may have been limited given that staff member positive social interaction was not acknowledged by their direct supervisors, a key aspect to any training intervention (Ward-Horner & Sturmey, 2012). Even so, Dormitory 04 allowed for a comparison, which was under the same administrative leadership and on the same campus, in how a rehabilitative environment for adjudicated adolescents may be arranged. It is possible that environmental factors such as staff training may be crucial in achieving resident behavior allocation that closely matches staff members attention delivery. This pattern strict matching may suggest that this environment is more "therapeutic" for adjudicated adolescents residing in a juvenile setting.

Third, it is unknown why resident behavior allocation revealed different patterns of matching across the dormitories. Specifically, Dormitory 01 and 02 pre-training and Dormitory 02 and Dormitory 03 post-training revealed residents' were overmatching. Overmatching behavior allocation occurs when there is disproportional relative rate of responding, often in favor of the richer schedule. Though undermatching are more prevalent, past investigations have shown when there is a "cost" to switching from one response alternative to another (Aparicio, 2001), overmatching is likely. It is unknown what the potential "cost" is for these residents in these dormitories. As suggested by McDowell and Caron (2010b), it is likely there are different histories of reinforcement and punishment from either change agents or peers that may be associated with resident behaviors. For example, the GME may have better fit the data if peer attention delivery was delivered. Presumably, the potentially positive reinforcing events between residents for engaging in disruptive behavior (peer approval) or social disapproval (teasing, bullying, mocking) for engaging in appropriate behavior may explain the deviations from

matching. Of note, a strict matching behavior allocation pattern was seen from residents in Dormitory 04. Future investigations should identify the extent to which interventions targeted to alter the interactions between staff members and residents are influenced by peers who may deliver more potent reinforcer.

Finally, the effect of an antecedent-based, group staff training had marginal visual and statistical effects (Fisher et al., 2003; Lanovaz et al., 2017; Lanovaz, Turgeon, Cardinal, & Wheatley, 2019) on staff members' delivery of praise for two of the three dormitories. Due to the constraints of this particular setting (the inability to conduct highly individualized training and data collection), it is noteworthy this training modality demonstrated *any* effect on staff members' delivery of praise statements. Despite the presence of clear functional relation through visual inspection for all three dormitories, the study may serve as rationale for the use of evidence-based training strategies (BST) within juvenile justice settings. Often these administrators in these settings adopt didactic training modalities with less emphasis on experiential approaches (Lott, 2018).

Future researchers should continue to use quantitative models of behaviors when describing and evaluating interventions with clinical populations. For example, the ideal free distribution is a quantitative model of group behavior commonly used in ecology to describe how nonhumans distribute amongst locations for resources (Charnov, 1976). The ideal free distribution may be particularly insightful when describing how groups of residents allocate or distribute amongst available reinforcers in settings such as juvenile detention centers, group homes, and in-patient psychiatric hospitals. In addition, the ideal free distribution could be used as an evaluative tool in identifying if training staff members to deliver frequent positive social interactions would influence the duration in which residents interact with staff members.

Behavior-analytic researchers consistently study interventions with small sample sizes. In settings where there are financial barriers to hiring consultants or low staff member-to-client ratios, institutions may opt to adopt less effective training modalities to limit costs. This leaves already under resourced and vulnerable groups at a great disadvantage without access to effective behavioral interventions (Traub, Joslyn, Kronfli, Peters, & Vollmer, 2017). For example, youth in foster care may be placed in residential treatment centers and may engage in problem behavior that deters placement in a therapeutic, foster-care home environment (Crosland & Dunlap, 2015). Staff members in these settings may not be equipped to respond to these disruptive behaviors with evidence-based procedures and may resort to restraint or seclusion (Reynolds et al., 2018). It is of upmost importance that further investigations adapt individualized training approaches to avoid the potential use of restrictive procedures with populations with externalizing behaviors and diagnoses. For example, recent investigations have evaluated a variety of staff instructional strategies such as self-instructional packages (Luna et al., 2019; Weldy et al., 2014), e-learning (Geiger, LeBlanc, Hubik, Jenkins, & Carr, 2018), or virtual training. These modalities could potentially lower cost, increase accessibility, and allow for opportunities for staff members to practice targeted skills in a simulated, risk-free environment.

Concluding Remarks

Researchers in applied behavior analysis investigate socially significant human behavior (Baer, Wolf, & Risley, 1968) in one participant or a cluster of participants (Smith, 2012), repeatedly measure the target behaviors without the intervention, apply an intervention, and establish experimental control of the target behavior with the use of single-case experimental design (Cooper, Heron, & Heward, 2007; Horner et al., 2005; Kazdin, 2011). These designs offer

a within-subject method of determining the presence of a functional relation between target behaviors and intervention application (Kazdin, 2011; Smith 2012). With this methodology, behavior-analytic researchers have addressed a wide array of societal problems including early behavioral intervention for children with developmental disorders (Eldevik et al., 2009; Lovaas, 1987; Perry, Koudys, & Prichard, 2019), training and educational practices (Maffei-Almodovar & Sturmey, 2018; Saville, Zinn, Neef, Norman, & Ferreri, 2006), and assessment and treatment of problem behavior (Beavers, Iwata, & Lerman, 2013; Chezan, Wolfe, & Drasgow, 2018; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994)

Despite being successful in treating conditions with individuals with intellectual and developmental disabilities, over 30 years ago, B.F. Skinner asked, "why [scientists of behavior] were not acting to save the *world*?" (Skinner, 1987; italics added by author for emphasis). This refrain has been reiterated throughout the decades (Chance, 2007; Dixon, Belisle, Rehfeldt, & Root, 2018) and questions remain why society fails to embrace behavior-analytic knowledge and apply behavioral principles on a large scale. To remedy the perceived focus of ABA, it is imperative behavior-analytic researchers disseminate their *science,* which is often mistaken as a *treatment,* in the assessment and treatment of behaviors with novel methods, settings, and populations. Presumably, if behavior-analytic researchers expand their scope to diverse populations and new methodological approaches, they may be more widely embraced by other scientific communities and hopefully, society at large.

Table 1

Mean Interobserver Agreement Percentages for Staff Member and Resident Behaviors for Experiment 1

	Staff Member Behaviors					Resident Behaviors	
	General Attention Delivery	Negative Attention Delivery	Instruction Delivery	Reprimand Delivery	Praise Delivery	Appropriate Behavior	Disruptive Behavior
Dorm 01	96.2%	98.9%	98.0%	98.2%	100.0%	97.4%	90.8%
Dorm 02	95.0%	99.2%	97.4%	99.9%	99.8%	97.4%	94.5%
Dorm 03	92.1%	99.6%	96.1%	97.6%	99.8%	94.6%	94.4%
Dorm 04	91.0%	100.0%	97.8%	99.7%	99.2%	98.6%	99.9%

Table 2

Descriptive Statistics of Staff Member and Resident Behaviors across Dormitories

	Dormitory	*n* (observations)	*M* (responses per min)	*SD*	*P* value*
General	1	28	0.49	0.40	< .0001
Attention Delivery	2	30	0.32	0.30	
	3	51	0.42	0.34	
	4	51	1.26	0.74	
Negative	1	28	0.06	0.10	.005
Attention Delivery	2	30	0.08	0.16	
	3	51	0.02	0.12	
	4	51	0.00	0.00	
Instruction	1	28	0.08	0.14	<.0001
Delivery	2	30	0.16	0.22	
	3	51	0.27	0.30	
	4	51	0.33	0.28	
Reprimand	1	28	0.19	0.45	.011
Delivery	2	30	0.10	0.17	
	3	51	0.10	0.13	
	4	51	0.02	0.05	
Praise	1	28	0.00	0.00	<.0001
Delivery	2	30	0.01	0.03	
	3	51	0.01	0.03	
	4	51	0.07	0.12	
Resident	1	28	0.18	0.14	<.0001
Appropriate Behavior	2	30	0.11	0.14	
	3	51	0.38	0.30	
	4	51	0.27	0.28	
Resident	1	28	2.78	4.65	<.0001
Disruptive Behavior	2	30	1.53	4.37	

	3	51	0.29	0.36	
	4	51	0.02	0.05	
Staff	1	28	1.68	0.61	<.0001
Start	2	30	1.93	1.34	
	3	47	2.23	0.63	
	4	51	3.29	0.99	
Staff	1	28	1.64	0.91	<.0001
End	2	30	1.57	1.55	
	3	47	2.13	0.61	
	4	51	3.25	1.00	
Resident	1	28	11.36	3.02	*ns*
Start	2	30	11.77	3.28	
	3	47	12.30	1.89	
	4	51	9.55	2.21	
Resident	1	28	10.68	3.32	*ns*
End	2	30	11.53	3.44	
	3	46	12.54	1.50	
	4	51	9.39	2.60	

Note. *p-value showing the main effect of dorm, *ns* = not significant

Table 3

Multiple Comparisons across Dormitories using Bonferroni post hoc analyses

Variable		GEN			NEG			INST			REP			PRA			APP			DIS			ST ST			ST EN			RES ST			RES EN		
	Dorm	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
GEN	1	*ns*	*ns*	**																														
	2		*	**																														
	3			**																														
NEG	1				*ns*	*	*																											
	2					*ns*	*ns*																											
	3						*ns*																											
INS	1							*ns*	**	**																								
	2								**	**																								
	3									*ns*																								
REP	1										*ns*	*ns*	*																					
	2											*ns*	*ns*																					
	3												*ns*																					
PRA	1													*ns*	*ns*	**																		
	2														*ns*	*																		
	3															*																		
RES APP	1																*ns*	*	*ns*															
	2																	**	*															
	3																		*ns*															
RES DIS	1																			*ns*	*	*												
	2																				*ns*	*ns*												
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STAF ST	1																						*ns*	*ns*	**									
	2																							*ns*	**									
	3																								**									
STAF EN	1																									*ns*	*ns*	**						
	2																										*ns*	**						
	3																											**						
RES ST	1																												*ns*	*ns*	*			
	2																													*ns*	*			
	3																														**			
RES EN	1																															*ns*	*ns*	*ns*
	2																																*ns*	*ns*
	3																																	**

Note. GEN = general attention delivery, NEG = negative attention delivery, REP = reprimand delivery INS = instruction delivery, PRA = praise, APP = resident appropriate behavior, DIS = resident disruptive behavior ST ST = number of staff members present at start of observation, ST EN = number of staff members present at end of observation, RES ST = number of residents present at start of observation, RES EN = number of residents present at end of observation
ns = not significant
**p* < .05. ***p*< .001

Table 4

Mean Interobserver Agreement for Staff Member and Resident Behaviors for Experiment 2

	Staff Member Behaviors					Resident Behavior	
	General Attention Delivery	Negative Attention Delivery	Instruction Delivery	Reprimand Delivery	Praise Delivery	Appropriate Behavior	Disruptive Behavior
Dorm 01	93.8%	99.5%	99.1%	99.1%	99.7%	97.5%	91.4%
Dorm 02	93.3%	99.6%	98.9%	98.9%	99.8%	97.2%	93.5%
Dorm 03	89.0%	99.4%	96.8%	96.8%	99.6%	94.5%	93.3%

Table 5

Generalized Matching Equation Parameters Pre-and Post-Training across Dormitories

Parameters	Pre-Staff Training			Post-Staff Training		
	Dorm 01	Dorm 02	Dorm 03	Dorm 01	Dorm 02	Dorm 03
Bias	-0.24	-0.16	-0.05	-0.31	-0.18	-0.18
Sensitivity	1.55	1.37	0.79	0.21	1.40	1.30
R-squared	0.73	0.72	0.38	0.01	0.47	0.53

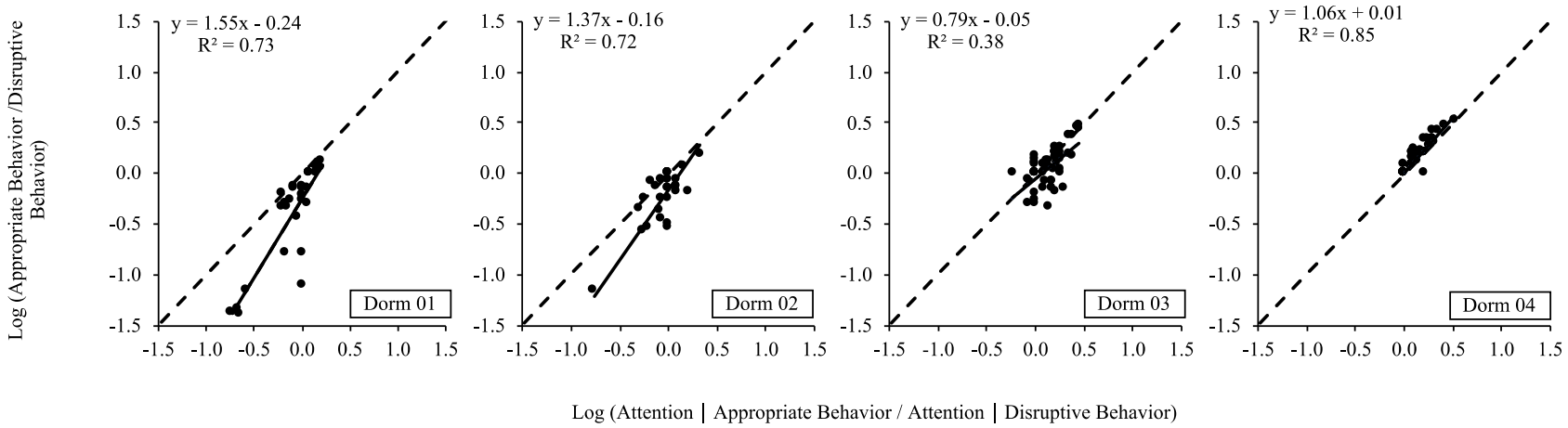


Figure 1. Results using the generalized matching equation (Eq. 4) for Dormitory 01, 02, 03, and 04 for Experiment 1. The y-axis captures the relative rate of responding of residents engaging in appropriate behavior and disruptive behavior, whereas the x-axis depicts the relative reinforcement rate of attention delivered by staff members following appropriate behavior and disruptive behavior. Each data point represents one, 10-min observation block. Dashed lines in each panel indicate strict matching as predicted by the generalized matching equation. The solid line represents the best fit line through the predicted data points. The linear equation in the upper left corner of each panel depicts the parameters of sensitivity (slope), bias (y-intercept), and variance accounted for (R^2).

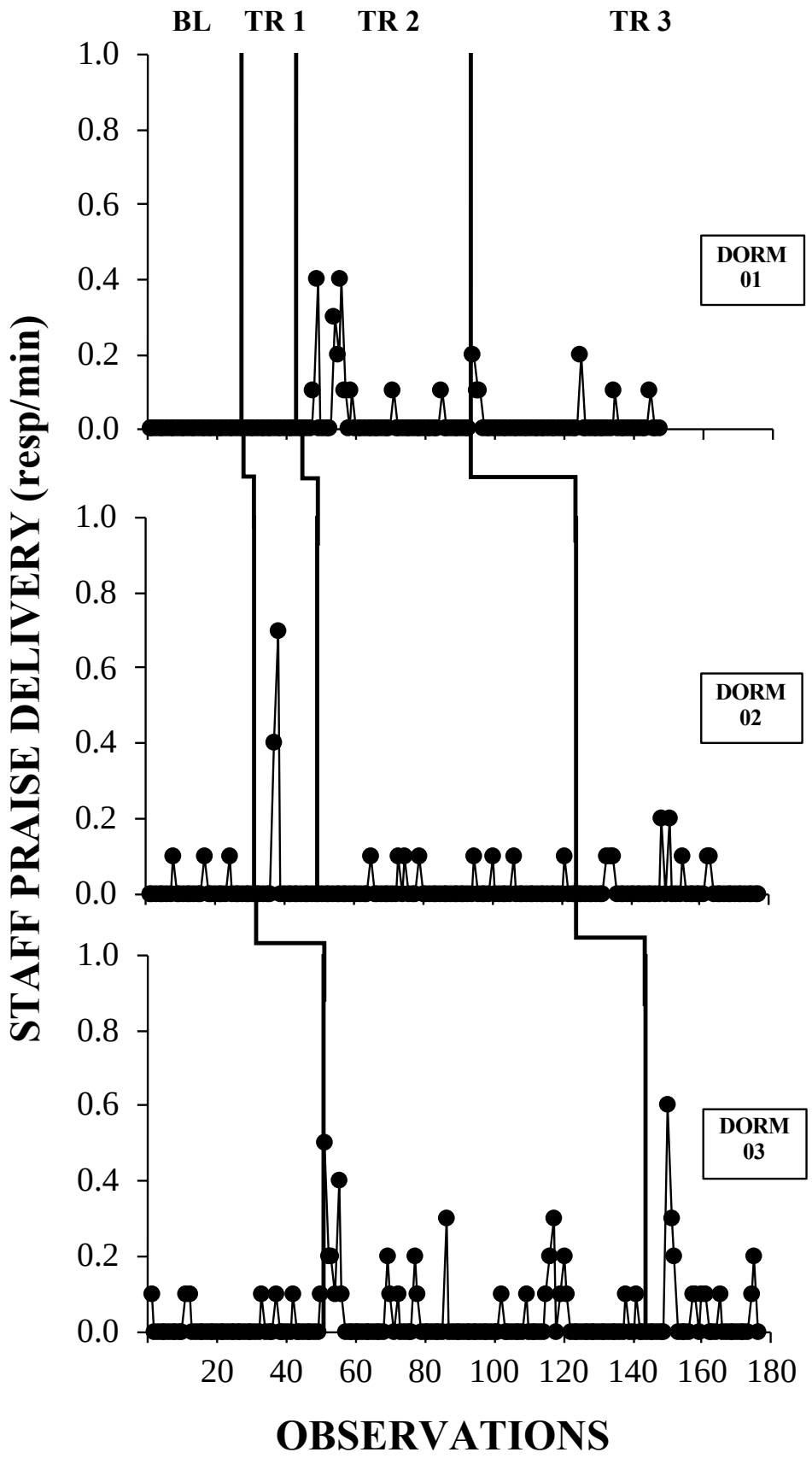

BL
TR 1
TR 2
TR 3
1.0
0.8
0.6
0.4
0.2
0.0
DORM 01
DORM 02
DORM 03
STAFF PRAISE DELIVERY (resp/min)
20
40
60
80
100
120
140
160
180
OBSERVATIONS

Figure 2. Rate (responses per minute) of staff member's delivery of praise across 10-min observations during baseline (BL), positive monitoring (TR 1), strategic interaction (TR 2), and offering options (TR 3) phases for Dormitory 01, 02, and 03.

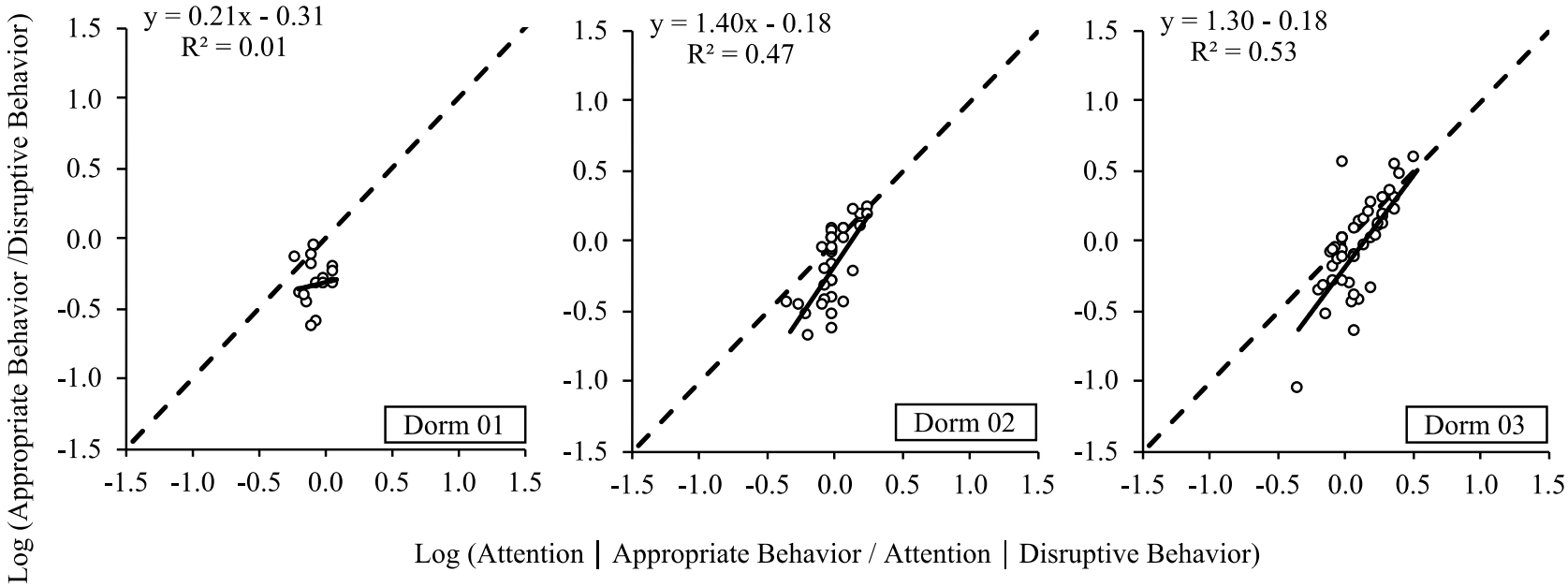


Figure 3. Results using the generalized matching equation (Eq. 4) for Dormitory 01, 02, and 03 for Experiment 2 post-staff training for the observations post-training three after one and two weeks. The y-axis captures the relative rate of responding of residents engaging in appropriate behavior and disruptive behavior, whereas the x-axis depicts the relative reinforcement rate of attention delivered by staff members following appropriate behavior and disruptive behavior. Each data point represents one, 10-min observation block. Dashed lines in each panel indicate perfect matching as predicted by the generalized matching equation. The solid line represents the best fit line through the predicted data points. The linear equation in the upper left corner of each panel depicts the parameters of sensitivity (slope), bias (y-intercept), and variance accounted for (R^2).

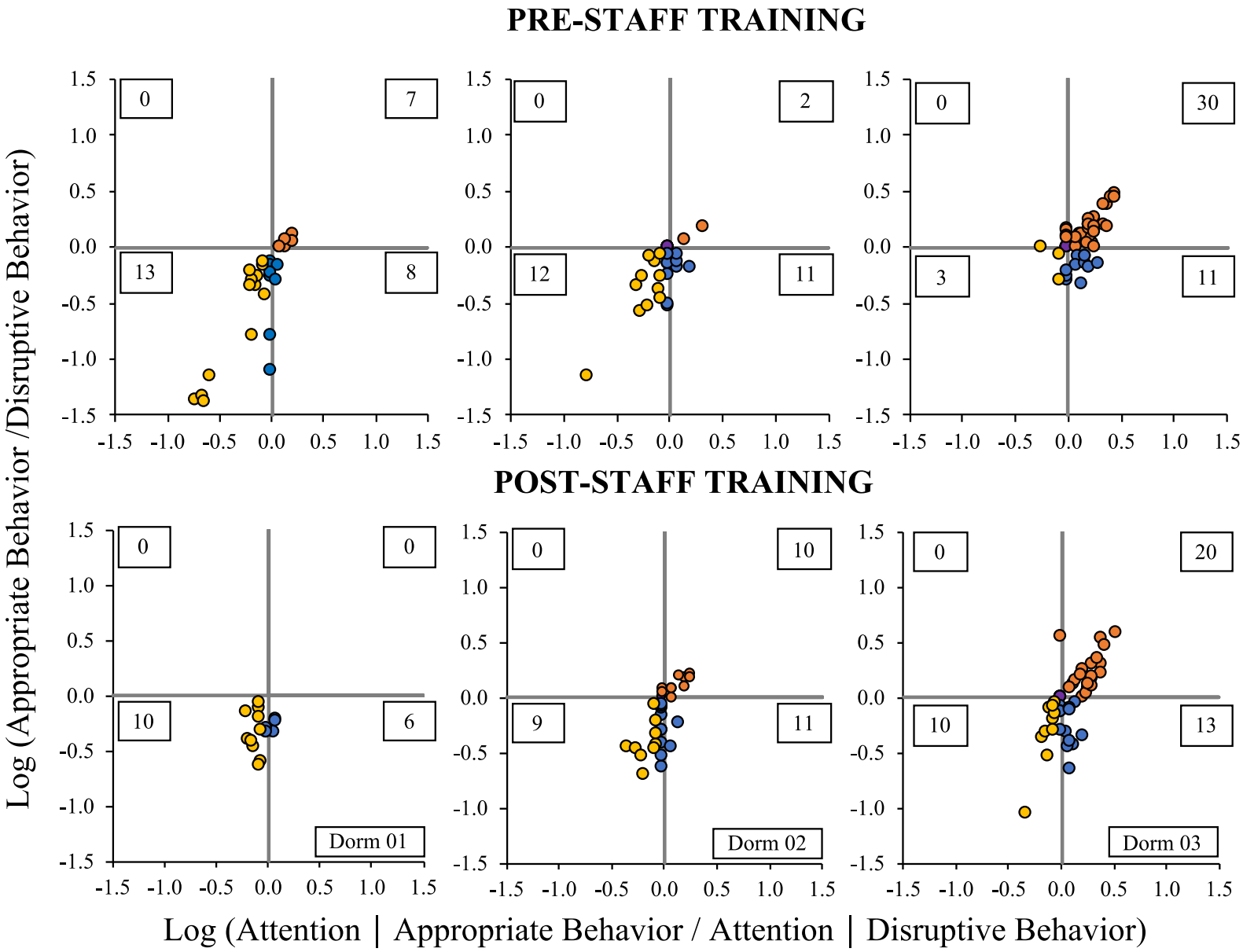

PRE-STAFF TRAINING
POST-STAFF TRAINING
Log (Appropriate Behavior /Disruptive Behavior)
Log (Attention | Appropriate Behavior / Attention | Disruptive Behavior)
0
7
13
8
0
2
12
11
0
30
3
11
0
0
10
6
Dorm 01
0
10
9
11
Dorm 02
0
20
10
13
Dorm 03
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5

Figure 4. Results using the generalized matching equation (Eq. 4) for Dormitory 01, 02, and 03 pre-and post-staff training for the observations (top and bottom panels respectively). The y-axis captures the relative rate of responding of residents engaging in appropriate behavior and disruptive behavior, whereas the x-axis depicts the relative reinforcement rate of attention delivered by staff members following appropriate behavior and disruptive behavior. Each data point represents one, 10-min observation block. Each figure is divided into four quadrants, and data points are coded for each quadrant for ease of interpretation. The box with an integer in each quadrant indicates the number of data points in that respective quadrant.

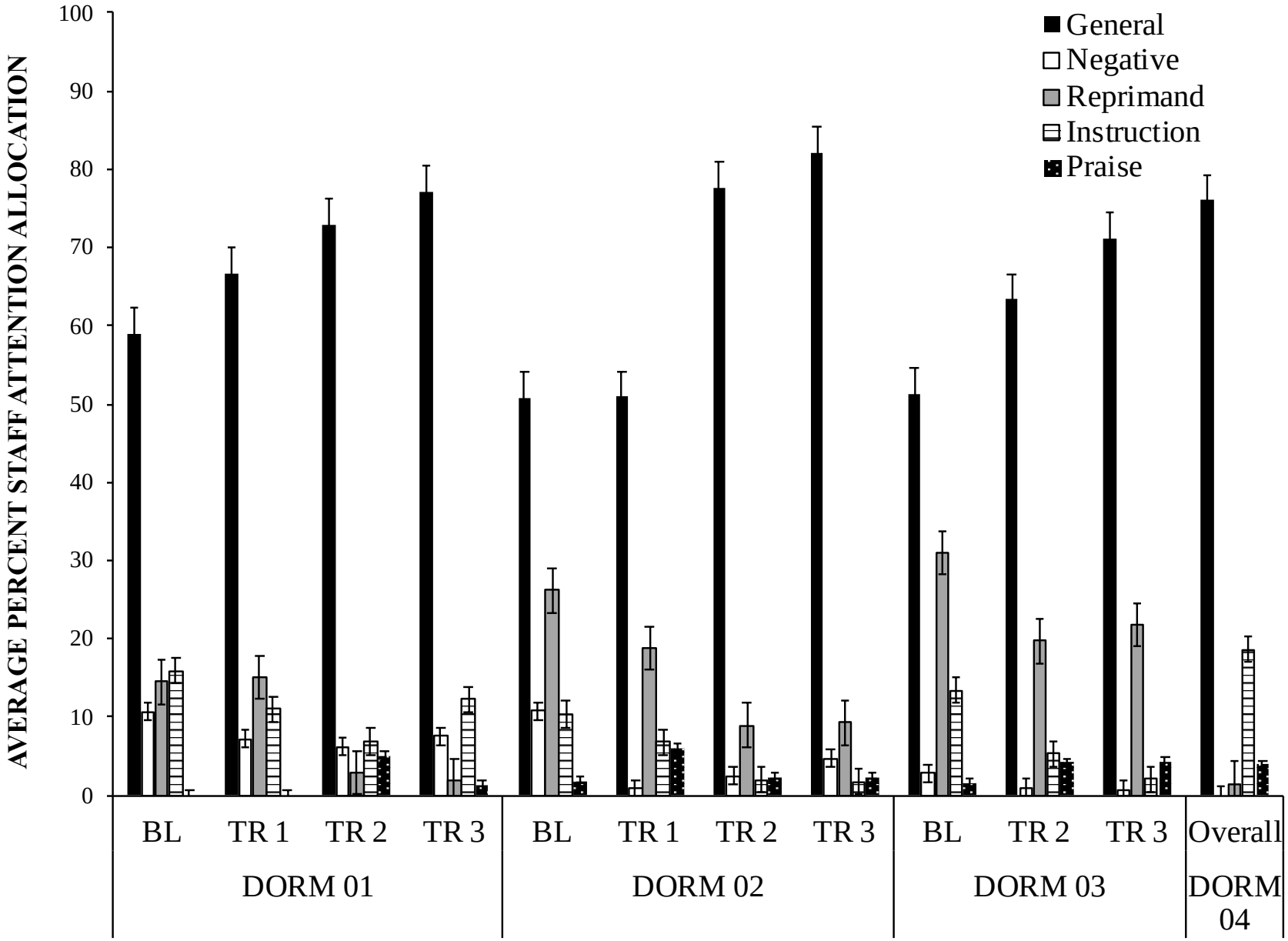
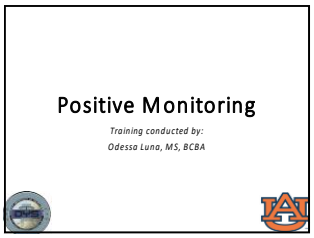
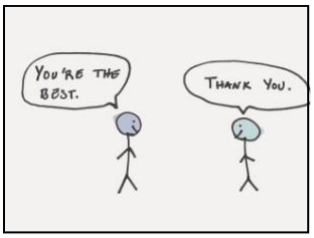

AVERAGE PERCENT STAFF ATTENTION ALLOCATION
100
90
80
70
60
50
40
30
20
10
0
General
Negative
Reprimand
Instruction
Praise
BL
TR 1
TR 2
TR 3
BL
TR 1
TR 2
TR 3
BL
TR 2
TR 3
Overall
DORM 01
DORM 02
DORM 03
DORM 04

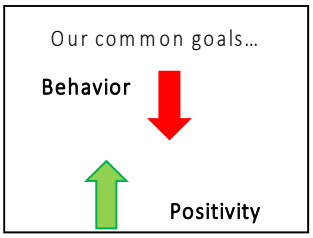
Figure 5. Average percent of staff allocation of five response topographies (general attention delivery, negative attention delivery, instruction delivery, reprimand delivery, and praise delivery) for Dormitory 01, 02, 03, and 04 across baseline (BL), positive monitoring training (TR 1), strategic interaction training (TR 2), and offering options training (TR 3) during Experiment 2 and Dormitory 04 during Experiment 1.

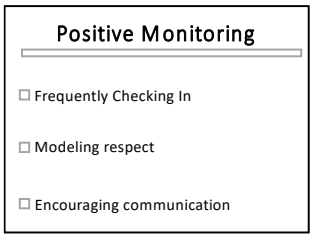
Appendix A

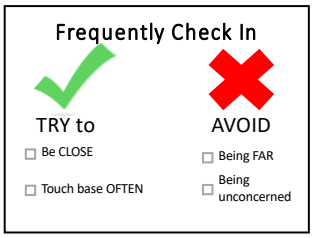
Positive Monitoring Slides (Training One)

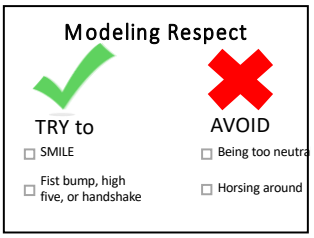


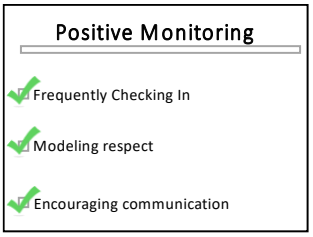












Appendix B

Strategic Interaction Slides (Training Two)

Strategic Interaction

Training conducted by:
Odessa Luna, MS, BCBA

Our common goals…

Behavior

Positivity

Last time….

Positive Monitoring

- ☐ Frequently Checking In
- ☐ Modeling respect
- ☐ Encouraging communication

Strategic Interaction

- ☐ Set timer
- ☐ Hide timer
- ☐ Continue as usual
- ☐ Provide interaction

Step 1: Set Timer

Step 2: Hide Timer

Step 3: Continue as usual

Provide Interaction

TRY to	AVOID
☐ Positive	☐ Negative
☐ Present	☐ Past
☐ Close	☐ Distant

Putting it all together

Video #1

Video #2

Video #3

Let's practice!

Strategic Interaction

- ☐ Set timer
- ☐ Hide timer
- ☐ Continue as usual
- ☐ Provide interaction

Questions, comments, concerns?

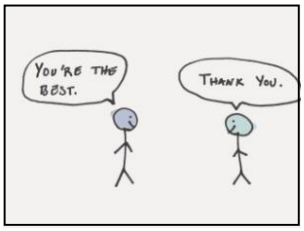
Training conducted by:
Odessa Luna, MS, BCBA

Appendix C

Offering Options Slides (Training Three)

Offering Options: Leisure/Rec Time

Training conducted by:
Odessa Luna, MS, BCBA



Our common goals…

Behavior ↓

↑ Positivity

First time….

Positive Monitoring

- ☐ Frequently Checking In
- ☐ Modeling respect
- ☐ Encouraging communication

Last time….

Strategic Interaction

- ☐ Set timer
- ☐ Hide timer
- ☐ Continue as usual
- ☐ Provide interaction

Offering Options

1. *Gather*
2. **Announce**
3. *Check out*
4. **Acknowledge**
5. *Monitor*
6. **Announce**
7. *Check in*
8. **Acknowledge**

1. Gather

- Timer to remind you to monitor
- Leisure materials
- Binder to check out/in materials

2. Announce

- Indoor recreation time
- Tell students items are available
- Politely redirect if student wants something else or is rude
- **Note:** items only in MAIN AREA (*NOT in students' rooms*)

3. Check Out

- Date
- Staff /Students Initials
- Item checked out
- Note: missing, damage, request

Check Out				
Date	Staff Initials	Student Initials	Item	Note:
	CL	TJ	Scrabble	

4. Acknowledge

- Student appropriate request
- Student appropriate waiting
- Student appropriate sharing

"I appreciate those manners."

"Thank you for your patience."

"It was good of you to let Jones have that."

5. Monitor

- **Set timer** to remind (5 min)
- When timer vibrates, **PROVIDE INTERACTION** with other students (praise, compliment, acknowledge)

Provide Interaction

TRY to	AVOID
☐ Positive	☐ Negative
☐ Present	☐ Past
☐ Close	☐ Distant

5. Monitor

- **Set timer** to remind (5 min)
- When timer vibrates, **PROVIDE INTERACTION** with other students (praise, compliment, acknowledge)
- **Avoid** engaging with items
- **Encourage restless students** to find an activity

6. Announce

- Tell students time to clean up
- Tell students to check in materials
- Politely redirect requests for longer time and on complaints

7. Check In

- Date
- Staff /Students Initials
- Item checked out
- Note: missing, damage, request

Check In				
Date	Staff Initials	Student Initials	Item	Note:
	CL	TJ	Scrabble	Looks like board is ripped

8. Acknowledge

- Student appropriate check in
- Student appropriate waiting
- Student appropriate interaction

"Thank you."

"I like your patience."

"Your drawing looks fantastic!"

Putting it all together

Offering Options

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Offering Options

1. *Gather*
2. **Announce**
3. *Check out*
4. **Acknowledge**
5. *Monitor*
6. **Announce**
7. *Check in*
8. **Acknowledge**

Questions, comments, concerns?

Training conducted by:
Odessa Luna, MS, BCBA

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