EVALUATIONS OF REPETITIVE BEHAVIOR IN TYPICALLY FUNCTIONING ADULTS AND INTELLECTUALLY DISABLED CHILDREN: IMPLICATIONS OF THE DEMAND CONDITION

By

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To my parents, who taught me to persevere

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Abstract of Dissertation Presented to the Graduate School
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EVALUATIONS OF REPETITIVE BEHAVIOR IN TYPICALLY FUNCTIONING ADULTS AND INTELLECTUALLY DISABLED CHILDREN: IMPLICATIONS OF THE DEMAND CONDITION

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Repetitive behavior occurs in a wide variety of populations, settings, and topographies. Research that has focused on determining why repetitive behavior (e.g., nail biting, hair twirling, and skin scratching) occurs in typically functioning populations has concluded that the behavior is maintained by automatic reinforcement (e.g., Deaver, Miltenberger, & Stricker, 2001). However, various conditions may evoke repetitive behavior and establish the consequence produced by the behavior as a reinforcer. Woods and Miltenberger (1996) showed that typically functioning adults engaged in high levels of repetitive behavior when presented with a demand. . The absence of social consequences in their demand condition suggests that repetitive behavior in this condition may have been maintained by automatic reinforcement established as such by the presence of demands. This particular function is important because, given the presence of demands, researchers and clinicians could incorrectly conclude that the behavior is maintained by escape from demands. This possibility has important implications for the assessment and treatment of stereotypy, or repetitive behavior, in intellectually disabled children. Some previous researchers have

concluded that stereotypy is escape-maintained if it occurs in the demand condition of an antecedent-based functional assessment (e.g., Durand and Carr, 1987). However, given the lack of programmed consequences, the behavior may actually be maintained by automatic reinforcement established as such by demands. Hence, we aimed to evaluate whether this function occurs in typically functioning adults and intellectually disabled children. Results of the Studies 1 and 2 showed that 22% of typically functioning adults and 33% of intellectually disabled children engaged in high levels of repetitive behavior when presented with demands. Results from Study 2 demonstrated that at least one topography of stereotypy occurred most often in the demand conditions for three individuals. Results from Study 3 confirmed that this behavior was not maintained by escape from demands, but rather by automatic reinforcement.

CHAPTER 1
INTRODUCTION

Repetitive Behavior in Typically Functioning Individuals

Repetitive behavior such as nail biting, skin picking, and hair pulling are often called habits or nervous habits and occur both in general and clinical populations (Woods, Miltenberger, & Flach, 1996). Through a survey given to 246 undergraduate students, Woods et al. determined that roughly 20% of college students reported repeatedly touching their face, shaking their legs, chewing on their mouth, and playing with pencils. Fifteen percent also endorsed repeatedly playing with their hair or jewelry. Nail biting, head scratching, knuckle cracking, and lip touching were each reported by 10% of the students sampled. Unfortunately, the authors did not provide information about the overall prevalence of repetitive behavior (i.e. the total percentage of subjects who engaged in at least one type of habit). An earlier study using a similar method reported that all of the 142 undergraduate subjects endorsed engaging in at least one type of habit behavior (Hansen, Tishelmian, Hawkins, & Doepke, 1990). However, as Woods et al. noted, the criterion used by Hansen et al. to determine whether a subject had a “habit” may have been overly liberal; subjects needed only endorse engaging in behavior occasionally for it to count as a habit. Thus, the overall prevalence of habits or repetitive behavior in typically functioning individuals is not known.

The Function of Repetitive Behavior

Several studies have evaluated the conditions under which repetitive behavior, namely hair twirling, finger sucking, and nail biting, occurred most frequently (Deaver et al., 2001; Dufrene, Watson, & Kazmerski, 2008; Stricker, Miltenberger, Anderson, Tulloch, & Deaver, 2002). Results of these studies showed that repetitive behavior was

maintained by automatic reinforcement (i.e., occurred in the absence of socially mediated reinforcement). In one study that attempted to assess the function of repetitive behavior, Woods and Miltenberger (1996) exposed 44 undergraduates to three conditions designed to have a boring, anxiety-provoking, or neutral effect. Results of the assessment indicated that hair and face manipulation occurred most often in the anxiety condition and object manipulation occurred most often in the bored condition. Based on these results, Woods and Miltenberger concluded that repetitive behavior may serve an anxiety-reducing or self-stimulatory function (i.e. automatic negative and automatic positive reinforcement, respectively).

Stereotypy Is Repetitive Behavior

In a review on stereotypy, Rapp and Vollmer (2005a) defined stereotypy as behavior invariant or repetitive in movement that persists in the absence of social consequences. Stereotypy occurs in a wide variety of topographies, including countless variations of body postures, vocalizations, and head, arm, hand, leg, or face movements (Berkson and Davenport, 1962). Stereotypy may begin as behavior that is part of typical motor development; typically developing infants engage in stereotypic behavior that gradually decreases in frequency or changes in topography (Berkson & Tupa, 2000; Lovaas, Newsom, & Hickman, 1987). Stereotypy in individuals with intellectual disabilities (ID) may follow a similar course of development and fail to decrease due to a lack of a development of alternative behavior or of alternative sources of reinforcement (Lovaas et al.). In a seminal study, Berkson and Davenport (1962) found a significant negative correlation between the incidence of stereotypy and IQ, suggesting that higher levels of stereotypy occur with lower functioning individuals. Bodfish, Symons, Parker, and Lewis (2000) observed that individuals with autism exhibited more stereotypy than

age- and functioning-matched peers with mental retardation without autism. One study on the longevity of stereotypy showed that it was maintained at moderate levels in a sample of 7 individuals with ID at a ten year follow-up (Jones, 1999).

In a preliminary investigation of stereotypy in 1962, Berkson and Davenport observed that stereotyped movements and postures occurred in two-thirds of their sample of 71 individuals with ID. In a similar study, Kaufman and Levitt (1965) discovered that 57-69% of 83 individuals with ID engaged in at least one of the three topographies hypothesized to be the most common forms of stereotypy: body rocking, head rolling, and hand to eye stereotypy. More recently, Bodfish et al. (2000) found that 100% of individuals with autism and over 80% of individuals with mental retardation without autism engaged in stereotypic behavior.

The Function of Stereotypy

Rapp and Vollmer (2005a) recently reviewed the evidence that stereotypy is maintained by automatic reinforcement. They list five sources of support, gleaned from empirical research, for the automatic reinforcement hypothesis: stereotypy persists in the absence of social consequences, competing sources of stimulation sometimes reduce stereotypy, blocking the putative sensory consequences of stereotypy leads to its reduction, contingent access to stereotypy can reinforce other behavior, and restricting access to stereotypy changes the subsequent level of stereotypy. This evidence suggests that the behavior is operant, rather than reflexive or tic-like and that the reinforcement is not delivered by one person to another.

Over the past 60 years**,** profuse evidence has indicated the role of automatic positive reinforcement in the maintenance of stereotypy. Berkson and Davenport (1962) found that higher levels of stereotypy occurred with visually-impaired individuals,

suggesting that stereotypy served a self-stimulatory function. In 1963, the same researchers (Davenport and Berkson) observed that lower levels of stereotypy occurred when preferred items were manipulated by subjects, which suggests that the stimulation provided by the objects competed with the stimulation created by the subjects' stereotypy. In a literature review, Lovaas, Newsom, and Hickman (1987) provided ample evidence that stereotypy is maintained by automatic positive reinforcement in the form of perceptual or sensory stimulation.

Several researchers have suggested that stereotypy could also be maintained by automatic negative reinforcement. Kaufman and Levitt (1965) hypothesized that stereotypy may have served a tension-reducing function because it occurred more often before times of meals or rest, which have been observed to be periods of high tension. Forehand and Baumeister (1971) showed that frustration achieved by blocking previously reinforced responses increased stereotypy in individuals with ID; thus stereotypy could have been tension- or frustration-reducing. Lovaas et al. (1987) noted that studies on the arousal theory of stereotypy showed that increased levels of stereotypy occurred under conditions of aversive stimulation. Results from animal studies have shown that stereotypy may serve a stress-reducing function (e.g., Bildsoe, Heller, & Jeppesen, 1991); however, little research in this area has been conducted with ID humans (Rapp and Vollmer, 2005b). Given these various sources of evidence, it appears likely that stereotypic behavior in individuals with ID may at times occur in the presence of aversive stimulation and likely is maintained by automatic reinforcement even in that context.

Stereotypy That Occurs During Demands

Several researchers have conducted analyses of stereotypy that occurs during demands. Durand and Carr (1987) conducted evaluations of stereotypic behavior using antecedent-based assessments. Because stereotypy occurred most often in the condition with increased task difficulty, they concluded that stereotypy was reinforced by escape from demands. To further demonstrate, they conducted a reversal phase in which escape from demands was and was not provided contingent on stereotypic behavior; for two of four subjects, levels of stereotypic behavior were higher in the contingent timeout condition relative to the baseline condition. Thus the researchers concluded that the subjects' stereotypy was reinforced by social negative reinforcement in the form of escape from demands. However, two of the four subjects showed marginal differences between baseline and contingent timeout phases. Furthermore, the demand condition in Experiment 1 and the baseline condition in both Experiments 2 and 3 consisted of a procedure akin to escape extinction; the children were continually presented with tasks and a break was never presented contingent upon stereotypy. Although baseline was functionally equivalent to escape extinction, all subjects engaged in stereotypy throughout baseline sessions: as many as 21 consecutive sessions for one subject. Given this finding, it seems unlikely that the subjects' stereotypy was escape-maintained and instead seems likely that it was maintained by automatic reinforcement established as such by aversive stimulation (task demands).

In a similar study, Mace, Browder, and Lin (1987) evaluated the effect of demands on the stereotypic mouthing of one subject with ID. Because the highest levels of stereotypy occurred in the demand condition with the more difficult tasks (tasks that were novel or had more frequent response requirements), they concluded that the

subject's behavior was escape maintained. However, several of the conditions in this study involved the continuous presentation of demands without the presentation of escape, and yet the subject's responding maintained for many sessions. Because the behavior persisted in conditions akin to escape extinction, it seems unlikely that the behavior was escape maintained. Instead, it would appear that this study is another case in which stereotypy was maintained by automatic reinforcement in the presence of demands but was incorrectly described as escape behavior.

Kennedy, Meyer, Knowles, and Shukla (2000) concluded that stereotypy was multiply controlled because it occurred throughout multiple conditions of a consequence-based functional analysis. Because, for two subjects, differentially higher levels of stereotypy occurred in the attention, demand, and no attention conditions relative to the free (recreation) condition; they concluded that these subjects' behavior was maintained by attention, escape, and automatic reinforcement. However, this pattern of responding would typically be thought indicative of maintenance by automatic reinforcement. In addition, they concluded that the behavior of one subject who engaged in differentially higher levels in the demand and no attention conditions was maintained by escape and automatic reinforcement. Given that stereotypy had been shown by the elevated levels in the no attention condition to be sensitive to automatic reinforcement, it is possible that the stereotypy in the demand condition was maintained by automatic reinforcement established as such by the presence of the demands. Overall, the researchers do not provide convincing evidence that the stereotypy of their subjects was maintained by anything other than automatic reinforcement,

The possibility of behavior maintained by automatic reinforcement under conditions of aversive stimulation also has implications for consequence-based

functional analyses in general. If demands are an establishing operation for automatically reinforced stereotypy, a researcher or clinician could conduct a functional analysis (Iwata, Dorsey, Slifer, Bauman & Richman, 1982/1994) and conclude that behavior was maintained by escape from demands. Iwata et al. (1994) reported that 3 of 46 applications of escape extinction to self-injurious behavior (SIB) thought to be maintained by escape were ineffective. Although rare, the possibility exists that escape extinction failed in this small number of cases because SIB was not escape-maintained and was instead stereotypic SIB maintained by automatic reinforcement established as such by aversive stimulation (task demands).

General Purpose

The purpose of the current series of experiments was twofold. The first purpose was to determine whether in some cases automatically reinforced behavior is most likely to occur under demand-like situations in typically functioning and intellectually disabled individuals. The second purpose was to evaluate whether behavior that occurs in the presence of demands is maintained by automatic reinforcement.

CHAPTER 2
AN EVALUATION OF CONDITIONS THAT EVOKE REPETITIVE BEHAVIOR IN TYPICALLY FUNCTIONING ADULTS

Experiment 1: Purpose

Wood and Miltenberger (1996) developed an antecedent-based assessment to evaluate the function of repetitive behavior in typically functioning individuals; however, subjects were only exposed to each condition once, thus limiting knowledge about trends over time. Thus, the purpose of Experiment 1 was to systematically replicate Woods and Miltenberger (1996), using repeated-measures and single-subject designs. Of central interest was evaluating whether automatically reinforced behavior can sometimes occur at the highest rates during demanding environmental situations. Intuitively and through casual observation this seems true; for example, sometimes people bite their nails while stuck in traffic or twirl their hair while taking an exam. If behavior occurs at high levels during demand situations, it is likely that demands establish the automatic consequences of the behavior as reinforcement.

Experiment 1: Method

Subjects and Setting

Subjects were 50 undergraduate students recruited through the subject pool at the University of Florida; subjects received course credit for participation. Consent was obtained by having subjects sign a consent form to participate in a study on behavior during various tasks. At the end of the three-hour session, subjects were debriefed on the true nature of the study and allowed to choose whether their data could be included in the study. No subject declined to have their data included

All sessions were conducted in a research room at the University of Florida equipped with a one-way mirror. The subjects sat in a computer chair at a table

outfitted with a desktop computer. Depending on the condition, subjects were given access to the computer, magazines, or study materials (paper, pens, and note cards).

Target Behavior and Data Collection

The targets included the following topographies of repetitive behavior: hair manipulation, self scratching, tapping, limb movements, object manipulation, nail biting, object mouthing, lip biting, chair swiveling, self-focused vocalizations, and knuckle cracking. An operational definition was written for each topography. Definitions are presented in Table 2-1. Topographies were similar to those used by Woods et al (1996). However, some topographies were combined to reduce the number of classes scored; (e.g. touching face, touching lips, and scratching head were collapsed into one class called self-scratching that included contact between the hand and any body part) .

Data were collected by one or more researchers who observed the subject through the one-way mirror continuously for each 5-minute session. . Subjects were blind to the true nature of the study. Subjects were told that they would be participating in a study to see how people behave when asked to perform various types of tasks. They were told they would be watched through the one-way mirror to make sure they were working, but were not told what behaviors were being observed. Using handheld computers, observers collected data on the duration of each topography of repetitive behavior and data were later analyzed as the percentage of session in which repetitive behavior occurred. Each topography was graphed individually and all topographies were combined in one total measure (i.e., the percent of session in which any form of repetitive behavior occurred).

Two observers independently collected data for 61% of sessions (range 29%-76% across subjects). We divided each 5-min observation into 10-s intervals and the

percent of agreement for each interval was calculated by dividing the smaller number of seconds of a behavior scored by the larger number scored and then multiplying by 100. An overall agreement score was then calculated by averaging the agreement scores for all intervals; this method is typically called “proportional agreement” and is commonly used in behavior analysis research. Mean agreement was 98% (range, 81%-100%) for hair manipulation, 95% (range, 69%-100%) for self scratching, 99% (range, 81%-100%) for tapping, 96% (range, 55%-100%) for limb movements, 99% (range, 67%-100%) for object manipulation, 98% (range, 72%-100%) for nail biting, 99.9% (range, 94%-100%) for object mouthing, 99.8% (range, 75%-100%) for lip biting, 98% (range, 56%-100%) for chair swiveling, 99.6% (range, 79%-100%) for self-focused vocalizations, 99.7% (range, 87%-100%) for knuckle cracking.

Because the observers collected live data on a subject with whom they had no history, the first five sessions of interobserver agreement (IOA) were calibration sessions. During these sessions, the observers discussed the behavior of the subject and determined which behavior to score as which topography. Thus, these sessions were not included in the calculation of either IOA scores or the proportion of sessions with IOA.

Procedure

Antecedent-based assessment. Each subject was exposed to several conditions of an antecedent-based assessment in a multielement design. Antecedent-based assessments were used because we were only interested in identifying repetitive behavior that occurred independently of social reinforcement (i.e., was automatically reinforced). Due to limited time with the subjects (3 hours of total session time), each subject was exposed to between 15 and 21 five-minute sessions. Each subject was

randomly selected to participate in one of the demand conditions; thus sessions quasi-randomly alternated between Alone, Free, and either IQ, Video Game, or Presentation (the latter three were considered possible demand conditions). Conditions were randomly chosen within a group of three sessions; no condition was repeated until each had been run once in a group. In each of the demand conditions, to enhance motivation to do well, subjects were told fictional high scores disguised as the scores of the previous five subjects. Programmed consequences did not occur contingent upon repetitive behavior in any condition.

The conditions of the antecedent-based assessment were: (1) Alone*.* In this condition, the subject was left alone in the room with no materials other than those typically present in an office. The subject was told to wait for the researcher to return. This condition was designed to test if the subject would engage in repetitive behavior when given nothing to do, which would suggest that repetitive behavior was maintained by automatic reinforcement. (2) Free*.* In this condition, the subject was alone in the room and was given access to the internet and magazines; this condition was used to identify the level of repetitive behavior when the subject had preferred materials and was not asked to do anything. (3) Demand*.* Each of the following demand conditions was intended to test the level of repetitive behavior exhibited during three potentially stressful tasks; high levels of repetitive behavior in these conditions could suggest that demand situations establish the stimulus products of repetitive behavior as reinforcement.

The three demand conditions were: (1) IQ. In this condition, the subject was instructed to complete difficult intelligence-test-type questions; they were told the items were from an IQ test but were not told that their IQ was being measured. The items

used were visual testing items from *IQ Tests to Keep You Sharp* (Carter & Russell, 2002); the items involved visual tasks such as pattern recognition. The items were chosen to be difficult but not so difficult that subjects might just give up. For 43% of the subjects who were exposed to this condition, an experimenter was in the room, but did not interact with the subject other than to hand them intelligence testing questions. (2) Presentation. In this condition, the subject was alone in the room and asked to read a research article and prepare a summary and opinion statement. The subject was told that they would be expected to give an oral presentation to a group of graduate students at the end of the 3-hour block. (3) Video game. In this condition, the subject was alone in the room and played a video game that was fast-paced and chosen to be challenging in five-minute segments. The video game used was Collapse! ® which is a game that is available for free from a number of websites. The game involved clicking on same colored blocks to clear them before the blocks reached the top of the screen.

The first six subjects were exposed to all five of the experimental conditions: alone, free, IQ test, presentation, and video game. Because of the limited time with each subject, we were not able to conduct a sufficient number of sessions in each condition. Hence, we chose to randomly assign future subjects to one of the demand conditions and did not include subjects 1-6 in data analyses.

Data for each subject were classified via visual analysis as one of five outcomes: differentially higher in alone, differentially higher in demand, differentially higher in alone and demand but highest in alone, differentially higher in alone and demand but highest in demand, and undifferentiated. For each data set, alone and demand conditions were visually compared to the free condition to determine if the former data paths were differentiated from the latter. In the case that data paths visually overlapped, individual

pairs of points were examined and more than 70% of the data points for either alone or demand must have been higher than the adjacent free data points to be called differentiated. For example, data for UG45 are presented in Figure 2-1; the complete data set is presented in the top panel followed by the comparisons of alone versus free and demand versus free in the middle and bottom panels, respectively. Initial visual inspection shows that the alone data path was consistently higher than the free data path. This can be verified by counting the number of alone data points higher than the adjacent free data points in the second panel; alone was higher in six of the seven pairs of data points (86%). To the contrary, although the demand data path may appear higher upon visual inspection, analyzing the data points in the bottom panel shows that demand was higher in only four of seven pairs (57%). Hence, the demand data path was not considered differentiated and the data set was classified as differentially higher in alone.

Experiment 1: Results and Discussion

All subjects engaged in at least one topography of repetitive behavior Thirty-three subjects (66%) engaged in differentially higher levels of repetitive behavior in only the alone condition of the assessment (see Figures 2-2 through 2-9 for data from these subjects). Nine subjects (18%) engaged in differentiated levels of repetitive behavior in both the alone and demand conditions relative to the free condition, but engaged in highest levels in the alone condition (see Figure 2-10 and 2-11 for data). Two subjects (4%) engaged in the highest levels of repetitive behavior in the demand condition; however, levels in the alone condition were also differentiated with respect to the free condition (see the top two panels of Figure 2-12). One subject (2%) engaged in differentiated levels of repetitive behavior in the demand condition only (see the bottom

panel of Figure 2-12). Five of the fifty subjects (10%) showed undifferentiated results (see Figure 2.13).

Table 2-2 displays the average percent of intervals with repetitive behavior for all subjects across conditions and topographies. The numbers in parentheses below the conditions represent the number of people who participated in each condition. Because knuckle cracking was added as a topography later in the study, the number of sessions with data for knuckle cracking is displayed (n=31). Results show that on average, repetitive behavior occurred most often in the alone and IQ conditions, 43.29% and 21.03% respectively. In addition, self scratching, limb movements, and nail biting occurred most often overall. These topographies occurred most frequently in the alone condition, with the exception of limb movements, which occurred most often in the alone and IQ test conditions.

In the vast majority of cases, repetitive behavior was most likely to occur at differentiated levels during the alone condition. Nonetheless, in some cases the behavior persisted at differentially higher levels during the demand condition. Repetitive behavior that occurred at differentially higher levels in a demand condition was presumably maintained by automatic reinforcement established as such by aversive stimulation. This function of repetitive behavior has implications for assessment and treatment for children who engage in repetitive or stereotypic behavior

In previous research, antecedent-based assessments have been conducted on the stereotypic behavior (repetitive behavior with no apparent social function) of ID children. As mentioned previously, Durand and Carr (1987) conducted an assessment of stereotypic behavior in which tasks were presented to the children as an antecedent manipulation. Because of the presence of the tasks, the researchers concluded that the

stereotypic behavior of these subjects was reinforced by social negative reinforcement. Given results of Experiment 1 and Woods and Miltenberger (1996), it seems possible that children with intellectual disabilities might engage in repetitive behavior that is maintained by automatic reinforcement during task presentation. To test this possibility, we conducted Experiment 2.

Table 2-1. Operational definitions for Experiment 1.

Behavior	Operational Definition
Hair Manipulation	Touching the hair with one or both hands while the hand is moving
Self-scratching	Pressing the nail of one or two hands on the surface of the skin with indentation or gathering of the skin
Tapping	Repetitive (greater than once per second) hitting of one object against another object or body part
Limb Movements	Moving a limb repeatedly in a recurring and rhythmic fashion, can be judged by leg shake or body bounce/shake
Object Manipulation	Repeatedly moving an object in a similar manner, e.g., rolling a pencil on a desk, does not include session material manipulation or just holding an item
Nail Biting	Placing any part of the end of the fingers between the lips and teeth or picking at the nail with the fingers of another hand
Object Mouthing	Placing any object inside the mouth, other than the individual's hands
Lip Biting	Closing the teeth around any part of the lip
Chair Swiveling	Moving the chair in one direction and back repeatedly
Self-Focused Vocalizations	Making any vocal statements or sounds
Knuckle Cracking	Cracking any joints or pushing on the knuckle with the other hand, another body part, or an object

Table 2-2. Summary data for Experiment 1 by condition. Averages are displayed for percent of session with repetitive behavior for any topography (total) and then each individual topography across conditions. The numbers next to each condition label represent the number of subjects who participated in each condition. For knuckle cracking, which was added after the 19th subject, data are shown only for the 31 subjects for whom data on knuckle cracking were collected.

Condition/ Topography	Total	Hair manip	Self scratch	Finger tap	Limb move	Object manip	Nail bite	Object mouthing	Lip bite	Chair spin	Self vocal	Knuckle crack (n=31)
Alone (n=50)	43.29	3.83	5.60	5.13	8.54	5.25	11.15	0.02	0.10	7.01	0.68	0.45
Free (n=50)	16.06	0.97	4.35	0.41	4.81	1.38	2.75	0.00	0.21	1.39	0.34	0.23
IQ test (n=28)	21.03	1.38	3.23	0.72	8.73	2.56	0.95	0.00	0.17	2.08	2.36	0.18
Presentation (n=10)	12.86	1.74	4.41	0.59	1.49	1.05	2.92	0.00	0.05	0.74	0.11	0.36
Video game (n=12)	7.45	0.30	1.29	0.02	4.96	0.00	0.33	0.01	0.49	0.10	0.06	0.00
Average	20.14	1.64	3.78	1.37	5.71	2.05	3.62	0.01	0.21	2.26	0.71	0.25

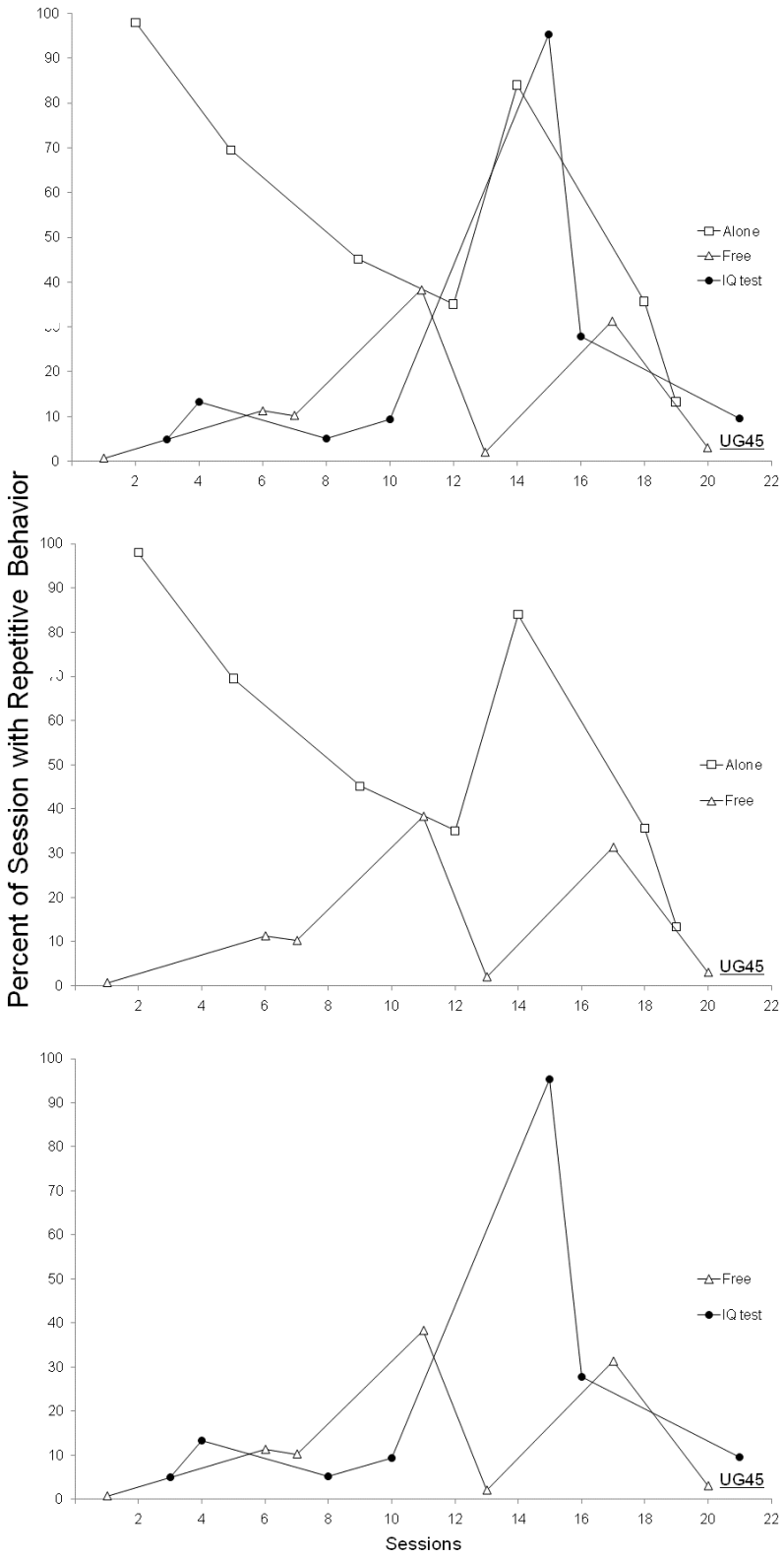

Figure 2-1. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG45. These data are presented to demonstrate the data analysis process (see the text).

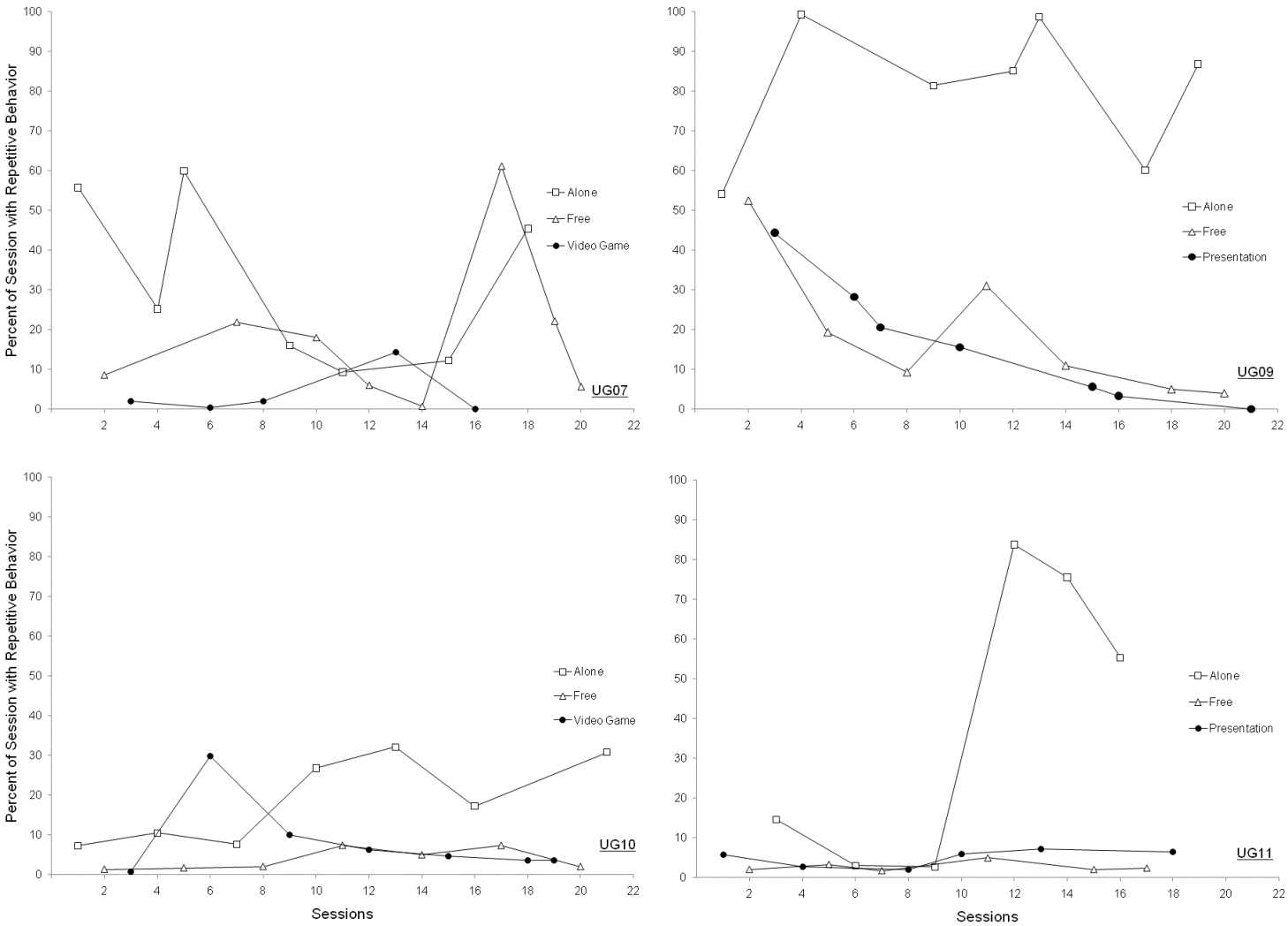

Figure 2-2. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG07, UG09, UG10, and UG11. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

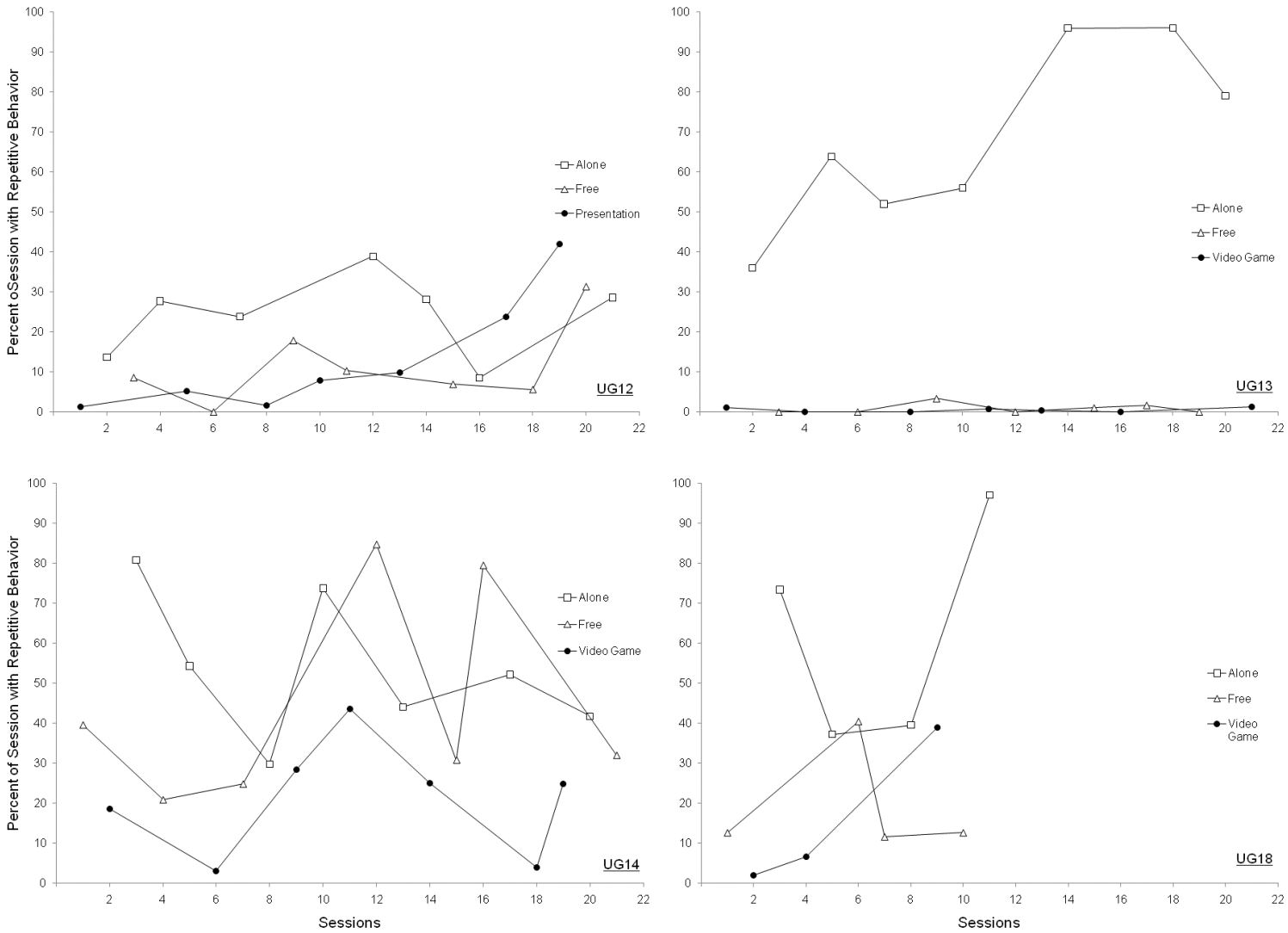

Figure 2-3. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG12, UG13, UG14, and UG18. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

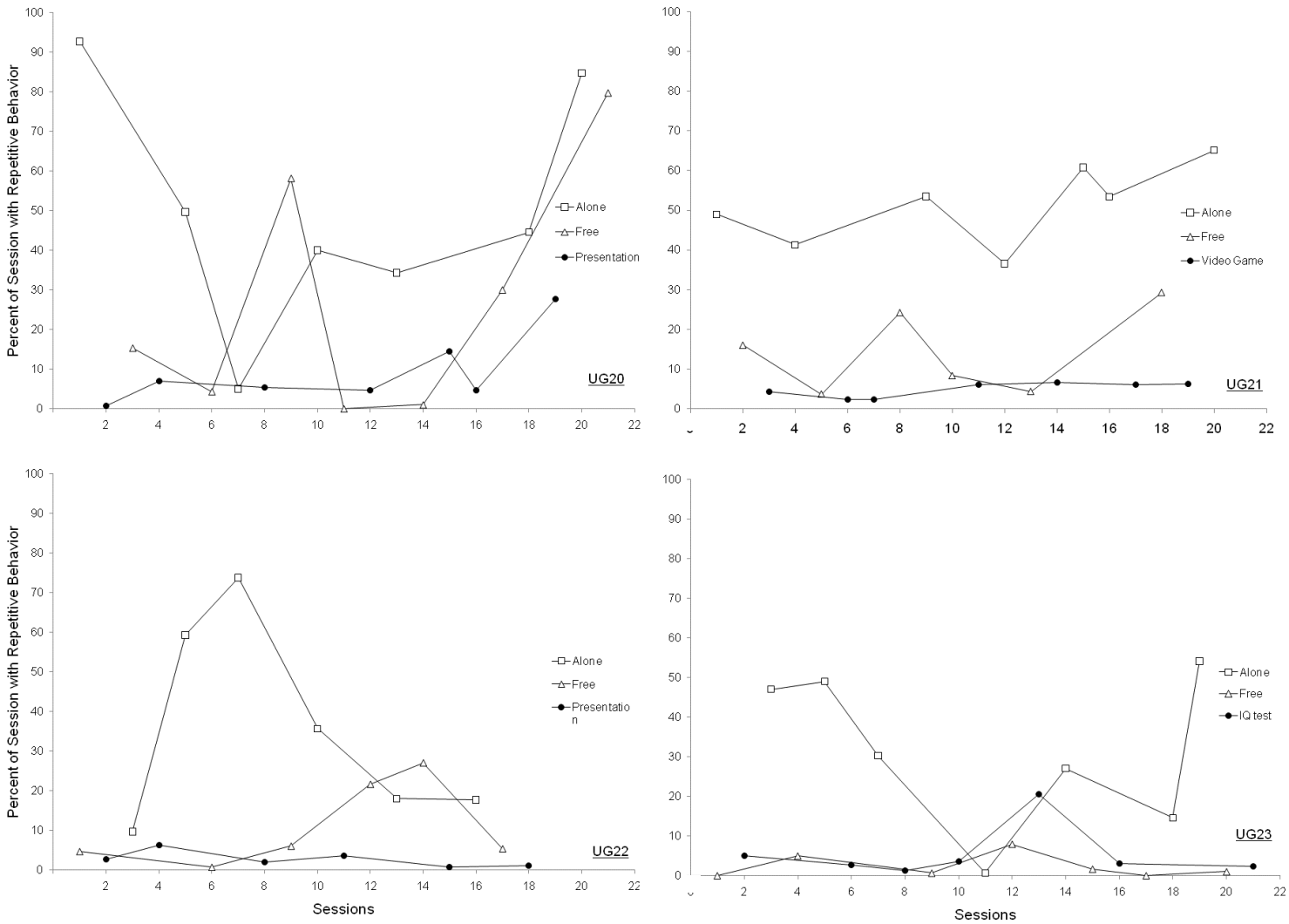

Figure 2-4. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG20, UG21, UG22, and UG23. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

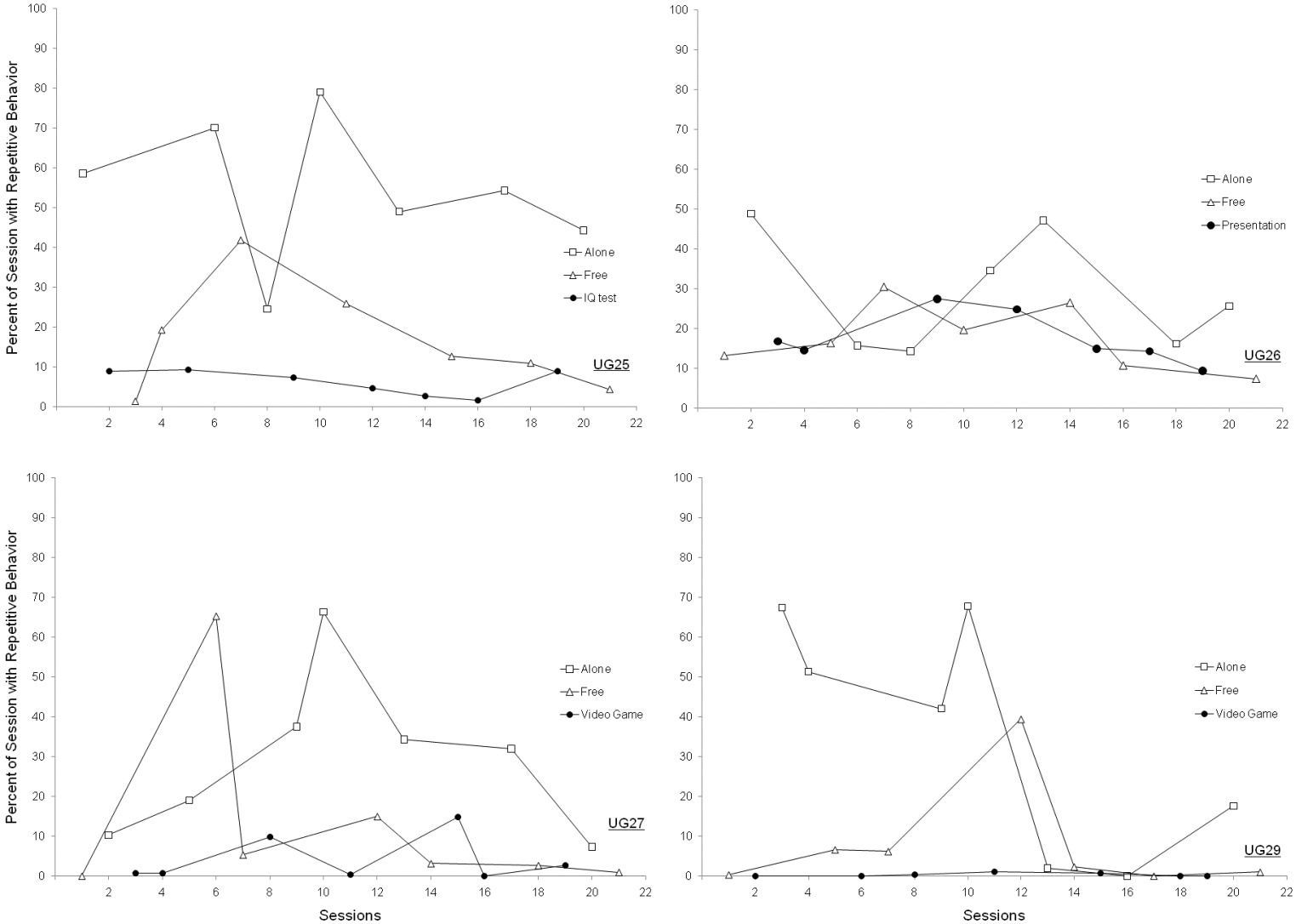

Figure 2-5. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG25, UG26, UG27, and UG29. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

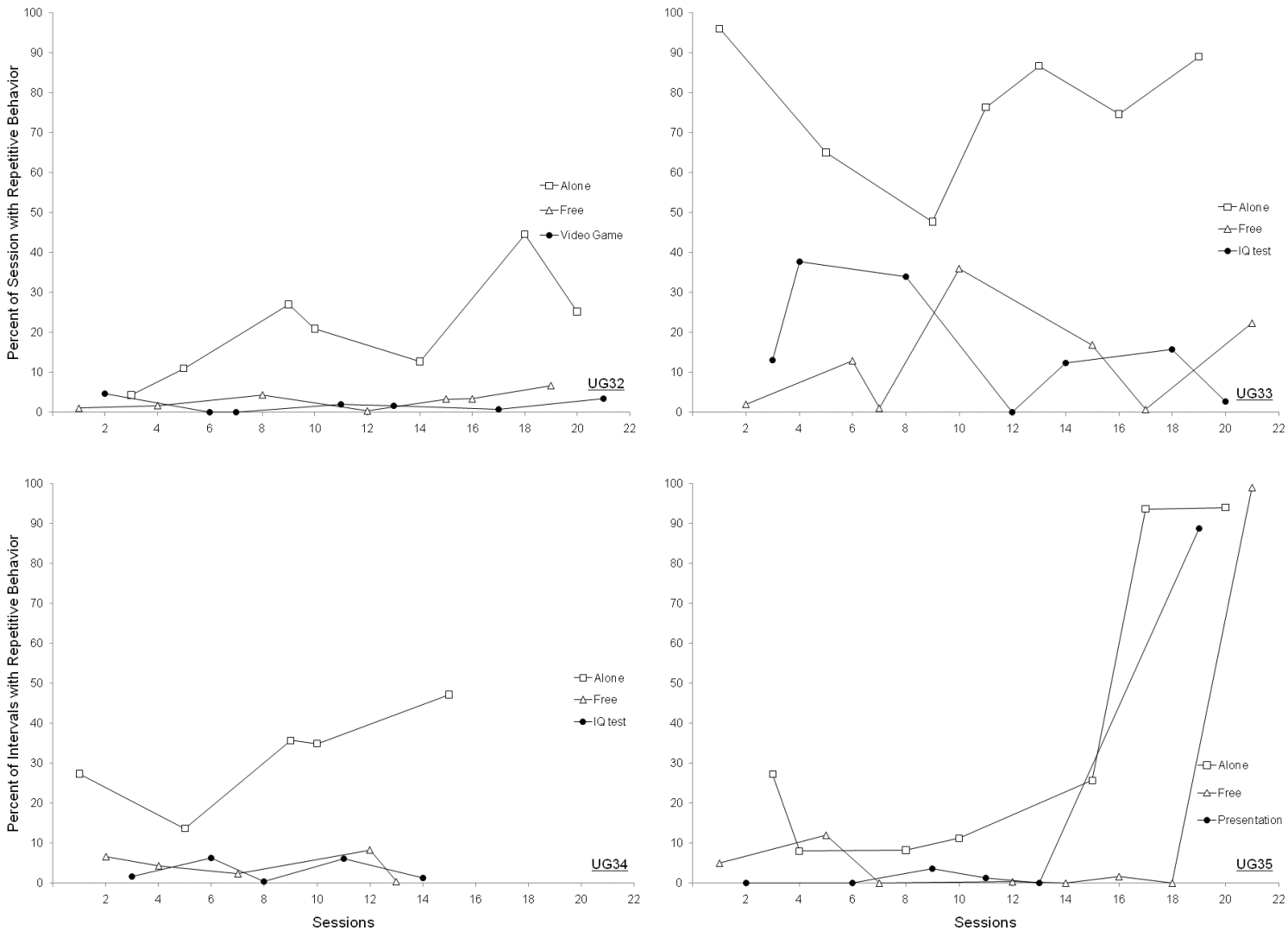

Figure 2-6. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG32, UG33, UG34, and UG35. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

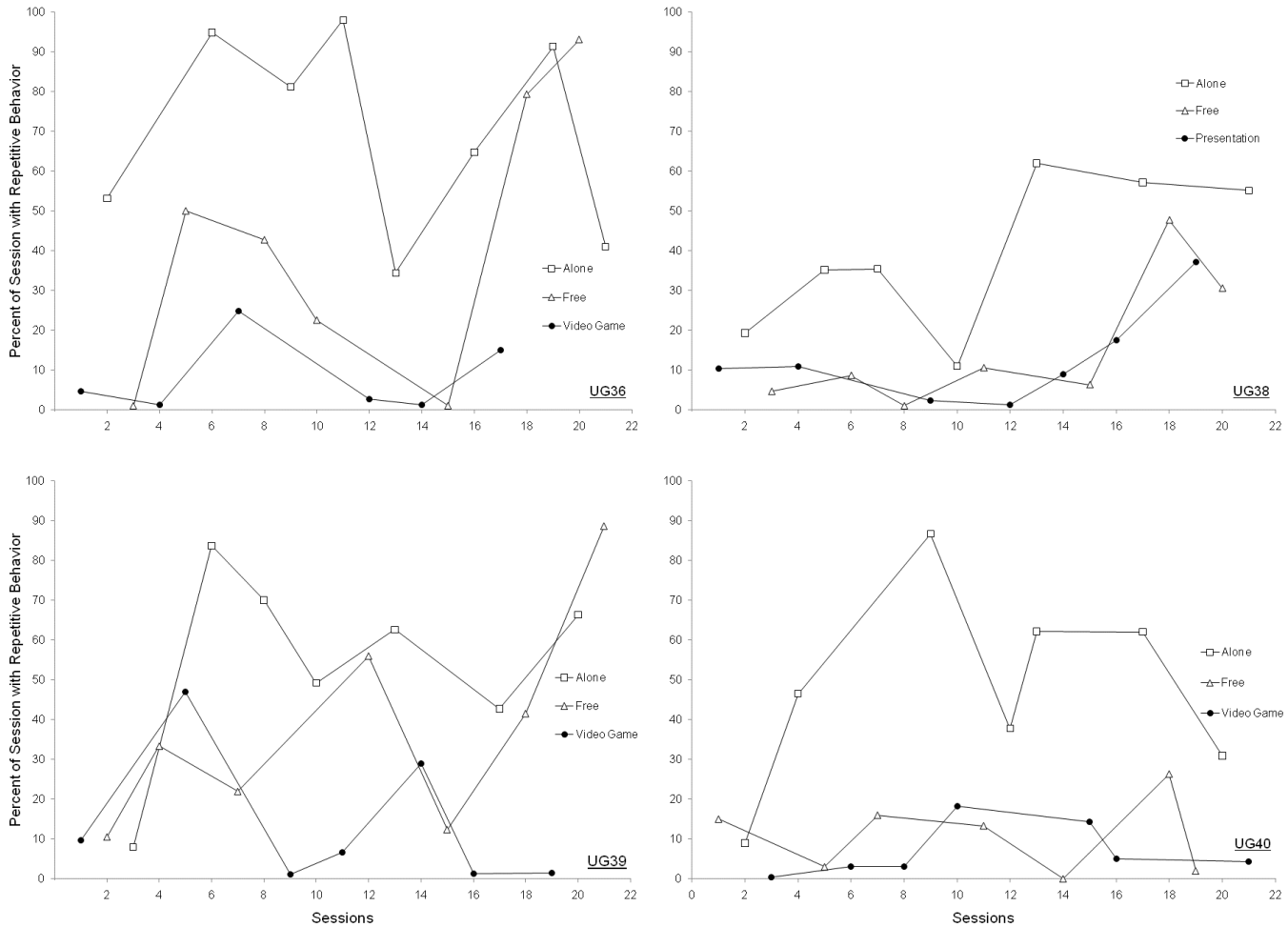

Figure 2-7. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG36, UG38, UG39, and UG40. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

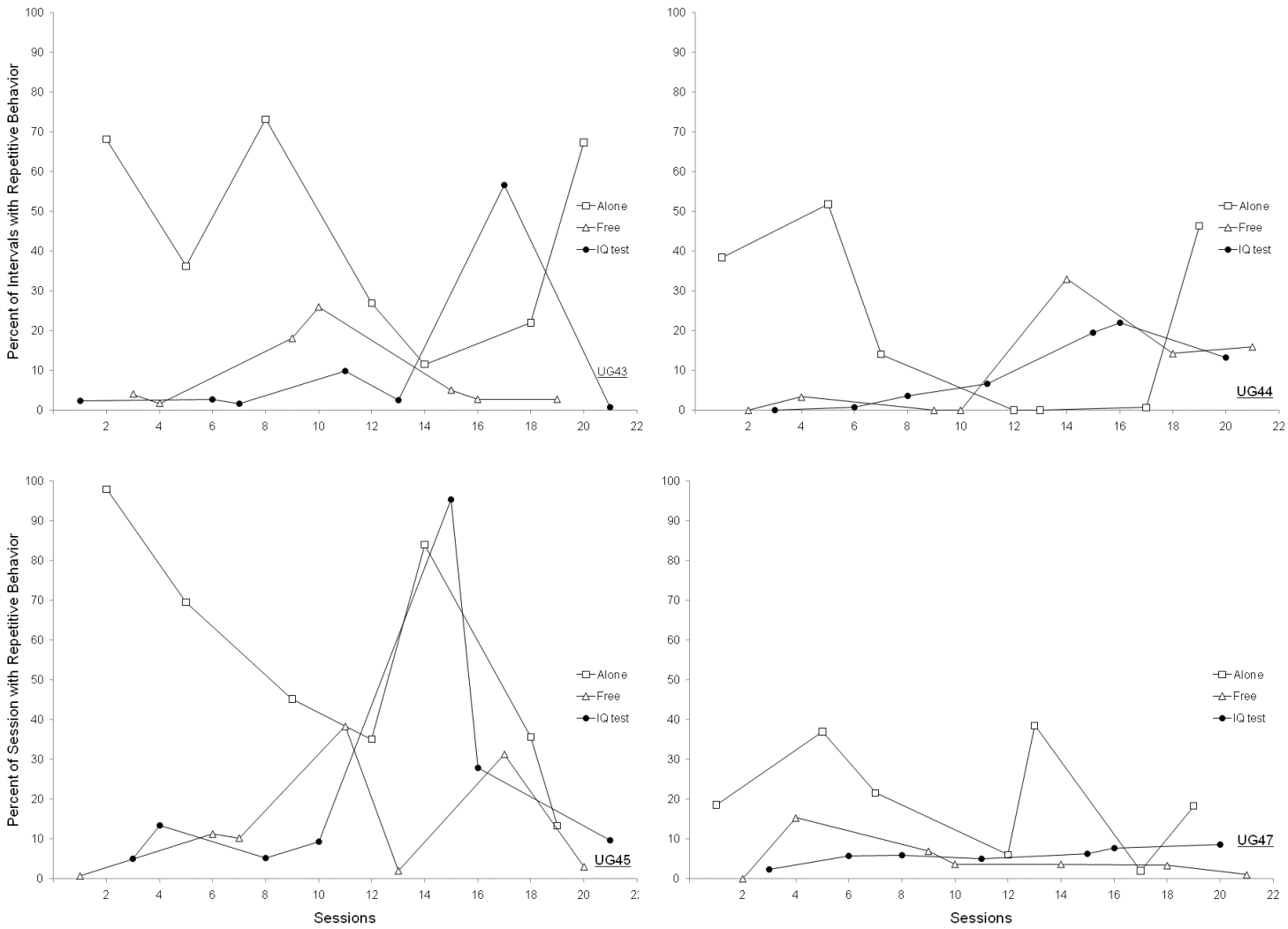

Figure 2-8. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG43, UG44, UG45, and UG47. These four subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

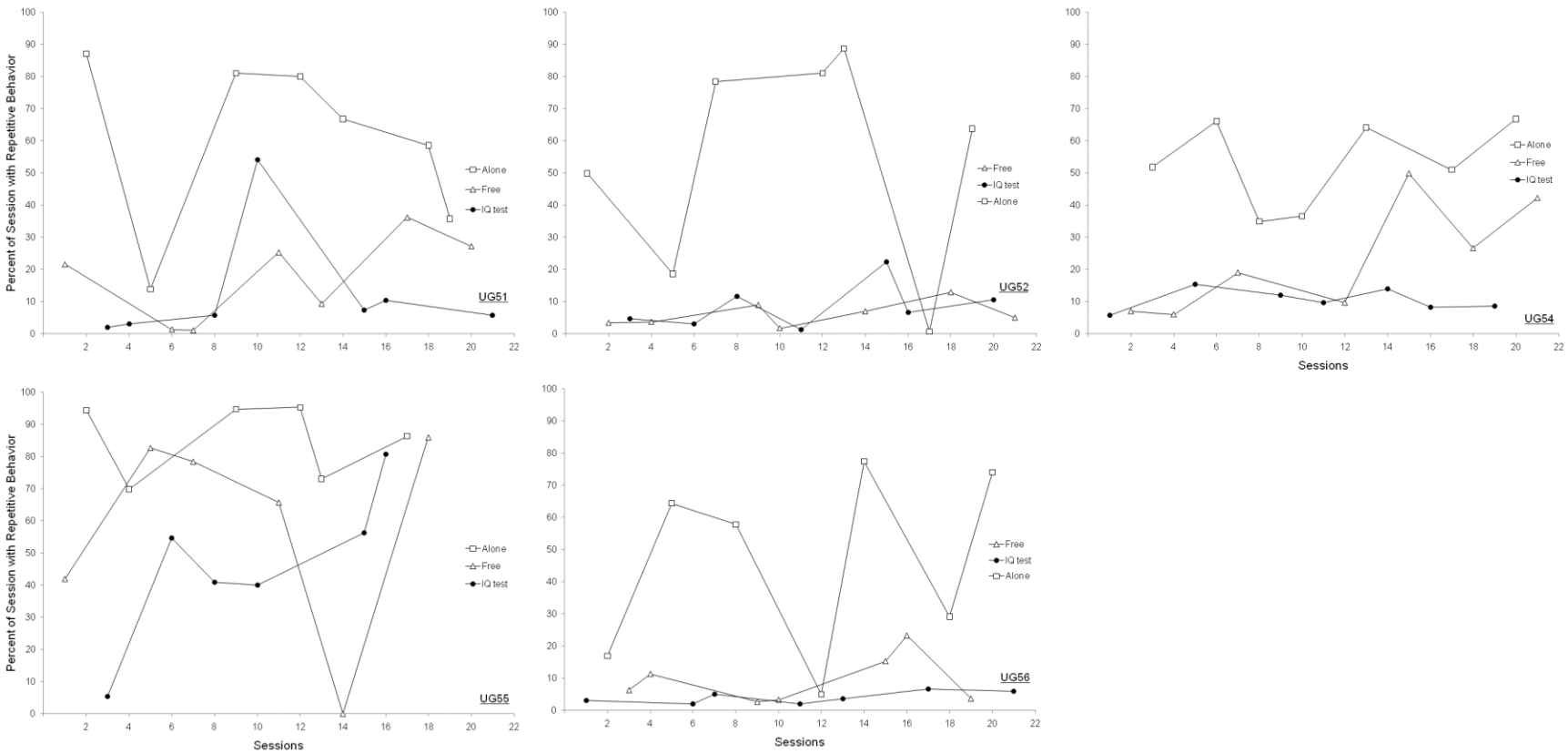

Figure 2-9. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG51, UG52, UG54, UG55, and UG56. These five subjects engaged in differentially higher levels of repetitive behavior in the alone condition.

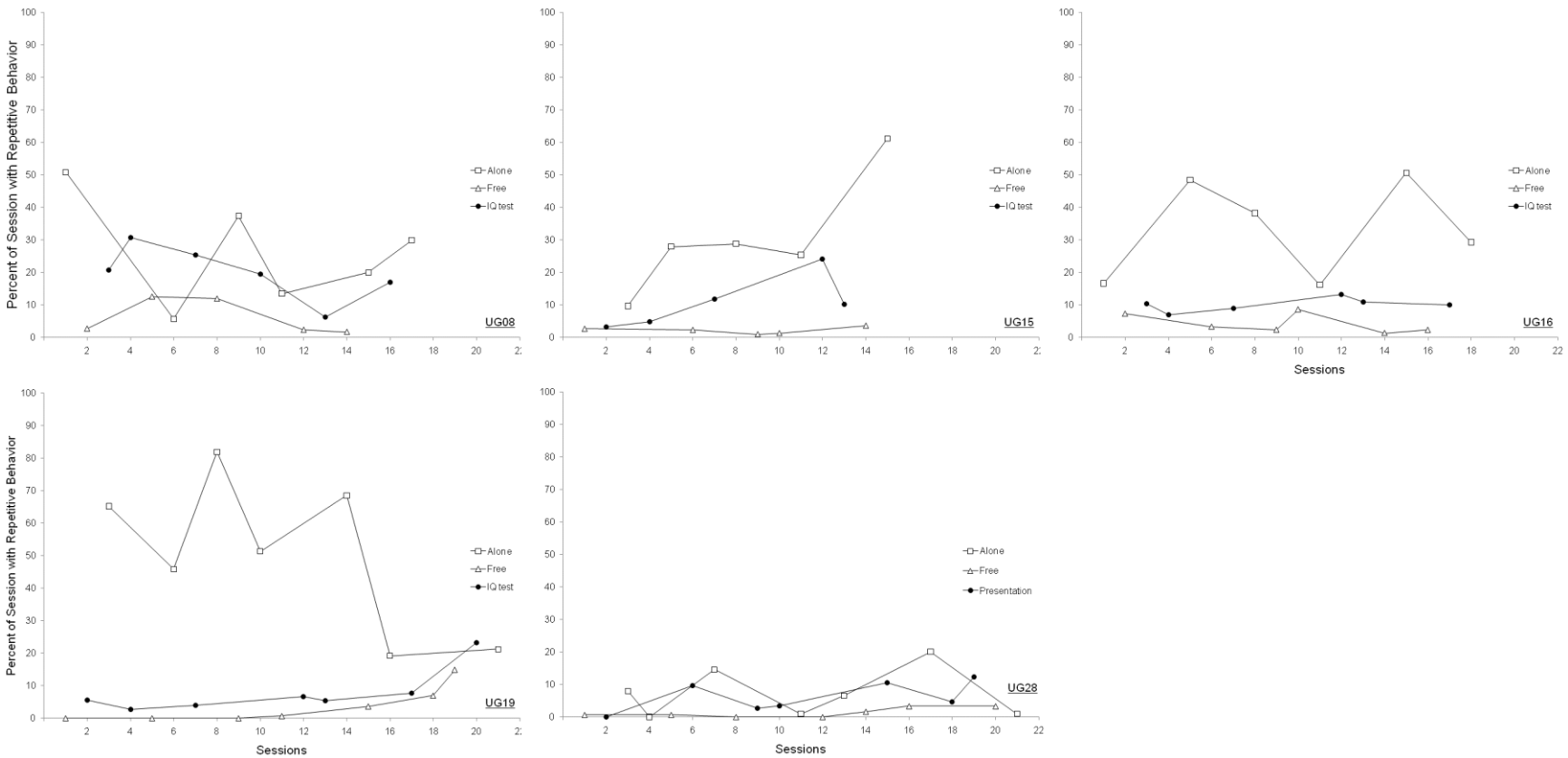

Figure 2-10. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG08, UG15, UG16, UG19, and UG28. These five subjects engaged in differentially higher levels of repetitive behavior in the alone and demand conditions with highest levels in alone.

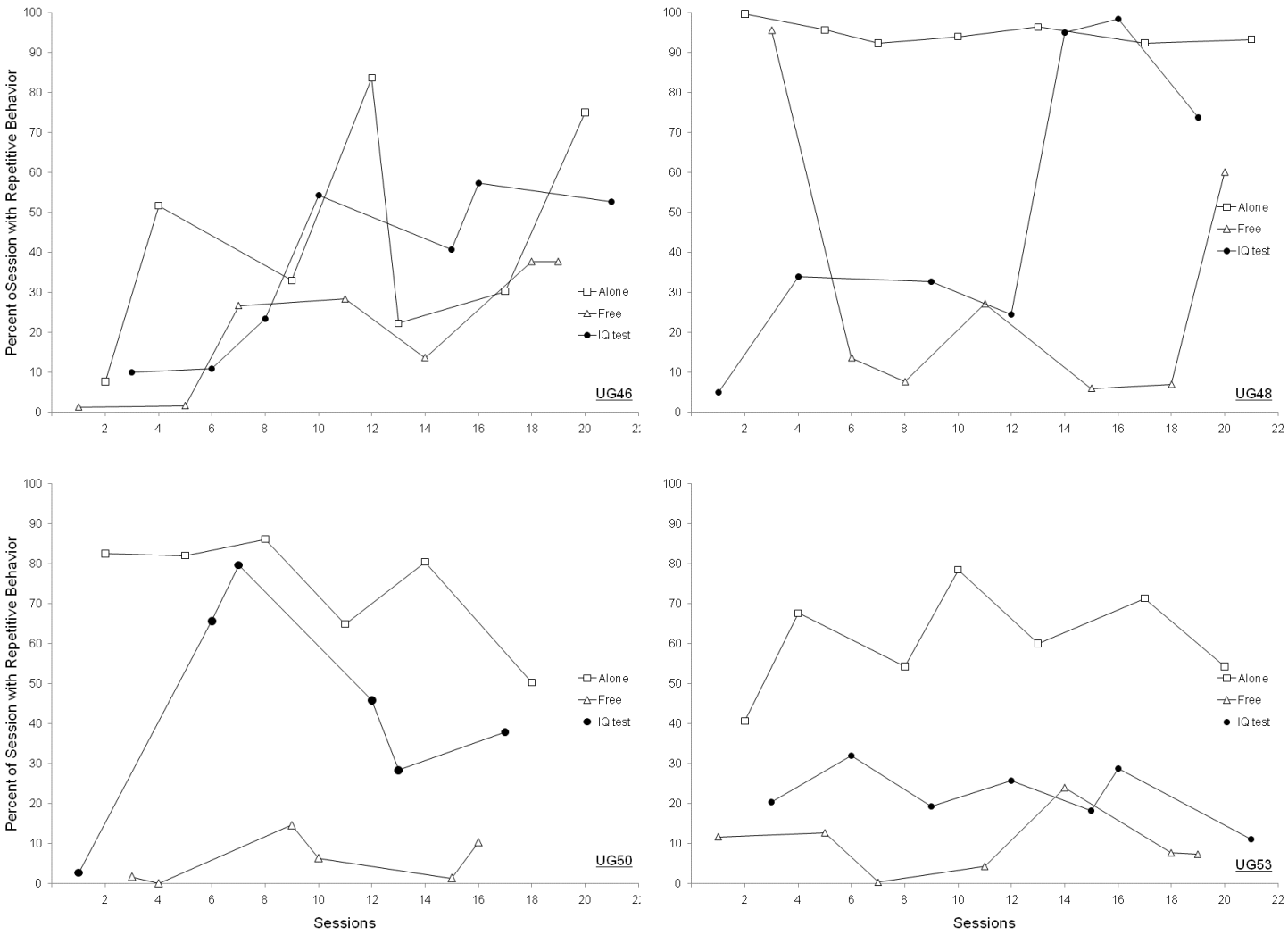

Figure 2-11. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG46, UG48, UG50, and UG53. These four subjects engaged in differentially higher levels of repetitive behavior in the alone and demand conditions with highest levels in alone.

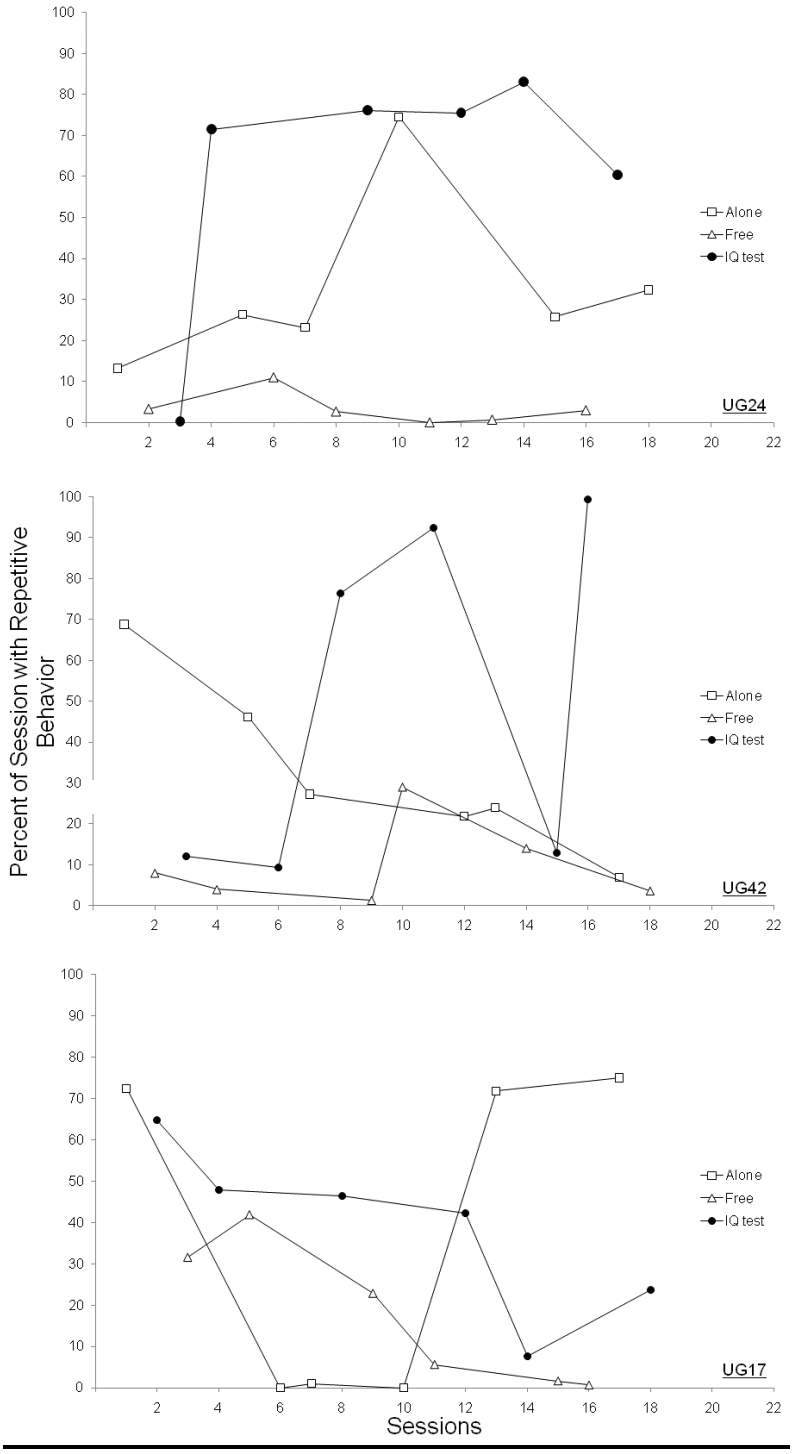

Figure 2-12. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and demand (black circles) conditions for UG24, UG42, and UG17. The first two subjects engaged in differentially higher levels of repetitive behavior in the alone and demand conditions with highest levels in demand. UG17 engaged in differentially higher levels of repetitive behavior in the demand condition only.

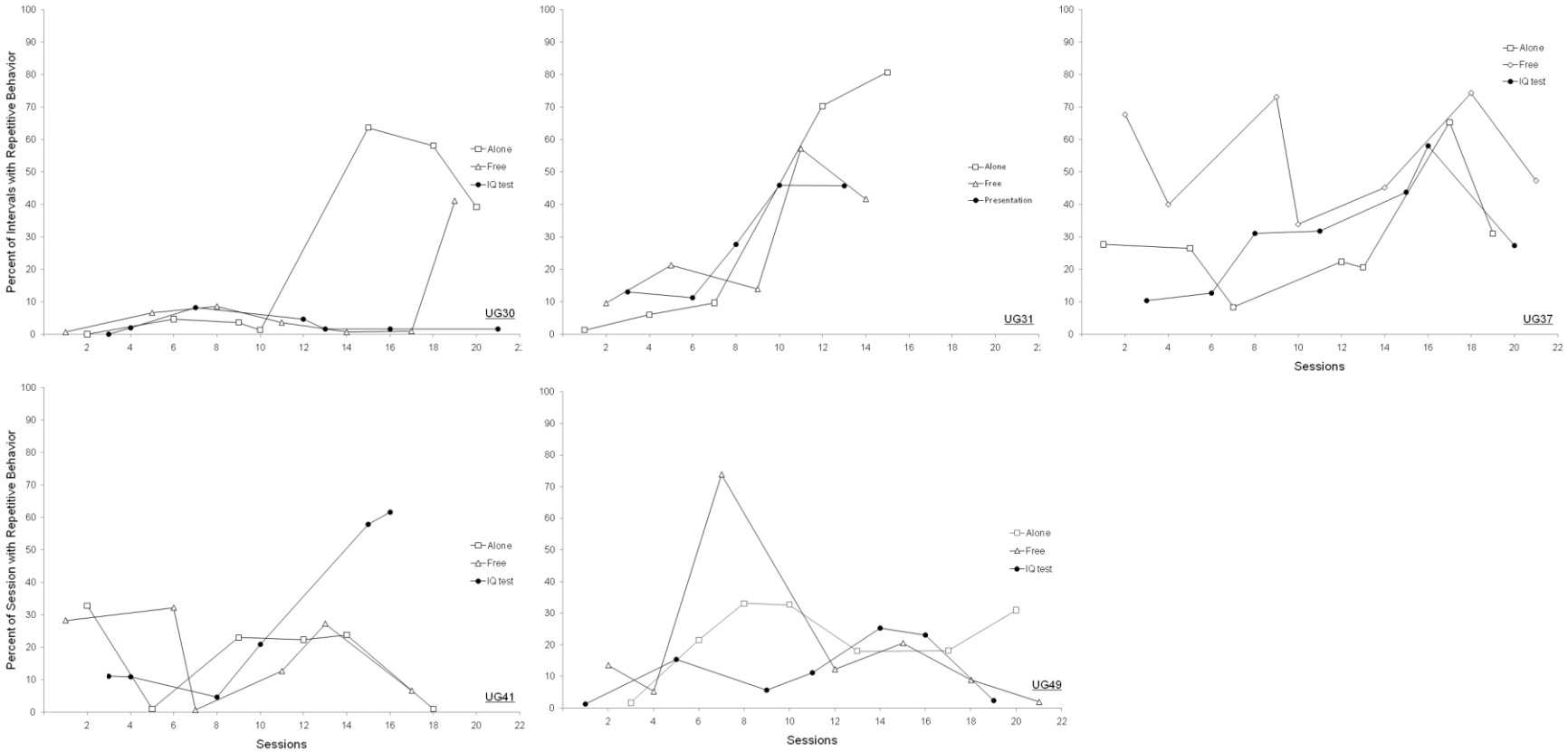

Figure 2-13. Percent of session with repetitive behavior across alone (white squares), free (white triangles), and presentation (black circles) conditions for UG30, UG31, UG37, UG41, and UG49. These five subjects displayed results that were undifferentiated.

CHAPTER 3
AN EVALUATION OF THE CONDITIONS THAT EVOKE STEREOTYPY IN INTELLECTUALLY DISABLED CHILDREN

Experiment 2: Purpose

Results of Experiment 1 showed that 20% of subjects engaged in differentially higher levels of repetitive behavior when presented with demands in the absence of social contingencies. The purpose of Experiment 2 was to evaluate whether elevated levels of stereotypy occur in a high-demand but no escape condition with ID children. This finding would have implications for behavioral assessment in ID because prior antecedent-based assessments of stereotypy may have falsely inferred a social function of the behavior (e.g., Durand & Carr, 1987).

Experiment 2: Methods

Subjects and Settings

Subjects were fifteen individuals, ages 5-20, who were diagnosed with autism or another intellectual disability and engaged in at least one topography of stereotypic behavior. Subjects were recruited from local schools. Informed consent was obtained from each subjects' parent who was provided with a consent form that included the detailed purpose and procedure of the study. Assent was obtained from the subject if the functioning level of the subject was appropriately high. Demographic information for each subject is presented in Table 3-1.

Sessions were conducted in a room in the subject's school separate from their typical classrooms. In all but one case, the room was devoid of distracting stimuli. For Tobias, a general-purpose room in his school that contained toys and other materials was used and a researcher sat near Tobias to ensure he did not get up from the research table or interact with items outside of the experiment.

Target Behavior and Data Collection

Operational definitions were constructed for any apparently stereotypic behavior; naturalistic observations were conducted with each subject until definitions were written for each topography. A list of all topographies of stereotypy for each subject is included in Table 3-2. Definitions for each topography are available from the author.

Data were collected by one or more researchers who observed the subject from an unobtrusive location in the room. All observers were instructed in the subjects' operational definitions and collected at least one session of training data with each subject before collecting IOA. Similar to Experiment 1, observers used handheld computers to collect data on the duration of each topography of behavior and data were summarized as a percentage of session with behavior; total repetitive behavior and individual topographies were analyzed. Two observers independently collected data for 49% of sessions (range 20%-67% across subjects). Percent agreement scores were calculated using the proportional method as described in Experiment 1. Average percent agreement across all subjects and topographies was 90.60% (range 86 %-96% across subjects).

Procedure

Preference assessment

Free operant preference assessments (Roane, Vollmer, Ringdahl, & Marcus, 1998) were used to identify items to use during the free condition of the antecedent-based assessment for all subjects but Clyde. Clyde's most preferred item was identified in a preference assessment previously conducted for an earlier study. Items were chosen for inclusion in the preference assessment based on the recommendations of the subjects' teachers. Eight items were selected and the subject was prompted to

interact with each item prior to the start of the assessment. During the sessions, the items were placed within arms' reach of the subject in a random order; data were collected on engagement with an item, defined as physical contact with or orientation to the item. One to five 5-min sessions were conducted per subject. One 20-min session was conducted for Dante after he failed to select any item in two prior 5-min sessions. For Jasmine, who is blind and therefore unable to see the different items in an array, after one 5-min preference assessment session in which all items were presented, we conducted eight 1-min single operant sessions (Pace, Ivancic, Edwards, Iwata, & Page, 1985) to determine the extent that Jasmine would engage with a single item.

Data were analyzed as a percentage of session in which the subject engaged with an item and percentages were averaged across sessions. Two observers independently scored engagement for 86% of all the preference assessment sessions (range, 50-100% across subjects). The average percent of agreement across items and subjects was 98% (range, 91%-100% across subjects)

Antecedent-based assessment

Similar to Experiment 1, each subject was exposed to several conditions of an antecedent-based assessment in a multielement design. The five-minute sessions alternated between ignore, free, and demand conditions. Conditions were randomly chosen within a group of three sessions; no condition was repeated until each had been run once in a group. No programmed consequences occurred contingent upon stereotypic behavior in any condition.

Ignore*.* In this condition, the subject was left in the room without materials; the data collectors were present in the room, but they did not interact with the subject. This condition tested whether the subject would engage in stereotypic behavior when given

nothing to do, which would suggest that stereotypic behavior was maintained by automatic reinforcement. For Tobias, a researcher was present at the experimental table to prompt him to sit back down if he attempted to leave the research area; Tobias never attempted this.

Free*.* This condition was identical to the ignore, except that the subject was given access to preferred materials. The top four items from the preference assessment were included unless the subject engaged with the item less than 5% of the session during the preference assessment (for exceptions see below). This condition was used to identify the level of repetitive behavior when the subject had preferred materials and was not asked to do anything. For Tobias, a researcher was present at the experimental table and provided attention to the subject if he engaged in appropriate attention-seeking behavior or indicated he needed help.

Demand*.* In this condition, the researcher sat next to the subjects and prompted them to complete a task. Demands were presented continuously and there was no programmed inter-trial interval; the only break in demands occurred when the researcher reset the demand, which lasted no longer than a few seconds. Tasks were chosen for each subject by asking their teachers to identify things they could do but did not like to do. Preliminary assessments were done to identify a task the subject did not complete correctly more than half of the time but for which the subject possessed prerequisite skills (e.g., grasping is a prerequisite for puzzle completion). The demand condition tested whether the subject would engage in repetitive behavior when presented with demands.

Experiment 2: Results and Discussion

Table 3-3 displays results of the preference assessment as the average percent of sessions with engagement, with the exception of Jasmine, for whom percent of sessions during the 1-min single operant sessions is displayed. Items chosen for inclusion in the antecedent-based assessment are denoted by an asterisk. The top four items were selected for inclusion if they were engaged with at least 5% of the session. Three exceptions to this rule were made. Ethel was only provided with three items due to a data analysis error that underestimated the percent of engagement with the keyboard. Jasmine was given 1 extra item (the book) because she was blind and frequently pushed items out of reach. In addition, because Jasmine had difficulty activating the See n' Say™ on her own and primarily used it to engage in stereotypic behavior, we chose to use the book in the subsequent assessment rather than the See n' Say™. The final exception to the rule was made for Heidi. Heidi engaged with dolls, a car, a football, and a puppet most during the preference assessment. However, it was later observed that Heidi often tossed the items onto the floor seemingly because of the sound the item made when it fell (based on her reaction). Thus, items were swapped out that could be thrown but not broken and that would make a noise when they landed; for this reason, the car, Bob the Tomato™, the nubby ball, and a set of keys were chosen. Despite this change, Heidi's engagement remained high in the free sessions of the following assessment.

Results of the antecedent-based assessment showed that three of the 15 subjects (20%) had undifferentiated results. Three subjects (20%) engaged in differentially higher levels of repetitive behavior in only the ignore condition of the assessment. Four subjects (26.67%) engaged in differentially higher levels of repetitive behavior in both

the ignore and free conditions relative to the demand condition. Four subjects (26.67%) engaged in differentiated levels of repetitive behavior in the ignore and demand conditions; however, levels in the ignore condition were elevated above the demand condition for all four. One subject (6.67%) engaged in the differentially high levels of repetitive behavior in the demand condition.

Results of the antecedent-based assessment for Gertrude, Jesus, and Pablo are displayed in Figure 3-1; these three subjects engaged in undifferentiated levels of stereotypy. All three engaged in high levels of repetitive behavior across all conditions of the assessment, indicating that their repetitive behavior was maintained by automatic reinforcement. This pattern was generally consistent across topographies; however, Pablo engaged in differentially more squinting in the demand condition of the assessment. Because it was suspected that squinting might actually represent trying to see the task and not stereotypy, this topography was not further evaluated.

Results of the antecedent-based assessment for Kandi, Mario, and Tobias are displayed in Figure 3-2. All of the subjects displayed the differentially higher levels of stereotypy in the ignore condition, suggesting that the behavior was maintained by automatic reinforcement established as such by the relatively barren environment of the ignore condition. Kandi (upper panel) engaged in the highest level of repetitive behavior in the ignore condition and moderately high levels in the other two conditions. Similar results were obtained for Mario (middle panel). Tobias (bottom panel) engaged in low levels of stereotypy overall, but differentially higher levels in the ignore condition.

Results of the antecedent-based assessment for Chad, Jasmine, Ethel, and Dante are displayed in Figure 3-3. These subjects all engaged in differentially higher levels of repetitive behavior in the ignore and free conditions, relative to the demand

condition. Chad, Jasmine, and Ethel engaged in the highest levels of repetitive behavior in the ignore condition, and levels in the free condition were only slightly lower, suggesting that the items available in the free condition did not adequately compete with stereotypy. Dante engaged in the highest levels in the free condition, suggesting that the items provided in the free condition may have somehow complemented Dante's stereotypy; anecdotally it was observed that Dante engaged in nearly constant hand stereotypy with one hand while holding the bells in his other hand. For all three subjects, the tasks presented in the demand condition appeared to compete with stereotypy, given that stereotypy levels were lowest in this condition.

Results of the antecedent-based assessment for Martin, Agatha, Ben, and Heidi are displayed in Figure 3-4; These subjects engaged in the differentiated levels of stereotypy in the ignore and demand conditions of the assessment, suggesting that their behavior was maintained by automatic reinforcement established as such by both low levels of stimulation and by demands (or that demands competed with stereotypy to a degree). Further evaluation of individual topographies showed that Ben engaged in differentially higher levels of vocalizations in the demand condition (see Figure 3-5), suggesting that this topography was uniquely sensitive to the presence of demands and stereotypy was maintained by automatic reinforcement established as such by demands; Ben was later included in Experiment 3 to further evaluate the demand conditions under which vocalizations would occur. Heidi also displayed differentially higher levels of hand stereotypy (see Figure 3-5) and foot kicking the in demand condition; however, because Heidi wandered around the room during both the free and alone conditions, foot kicking could not technically occur during these sessions. Thus, hand stereotypy alone was chosen for later inclusion in Experiment 3 (but see

explanation in Chapter 4 of a subsequent disqualification from Experiment 3) Hand stereotypy was apparently maintained by automatic reinforcement established as such by demands.

Results from the antecedent assessment for Clyde are displayed in Figure 3-6. During the antecedent-based assessment, Clyde engaged in the differentially higher levels of stereotypic behavior in the demand condition, suggesting that his behavior was maintained by automatic reinforcement established as such by demands; this was not only true of the total measure of stereotypy but also individual topographies, including high-pitched vocalizations, other vocalizations, and head hitting. Due to these results, Clyde was chosen for later inclusion in Experiment 3.

Results of this experiment showed that 33% of individuals engaged in differentially higher levels of stereotypy in the demand condition of an antecedent-based assessment, as compared to the free condition. Given that no consequences were manipulated, it seems likely that these subjects' behavior was reinforced by automatic reinforcement established as such by the presence of demands. Results of this study are important because they indicate a limitation of previous research. Researchers have concluded that stereotypy that occurs in the presence of demands is escape maintained (Durand & Carr, 1987; Kennedy et al., 2000; Mace et al, 1987); however, results of this study imply that stereotypy that occurs in the presence of demands and the absence of social consequences is more likely maintained by automatic reinforcement. Experiment 3 was conducted to further evaluate the possible role of escape and automatic reinforcement. Because the presence of demands produced the highest levels of at least one form of stereotypy for three individuals, these subjects were initially selected to participate in Experiment 3.

Table 3-1. Demographic information for each subject: Name, age, gender, diagnosis, medications, and task used in the antecedent-based assessment are displayed. (ASD=Autism Spectrum Disorder, ID=Intellectually Disabled, S/L=Speech/Language, ADHD= Attention Deficit Hyperactivity Disorder, PDD= Pervasive Developmental Disorder)

Name	Age	Gender	Diagnoses	Medications	Task
Martin	16	male	Cerebral Palsy, ASD, educable ID, S/L impairment, and other physical impairments	Abilify and Selexa	Receptively identifying words
Gertrude	18	female	ID, ASD, and language impairment	None	Completing wood puzzle
Ben	12	male	Dandy Walker Syndrome, other health impairment, physical impairment, ADHD	Intinuv and Straterra	Pointing to numbers
Kandi	12	female	Trisomy 9 Syndrome, PDD, severe ID and S/L impairment	Zoloft	Completing wood puzzle
Jesus	10	male	ASD, S/L impairment, visual impairment	None	Putting blocks in bucket
Mario	8	male	ASD, profound ID, orthopedic impairment, S/L impairment, Intractable Epilepsy, Congenital Ptosis, Porencephaly, Pachygyria	Topomax and Keppra	Taking out puzzle piece
Heidi	14	female	ID, Cerebral palsy, speech delay, legally blind, seizures, asthma, Cardiac arrhythmia	Lamictal, Prevacid, Melatonin, and Trazadone	Putting blocks in a shape sorter
Agatha	15	female	ID, S/L impairment, legally blind, Microcephaly, history of seizures	Carditrol, Colopine, and Miralax	Putting blocks in bucket
Pablo	20	male	Profound ID, S/L impairment, physical (orthopedic) impairment	None	Putting blocks in a shape sorter
Jasmine	19	female	Trainable ID, Hypopituitarism, visual impairment, S/L Impairment and physical disability	Cortef, Solucorteff, Synthyroid, and Iron	Folding a towel
Dante	18	male	ASD and language impairment	Clonodine and Abilify	Pointing to 3, 5, 10 on a number line
Chad	17	male	Trainable ID, language impairment, ASD	None	Completing 2 digit math problems
Clyde	19	male	ID, ASD, and S/L impairment	Clonodine	Walking
Ethel	15	female	ID and S/L Impairment	Levothyroxine and Methimdoze	Completing a soft puzzle
Tobias	6	male	ID, S/L Impairment, heart defect, seizures	Diastat PRN	Writing letters

Table 3-2. For each subject, topographies of stereotypy are listed.

Subject	Topographies
Martin	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Limb Movements, Head Tics, Body Hitting, Shoe Play, Flapping, Object Manipulations, Finger Picking
Gertrude	Hand Stereotypy, Body Rocking, Sneering, Vocalizations, Foot Kicking, Gross Motor Movements, Tapping
Ben	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Hand-to-Neck Stereotypy, Shirt Mouthing
Kandi	Hand Stereotypy, Body Rocking, Scratching, Soft Vocalizations, Pushing, Clicking, Loud Vocalizations, Mouthing
Jesus	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Mouth Stereotypy, Jumping, Tapping, Ear Covering, Arm Flapping
Mario	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Wall Kicking, Mouthing, Cheek Sucking, Chin Pressing, Yelling/whining
Heidi	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Stomping, Tossing, Chair Shaking
Agatha	Hand Stereotypy, Body Rocking, Face Rubbing, Vocalizations, Foot Kicking, Mouthing, Ear Covering, Towel Playing, Teeth Grinding, Arm Posturing
Pablo	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Mouth Stereotypy, Squinting, Inappropriate Sexual Behavior
Jasmine	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Mouthing, Arm Swinging, Bouncing, Head Rolling, Ear Covering, Swearing
Dante	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Arm Swinging, Bouncing
Chad	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Biting, Yelling, Head Rolling, Jumping/bouncing, Disrupting
Clyde	Head Hitting, Banging, Skin Picking, High-pitched Vocalizations, Low-pitched Vocalizations, Chomping, Stomping
Ethel	Hand Stereotypy, Banging/throwing, Scratching, Vocalizations, Leg Flapping, Mouth Stereotypy, Yelling, Hair Playing, Huffing
Tobias	Hand Stereotypy, Body Rocking, Scratching, Vocalizations, Foot Kicking, Mouthing, Other Stereotypy

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Table 3-3. Results of the free operant preference assessment are shown. Numbers under the subject's names represent the number of sessions run. Scores represent the average percent of session the individual interacted with each item, unless otherwise noted in the text. Asterisks denote those items chosen for inclusion in free sessions of the antecedent-based assessment.

Martin (n=1)		Gertrude (n=4)		Ben (n=3)		Kandi (n-2)	
Puzzle*	36	Keyboard*	50	Magna Doodle™*	34	Rain stick*	100
Mr. Potato Head ™*	27	Mirror*	48	Mr. Potato Head* ™	24	Ambulance	0
LEGO™	1	Lotion*	18	Book*	23	Keys	0
Keyboard	1	Dolls	1	Keyboard8	5	Book	0
Book	0	Puzzle	0	Cars	2	See n' Say™	0
Magna Doodle™	0	Magna Doodle™	0	Ambulance	0	Elmo™ cell phone	0
Playdoh™	0	Bear	0	Puzzle	0	Plush	0
Rain stick	0	Polly Pockets™	0	Coloring	0	Keyboard	0

Jesus (n=2)		Mario (n=2)		Heidi (n=2)		Agatha (n=3)	
Bells*	46	Ambulance*	90	Dolls	17.3	Bells*	33
Ribbon*	24	Elmo™ cell phone*	14	Car*	16.65	Farmer*	28
Keys*	12	Rain stick	1	Football	10.35	Rain stick*	20
Mirror*	11	Mr. Potato Head ™	0	Puppet	10.15	See n' Say™*	4
Rain stick	3	Football	0	Bear	7.7	Arrow	0
See n' Say™	0	Bob the Tomato™	0	Ribbon	1	Keys	0
Antlers	0	Racecar	0	Bob the Tomato™*	0	Piano	0
Bob the Tomato™	0	Keyboard	0	Nubby ball*	0	Kaleidoscope	0

Table 3-3. Continued.

Pablo (n=2)		Jasmine (n=1)		Dante (n=5)		Chad (n=3)	
Keyboard*	92	Bob the Tomato™*	100	Bells*	40	See n' Say™*	51
See n' Say™	1	Elmo™ cell phone*	100	Keyboard	2	Mr. Potato Head ™*	51
Rain stick	1	Microphone*	100	Cardboard	1	LEGO™*	30
Gator	1	Rain stick*	100	Drum	0	Keyboard*	23
Bob the Tomato™	0	See n' Say™	100	Gator	0	Puzzle	0
Radio	0	Book*	96.7	Puzzle	0	Book	0
Bells	0	Piano	96.7	See n' Say™	0	Truck	0
Elmo™ cell phone	0	Bells	86.7	Thomas and friends™ book	0	Magna Doodle™	0

Ethel (n=2)		Tobias (n=4)	
See n' Say™*	26	Ambulance*	52
Little Puzzle*	25	Coloring*	25
Book*	12	See n' Say™*	15
Keyboard	9	Magna Doodle™	4
Rain stick	9	Barney™ book	2
Bells	7	Book	0
Elmo™ cell phone	2	Puzzle	0
Big Puzzle	0	Rain stick	0

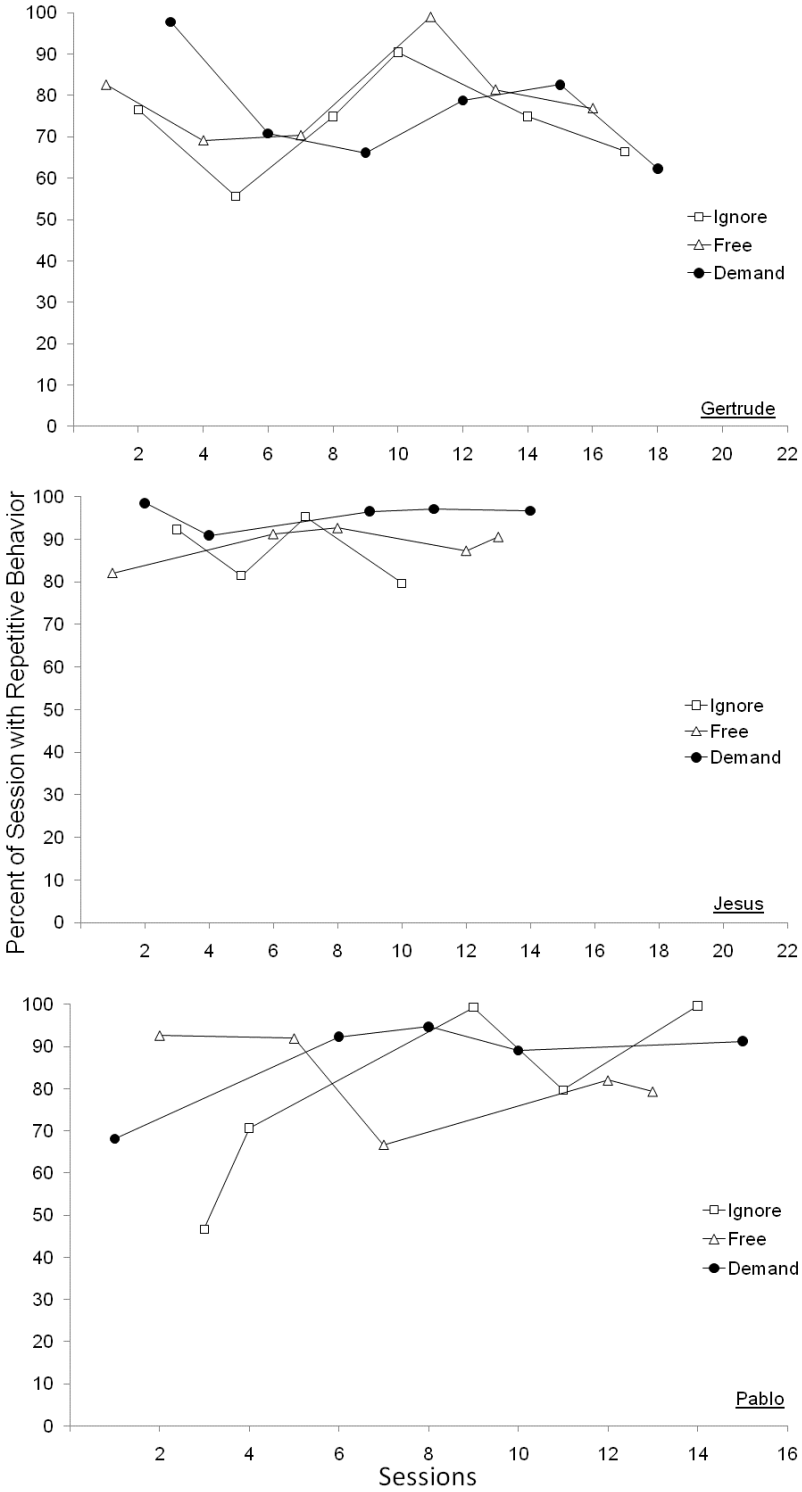

Figure 3-1. Percent of session with repetitive behavior across ignore (white squares), free (white triangles), and demand (black circles) conditions is displayed for Gertrude, Jesus, and Pablo. These subjects engaged in high levels of repetitive behavior across all conditions of the antecedent-based assessment.

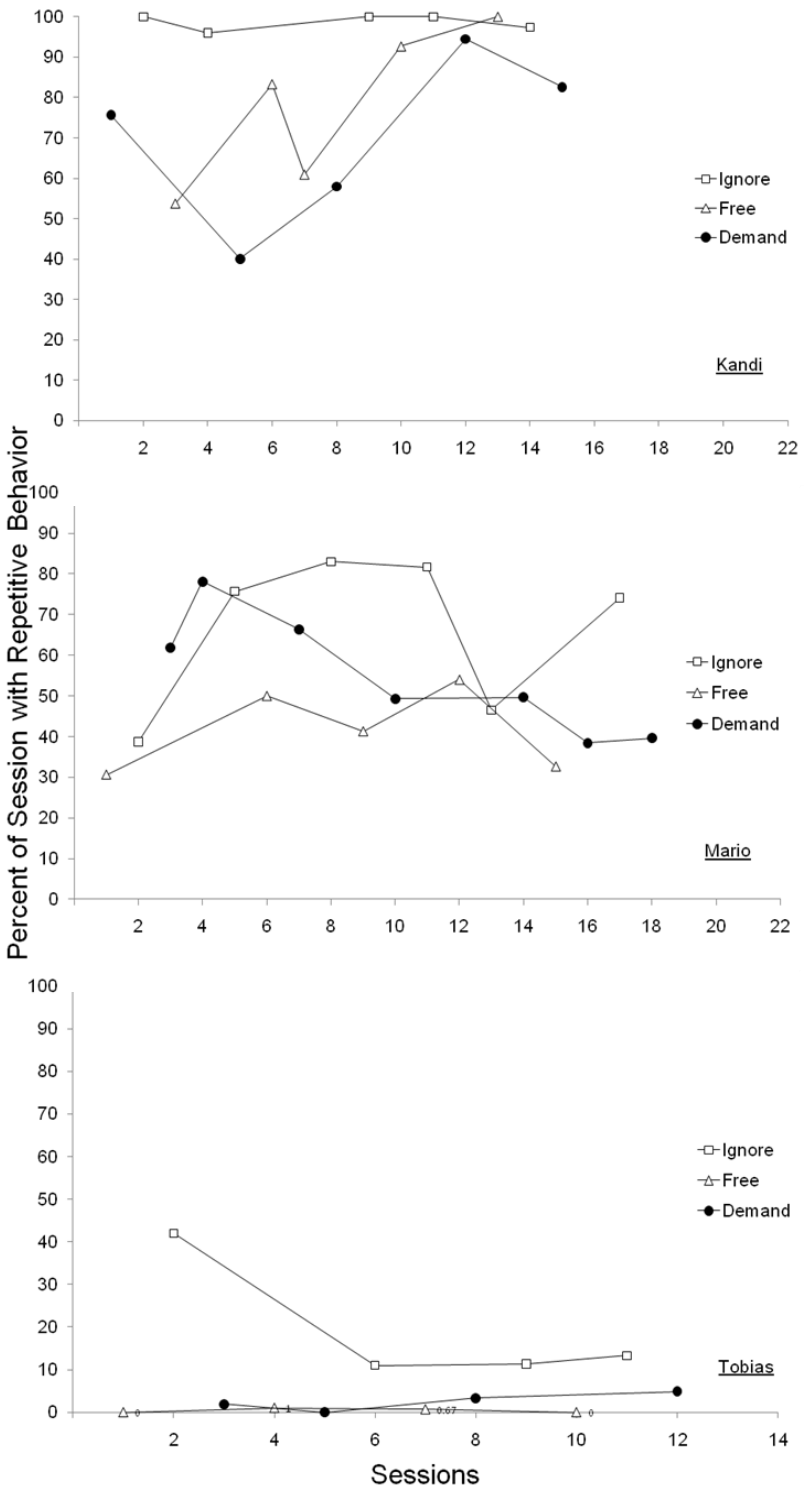

Figure 3-2. Percent of session with repetitive behavior across ignore (white squares), free (white triangles), and demand (black circles) conditions is displayed for Kandi, Mario, and Tobias, who engaged in the differentially higher levels of repetitive behavior in the ignore condition.

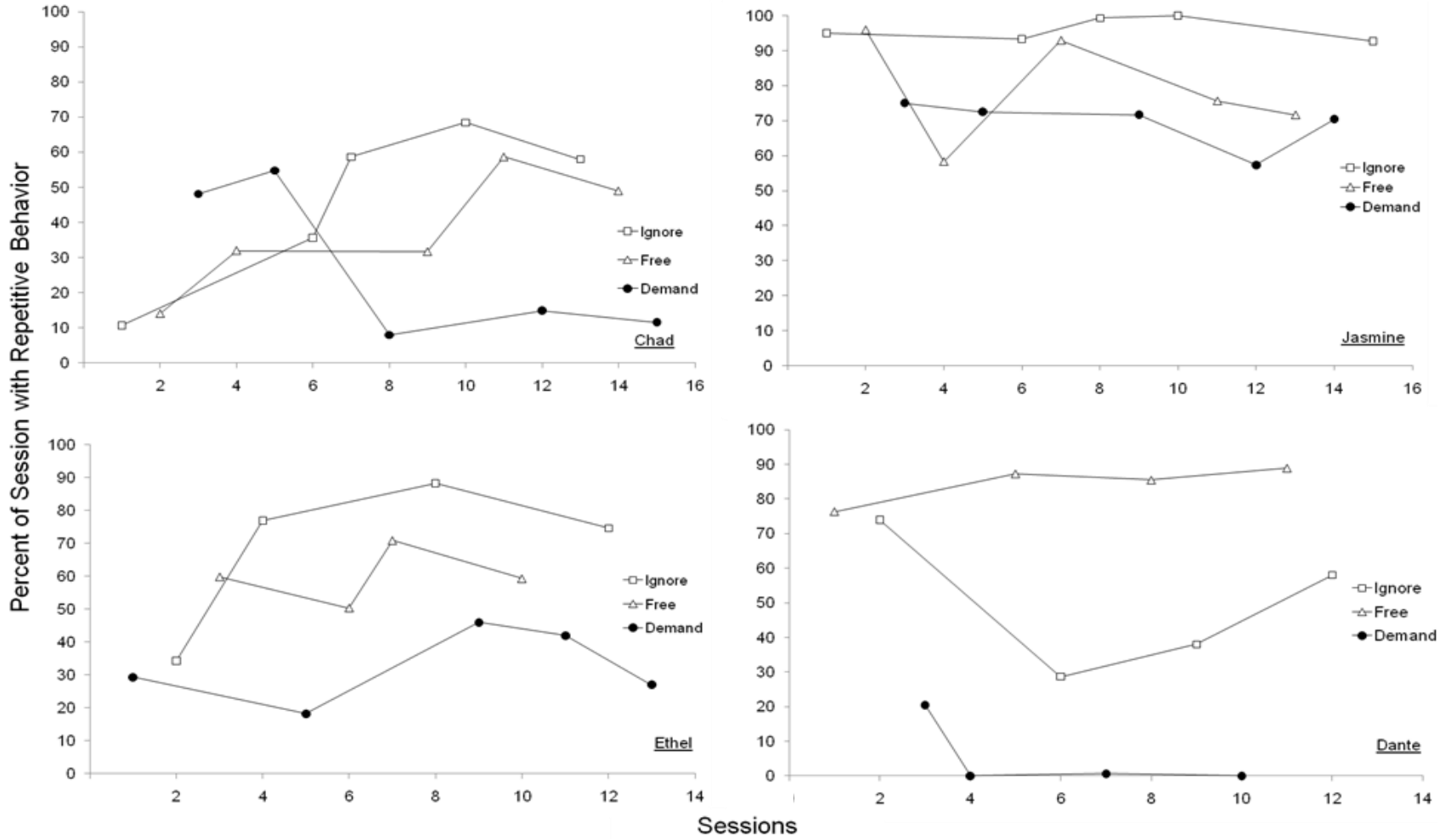

Figure 3-3. Percent of session with repetitive behavior across ignore (white squares), free (white triangles), and demand (black circles) conditions is displayed for Chad, Jasmine, Ethel, and Dante, who engaged in differentially higher levels of repetitive behavior in the ignore and free conditions.

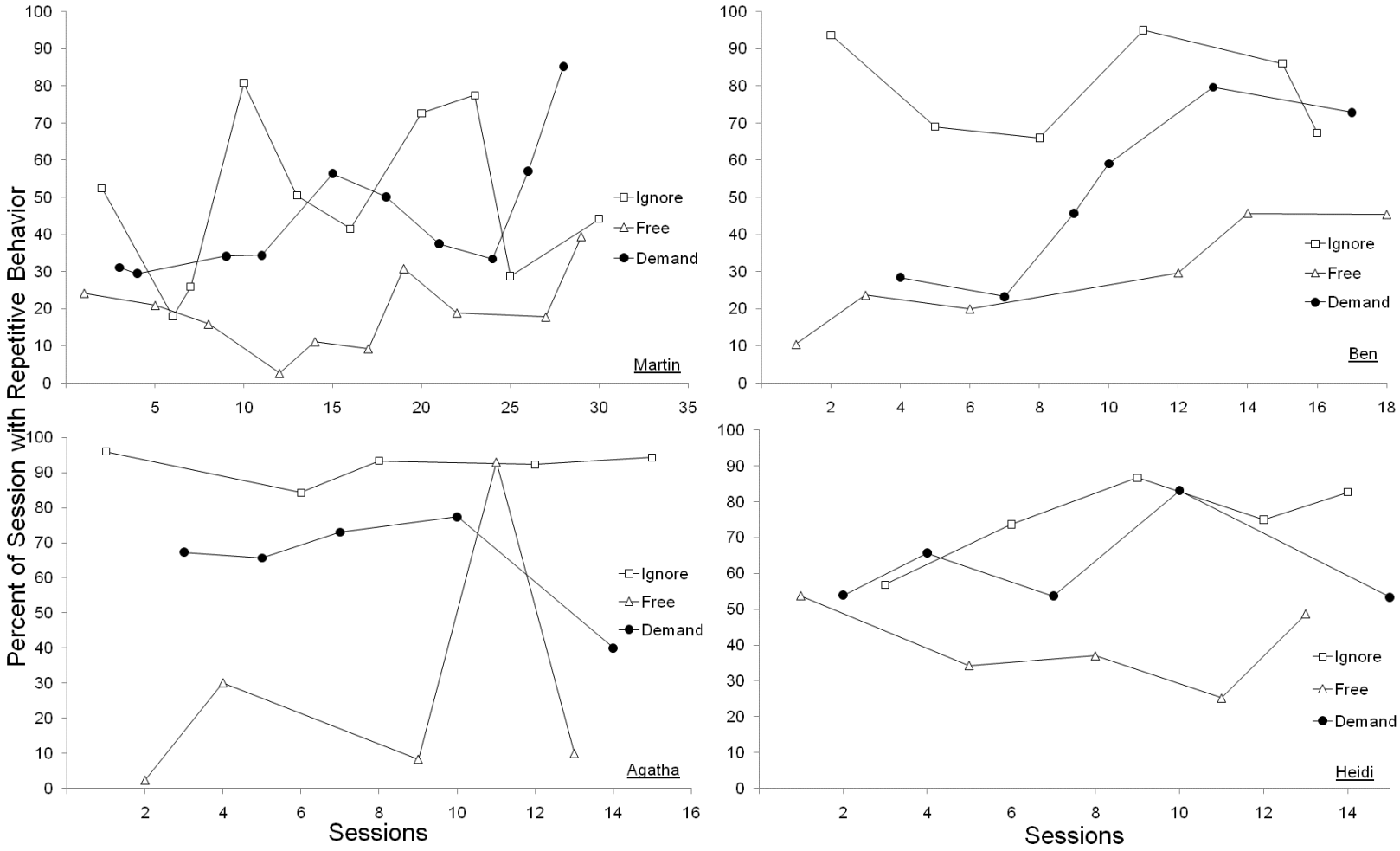

Figure 3-4. Percent of session with repetitive behavior is displayed across ignore (white squares), free (white triangles), and demand (black circles) conditions for Martin, Agatha, Ben, and Heidi who engaged in differentiated levels of repetitive behavior during the ignore and demand conditions of the antecedent-based assessment.

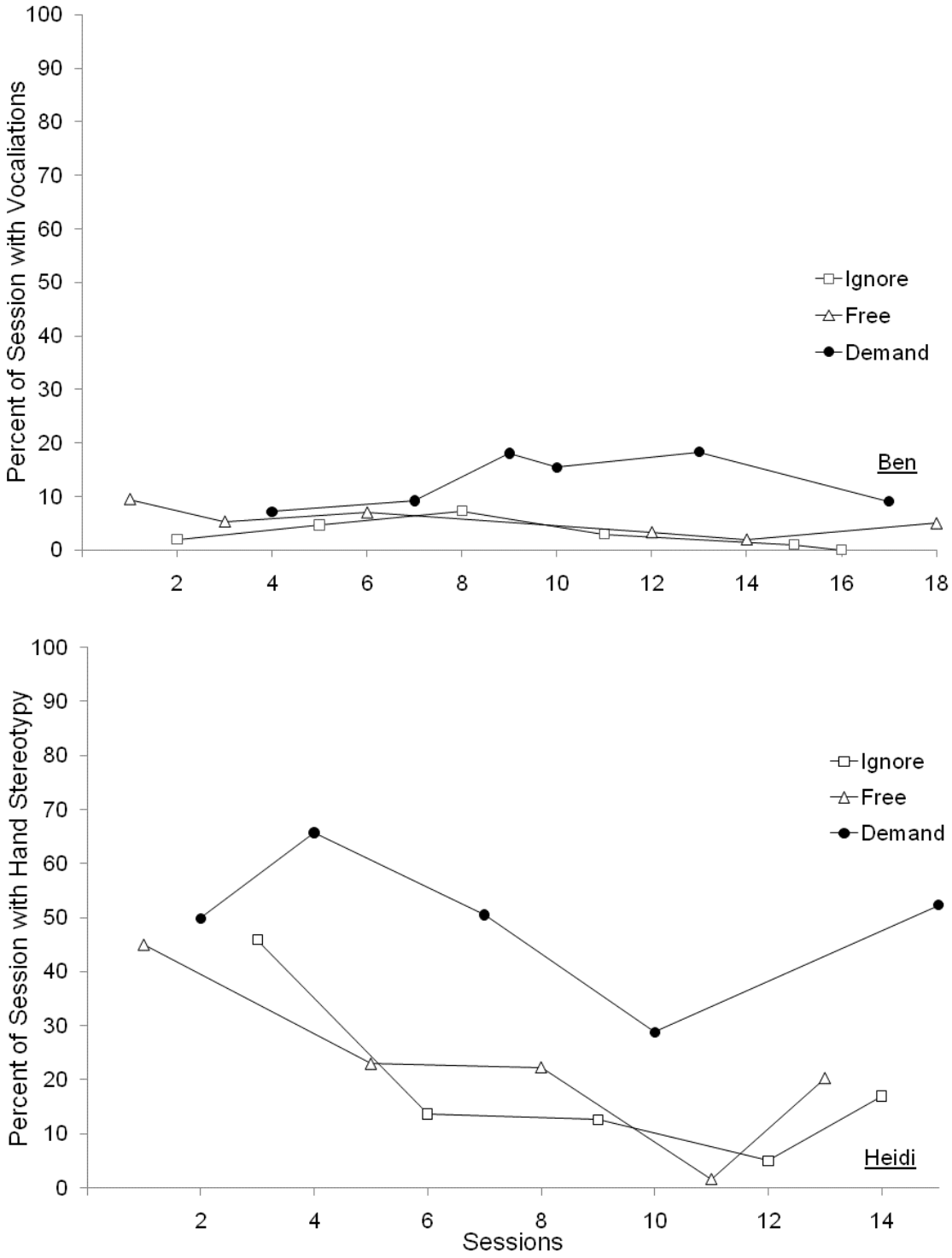

Figure 3-5. Percent of session with vocalizations (Ben) and hand stereotypy (Heidi) is displayed across ignore (white squares), free (white triangles), and demand (black circles); these topographies occurred at the highest levels in the demand condition.

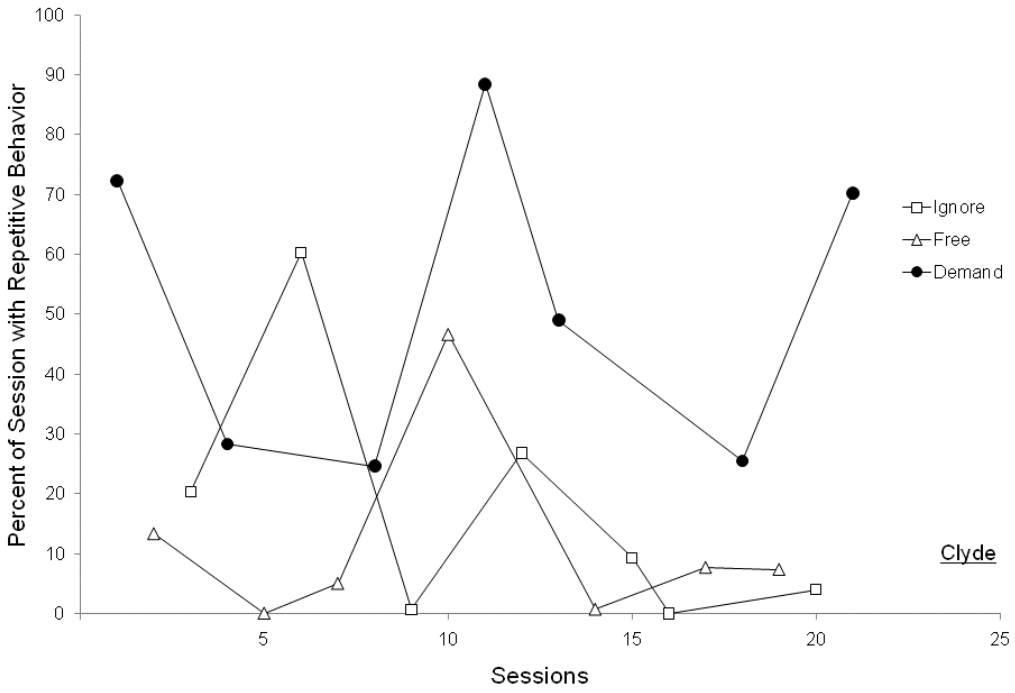

Figure 3-6. Percent of session with repetitive behavior is displayed across ignore (white squares), free (white triangles), and demand (black circles) conditions for Clyde. Clyde most often engaged in repetitive behavior during the demand condition of the antecedent-based assessment.

CHAPTER 4
AN EVALUATION OF REPETITIVE BEHAVIOR THAT OCCURS IN THE DEMAND CONDITION OF AN ANTECEDENT-BASED ASSESSMENT

Experiment 3: Purpose

Results of Experiments 1 and 2 showed that differentially higher levels of repetitive behavior occurred in the presence of demands for both typically functioning adults and intellectually disabled children, respectively. Because repetitive behavior occurred in the absence of social contingencies, automatic reinforcement was implicated as the maintaining reinforcer. The purpose of Experiment 3 was to further evaluate whether stereotypy that occurred at differentiated levels in the demand condition of an antecedent-based assessment was maintained by escape or automatic reinforcement established as such by the presence of demands.

Experiment 3: Methods

Subjects and Settings

Subjects were three individuals who engaged in the highest levels of at least one topography of stereotypy in the demand condition of Experiment 2. Ben, Heidi, and Clyde participated; demographic information for these subjects was provided in the previous chapter. Consent for each subject was obtained prior to the previous study in the manner described in Experiment 2. Sessions were conducted in a room in the subject's school separate from their typical classrooms; this room was devoid of distracting stimuli.

Target Behavior and Data Collection

Operational definitions and data collection procedures were identical to those used in Experiment 2. Two observers independently collected data for 56% of sessions (range 53%-61% across subjects). Percent agreement scores were calculated using

the proportional method as described in Experiment 1. Average percent agreement across all subjects and topographies was 92.29% (range 87 %-97% across subjects).

Procedure

Demand evaluation. For those individuals who engaged in highest levels of at least one stereotypic behavior in the demand condition of Experiment 2, relative to all other conditions, an additional analysis was conducted to further evaluate the function of the subject's stereotypic behavior. Sessions of the demand evaluation were five minutes and were conducted in a multi-element design. Conditions were randomly chosen within a group of two sessions; no condition was repeated until each had been run once in a group

Demand vs. free. In the first phase of the demand evaluation, demand and free sessions were alternated. These sessions were identical to those conducted in Experiment 2. The purpose of this phase was to replicate the results from Experiment 2.

Escape vs. free. In the second phase of the demand evaluation, free sessions were alternated with escape sessions in which 20 sec breaks from demands were provided contingent on stereotypic behavior. Escape sessions were otherwise identical to the demand sessions of the previous experiment and phase. For Ben the contingency in the escape sessions was applied to hand stereotypy. For Clyde, escape vs. free was conducted twice, once when vocalizations produced escape and once when head hitting produced escape.

Demand vs. enriched environment. In the final phase of the demand evaluation, the aversiveness of the demand was reduced via environmental enrichment. In this phase, demand sessions that were identical to those previously conducted were

alternated with enriched environment sessions to determine whether reducing the aversiveness of the environment would reduce stereotypy. Enriched environment sessions were identical to demand sessions except that access to preferred stimuli was made continuously available.

Items chosen for inclusion in the enriched environment assessment were those identified as highly preferred by an assessment or natural observations. For Clyde, a travel Magna Doodle™ and music were used; the Magna Doodle™ was Clyde's highest preferred item and Clyde was observed to react positively to music in the classroom. For Ben, the Magna Doodle™, book, silly putty, and music were used; the Magna Doodle ™ and book were highly preferred items. Music was chosen to approximate the music created by the keyboard, another preferred item. Silly putty was chosen to provide something Ben could hold in one hand while working; although Ben had not been observed with Silly Putty previously, he immediately approached the item when it was made available.

Experiment 3: Results and Discussion

Data are not shown for Heidi. Although Heidi engaged in differentially higher levels of stereotypy in the demand condition of the first phase, she was not included in subsequent phases of the evaluation. The reason for this was that Heidi's primary topography switched to foot kicking, which occurred at much higher levels during demand than during free. However, the sessions were confounded by the fact that she was seated during demands and usually not during free, so the foot kicking (although physically possible during free) was more likely in demand by mere virtue of the session structure. Unlike in experiment 2, hand stereotypy now occurred at levels comparable to those in free, so Heidi did not participate in subsequent phases

Results of the demand evaluation are displayed in Figure 4-1; results are shown for total repetitive behavior for Ben (top panel) and for Clyde (bottom panel). In the first phase, both subjects engaged in differentially higher levels of repetitive behavior in the demand condition relative to the free condition; these results are true of the individual topographies as well (See Figure 4-2). These outcomes replicate the results of the previous experiment showing that stereotypy was differentially higher in the presence of demands. In addition, these results provide preliminary evidence that the subjects' stereotypy was maintained by automatic reinforcement in the presence of demands. The demand sessions involved the continuous presentation of demands, a procedure akin to escape extinction. Were the subjects' stereotypy maintained by escape, we might see an initial extinction burst followed by a gradual decrease in the level of behavior. To the contrary, the behavior of both subjects increased or maintained at relatively stable levels across the first phase.

Figure 4-2 displays the results of the demand evaluation for the subject's individual topographies; hand stereotypy for Ben (top panel) and combined vocalizations (middle panel) and head hitting (bottom panel) for Clyde are displayed. Ben was originally chosen to participate in Experiment 3 based on his levels of vocalizations in the previous study; however, Ben engaged in similar levels of vocalizations across the demand and free sessions but much higher levels of hand stereotypy in the demand sessions relative to the free. Hence, hand stereotypy was chosen as the target behavior for the escape contingency in the second phase. Clyde engaged in differentially higher levels of both general topographies of stereotypy (vocalizations and head hitting) in the demand sessions relative to the free sessions. Thus, we chose to conduct two sections

of the second phase of the evaluation; first we applied the escape contingency to vocalizations and then later to head hitting. .

Results of the free vs. escape phase are displayed in the second phase of the top panel of Figure 4-1 for Ben and the second and third phases of the bottom panel of Figure 4-1 for Clyde. Both subjects engaged in differentially higher levels of stereotypy in the escape sessions relative to the free sessions. Similar results were observed for the individual topographies in Figure 4-2. These data might suggest that the subject's behavior was maintained by escape; however, for Ben, levels of stereotypy in the current phase were comparable to those observed in the previous phase. And, for Clyde, levels of stereotypy were actually lower in the escape sessions than in the demand sessions of the previous phase. These results differ from what would be expected with a reinforcement effect; if escape from demands had been reinforcing the subject's stereotypy, behavior should have increased or at a very minimum should have decreased in the demand condition without escape.

In addition, many of the stereotypic responses observed during the escape sessions occurred during the break from demands. Relative to levels displayed in the second phase in Figure 4-1, lower levels of stereotypy were observed in the escape sessions when the break intervals were removed. In addition, stereotypy occurred at higher levels during the break intervals than during those times when a break was not presented (when demands were present). These results are important because they draw into question the reinforcing value of the escape from demands. Results of the demand versus enriched environment phase are displayed for Ben and Clyde in the last phases of the top and bottom panels of Figure 4-1, respectively. During enriched

environment, Ben and Clyde engaged in differentially lower levels of all forms of stereotypy, even though they were still working continuously. These results suggest that the aversiveness of the demands was an establishing operation for stereotypy, which was maintained by automatic reinforcement. Decreasing the aversiveness of the demand context may have acted as an abolishing operation to decrease the reinforcing value of stereotypy. Alternatively, the preferred items may have provided access to behavior that effectively competed with stereotypy by producing higher quality reinforcement.

Taken together, these results show that although the subjects' stereotypic behavior occurred most often in the presence of demands, behavior was not maintained by escape from demands and was instead maintained by automatic reinforcement established as such by the demand. The results of the experiment demonstrate a potential problem with antecedent-based assessments. A researcher or clinician conducting an antecedent-based assessment similar to the first phase of Experiment 3 might be tempted to conclude that the stereotypy was maintained by escape because it occurred in the presence of demands.

Furthermore, the results of the second phase of the evaluation would also likely be interpreted as showing a demand function by a researcher or clinician conducting a functional analysis. This conclusion would also lead to a false positive because further analyses showed that the stereotypy was not reinforced by escape. Hence, these results hold potentially important implications for both antecedent-based assessments and functional analyses of stereotypy.

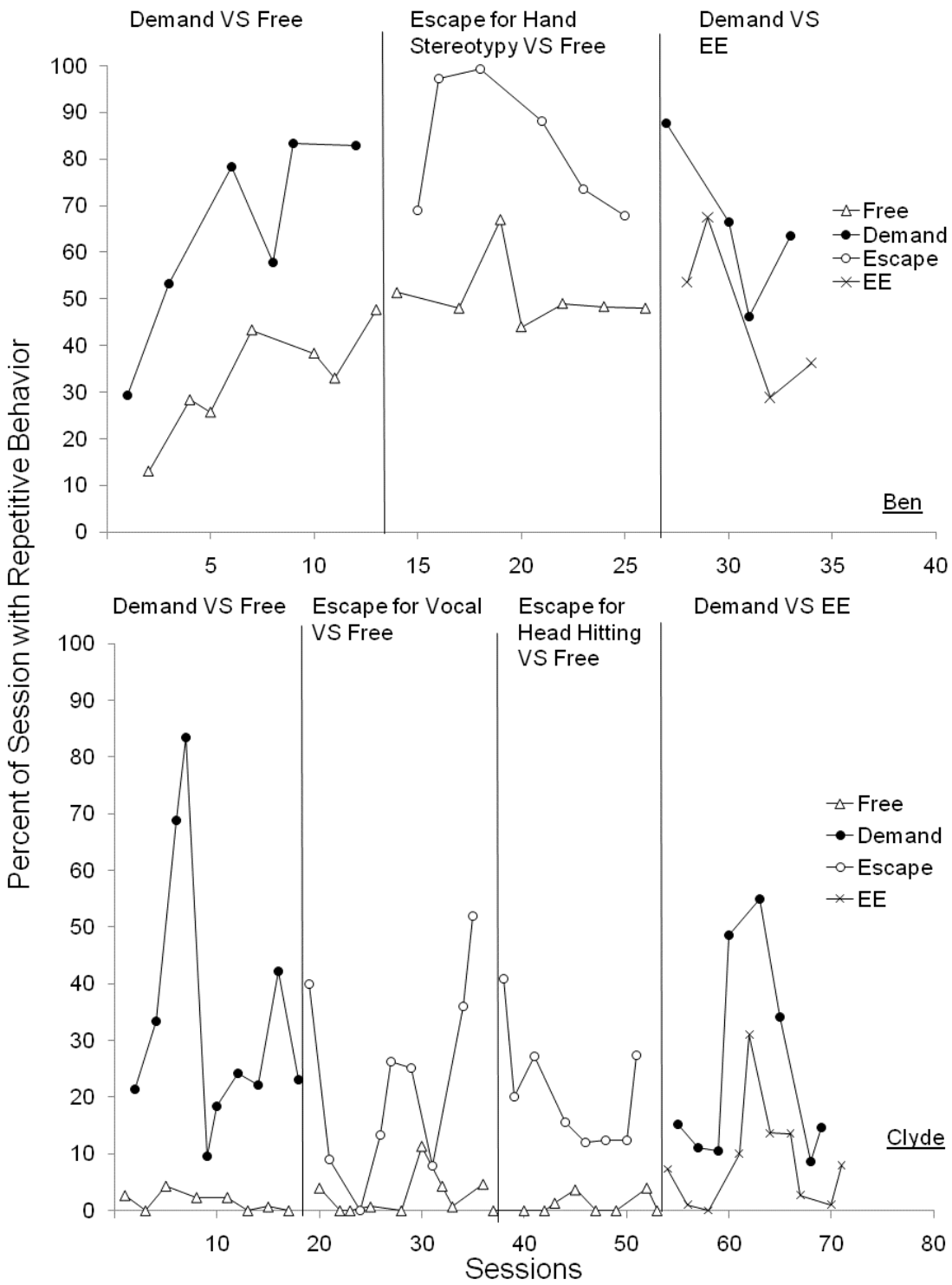

Figure 4-1. Results of the demand evaluation for Ben (top panel) and Clyde (bottom panel) are displayed. Percent of session with repetitive behavior is displayed across free (white triangles), demand (black circles), escape (white circles), and enriched environment (cross-hatches).

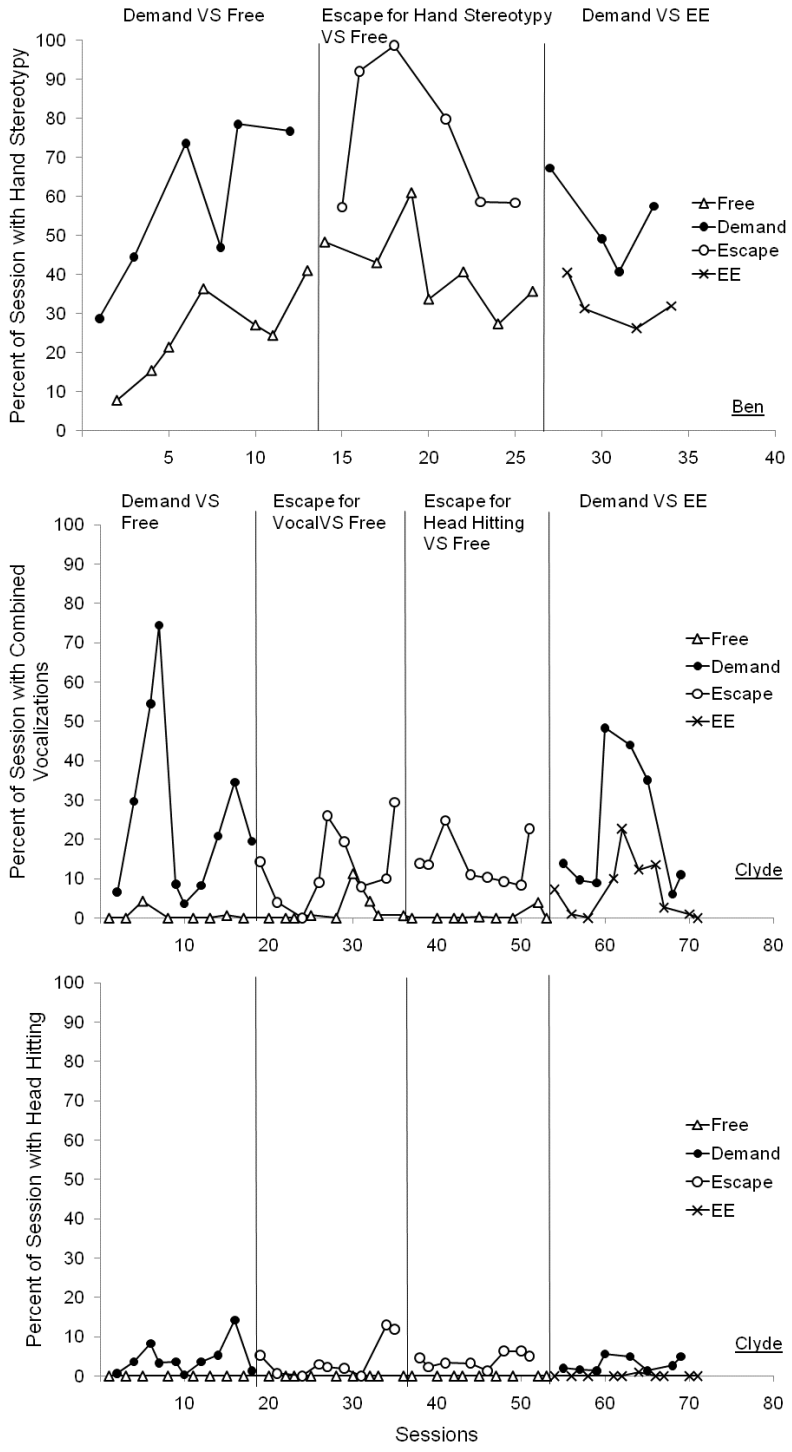

Figure 4-2. Results of the demand evaluation for Ben and Clyde's individual topographies are displayed. Percent of session with hand stereotypy for Ben (top panel) and combined vocalizations (middle panel) and head hitting (bottom panel) for Clyde is displayed across free (white triangles), demand (black circles), escape (white circles), and enriched environment (cross-hatches) conditions

CHAPTER 5
GENERAL DISCUSSION

Overall Summary

Experiment 1 determined that 24% of typically functioning adults engaged in differentially higher levels of repetitive behavior in the demand condition of an antecedent-based assessment in which consequences were not manipulated. An overwhelming majority of individuals engaged in differentially higher levels during the alone condition. Experiment 2 determined that 20% of individuals with intellectual disabilities engaged in at least one topography of repetitive behavior (stereotypy) most often in the demand condition. Results of Experiment 3 demonstrated that for those subjects who engaged in the highest levels of repetitive behavior in the demand condition, behavior was not reinforced by escape and was instead maintained by automatic reinforcement in the presence of demands.

Experiment 1

Experiment 1 evaluated which conditions were most likely to evoke repetitive behavior in typically functioning adults. Adults were exposed to three conditions of an antecedent-based assessment: alone, free, and demand. 66% of subjects engaged in differentiated levels of repetitive behavior in only the alone condition. 18% of subjects engaged in differentiated levels of repetitive behavior in both the alone and demand conditions, but engaged in highest levels in the alone condition. 4% of subjects engaged in the highest levels of repetitive behavior in the demand condition; however, levels in the alone condition were also differentiated. One subject (2%) engaged in differentiated levels of repetitive behavior in only the demand condition. 10% of the subjects showed undifferentiated results.

Several limitations of the study should be noted. First, sessions were not run to stability due to limited time which each subject. In addition, no manipulation check was done to assess the extent to which the alone condition was “boring” and the demand condition was “aversive.” However, given that the subjects were blind to the true nature of the study, we felt that conducting a manipulation check may have increased the subjects’ awareness of the purpose of the study and thus made them more reactive to the procedures. Future research should evaluate the extent to which the alone and demand conditions are actually boring and aversive.

. The results of this study provide several implications for the assessment of repetitive behavior or habits. First, these results have shown that repetitive behavior occurs in different contexts and is maintained by different types of reinforcement. If the goal is to reduce repetitive or habitual behavior, one should first begin with an assessment similar to the one conducted here to determine whether the behavior occurs more often during low or aversive stimulation. Behavior that occurs most often during low stimulation should be addressed by increasing the ambient stimulation in the environment, perhaps through environmental enrichment. Previous research has shown that behavior maintained by automatic reinforcement can be reduced through environmental enrichment in the form of noncontingent access to preferred materials (e.g., Horner, 1980; Ringdahl, Vollmer, Marcus, & Roane, 1997; Vollmer, Marcus, and LeBlanc, 1994). However, if behavior occurs most often when an individual is presented with demands or some type of aversive stimulation, treatment should address decreasing the aversiveness of the situation, perhaps by decreasing the rate of the demand or incorporating other types of preferred stimulation. Call, Wacker, Ringdahl,

Cooper-Brown, and Boelter (2004) found that decreasing task difficulty and adding noncontingent attention could decrease noncompliance in the presence of demands; similar methods could be used to decrease repetitive behavior that occurs in the presence of demands.

Results of Experiment 1 showed that some topographies occurred more often than others. Two of the three most frequently observed topographies were self-scratching and nail-biting, which are repetitive behaviors that can become harmful at extreme levels and intensities. Hence, results of Experiment 1 may have important implications for clinical populations who engage in these topographies at a distressing or disruptive level. Self-scratching and nail biting occurred most often in the alone condition, perhaps suggesting a self-stimulatory function. As mentioned previously, environmental enrichment may be an effective treatment for behavior that occurs in times of low stimulation; future research should determine whether environmental enrichment will be effective in decreasing repetitive behavior in both nonclinical and clinical populations. It is possible that treatments aimed at “anxiety-reduction” do not address the primary function of the behavior, which more colloquially might be akin to alleviation of “boredom” (i.e. automatic reinforcement).

Experiment 2

The purpose of Experiment 2 was to replicate Experiment 1 with intellectually disabled individuals and to evaluate whether stereotypy occurred at differentiated levels in the demand condition of an antecedent-based assessment. Results of Experiment 2 were similar to those observed in Experiment 1 with typically functioning adults. 40% engaged in the highest levels of repetitive behavior in the ignore condition of the assessment; 26.67% engaged in differentiated levels of repetitive behavior in the ignore

and demand conditions, with highest levels in the ignore condition. 20% engaged in high, undifferentiated levels across all conditions; one subject (6.67%) engaged in the highest levels of repetitive behavior in the demand condition only. One final subject (6.67%) engaged in the highest levels of stereotypy in the free condition.

For those subjects who engaged in lower levels of repetitive behavior in the demand condition, it is unclear what aspect of the condition suppressed responding. It is possible that the task, which incorporated the use of the hands for all subjects other than Clyde, blocked repetitive behavior that involved the hands, e.g., hand stereotypy. Alternatively, other sources of reinforcement such as the therapist's praise may have competed with the reinforcement produced by the repetitive behavior.

For three of the individuals who engaged in differentiated levels of stereotypy in the demand condition, at least one topography of stereotypy was differentially higher in demand than in any other condition. Given that consequences were not manipulated and the demand condition was akin to escape extinction, it seems unlikely that the subjects' behavior was maintained by escape from demands. Instead, it would appear that their behavior was maintained by automatic reinforcement established as such by the presence of demands. We conducted Experiment 3 to further evaluate the function of stereotypy.

Several limitations should be noted. First, brief assessments using five minutes session were conducted, which may not have allowed for enough time to observe an extinction effect during the demand sessions. Additionally, a formal demand assessment was not conducted at the beginning of the study. Informal assessments

were conducted to find a task that appeared difficult, but using a formal assessment may have ensured that an aversive task was used.

Experiment 3

Experiment 3 was conducted to determine whether escape from demands or automatic reinforcement was maintaining stereotypy that occurred most often in the demand condition of an antecedent-based assessment. To determine this, we conducted a series of evaluations. In the first evaluation, sessions with continuous demands were compared to session without demands, and all three subjects engaged in differentially higher levels of stereotypy in the demand sessions. In addition, although demand sessions were procedurally identical to escape extinction, levels of stereotypy maintained or increased across the demand sessions, which is contrary to an extinction effect. Had stereotypy been reinforced by escape from demands, we should have seen a gradual reduction in stereotypy. It should be noted that the use of five-minute sessions was a potential limitation and might not have allowed for enough time to observe the extinction effect.

The second evaluation in Experiment 3 compared sessions with contingent escape for target stereotypy to sessions without demands. Although both subjects engaged in differentially higher levels of stereotypy in the escape sessions, levels of stereotypy were not higher than in the previous demand sessions without escape. The application of the contingency did not produce an increase in responding and thus a reinforcement effect was not observed.

The third evaluation in Experiment 3 compared continuous demand sessions with preferred stimulation (enriched environment) to continuous demand sessions without preferred stimulation (escape extinction). The results of this evaluation showed that

when the aversiveness of the demand condition was reduced through the presentation of preferred stimuli, stereotypy decreased. In addition, because this phase also incorporated demand sessions that were procedurally identical to escape extinction, another opportunity was provided to observe the lack of an extinction effect.

Conclusions

This series of experiments further confirms that the vast majority of stereotypic behavior is not maintained by socially mediated reinforcement contingencies. However, it is possible that social contingencies played a role in the development of behavior maintained by automatic reinforcement established as such by the presence of demands. It is possible that a subject such as Clyde initially engaged in stereotypic behavior when presented with demands and the demands were removed. After being repeatedly paired with the reinforcing consequence of the environment becoming demand-free and thus less aversive, stereotypy may have acquired the properties of a conditioned reinforcer (CR). Thus stereotypy could be maintained by automatic reinforcement via CR effects even when demands were no longer removed.

Interestingly, because extinction would be very difficult to implement had stereotypy acquired its reinforcing value in this way, punishment would be implicated for treatment of behavior maintained by automatic reinforcement in the presence of demands. If behavior had acquired conditioned reinforcer properties because it was previously paired with a bettering of the environment, treatment would involve contingent worsening of the environment to remove the CR effect. This particular treatment recommendation is interesting because it is one of the few cases in which the results of a functional analysis would prescribe punishment as treatment. In addition, applying contingent aversive stimulation would assist in evaluating whether behavior

was truly operant, in which case it would decrease, or if it were elicited (respondent behavior), in which case it would increase.

In addition, the current studies draw into question the use of antecedent-based assessments to infer socially mediated sources of reinforcement. The results also draw into question the conclusions of previous research that have used antecedent-based assessments. Readers continue to interpret the results of studies such as Durand and Carr (1987) as indicating as escape function of behavior when the data presented here clearly refute that notion. Researchers and clinicians should be skeptical when interpreting the results of studies using antecedent-based assessments.

This sequence of studies also has important implications for researchers who conduct consequence-based functional analyses but are unable to decrease behavior during extinction, such as in the rare examples presented by Iwata et al. (1994). In the rare circumstances such as those seen with Clyde in Experiment 3, behavior maintained by automatic reinforcement in the presence of demands will appear to be escape maintained in typical functional analyses. If escape extinction is ineffective following the functional analysis, efforts should be made to determine whether the behavior is not in fact maintained by automatic reinforcement. Evaluations similar to those employed in Experiment 3 could be conducted.

These results and implications might have generality for behavior other than stereotypy and for populations other than ID individuals, especially given results of Experiment 1. Typically developing adults and intellectually disabled children both appear to engage in repetitive behavior maintained by automatic reinforcement in the presence of demands. In addition, stereotypic SIB may be reinforced in a similar

manner at least occasionally. Azrin, Hutchinson, and McLaughlin (1965) observed that aggression often occurs as a result of aversive stimulation; therefore aggressive behavior could also be reinforced by automatic reinforcement in the presence of demands (consider people who punch walls or punching bags during or immediately after aversive events). In conclusion, automatic reinforcement established as such by aversive stimulation is a function that may influence many populations and response topographies. This research may be viewed as a starting point to evaluate automatic reinforcement not only in austere environments but also in aversive environments.

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BIOGRAPHICAL SKETCH

Amanda Bosch was born in Fargo, North Dakota (ND) in 1978 and was raised in Reno, Nevada. After Amanda obtained her Bachelor of Arts in psychology from the University of Nevada, Reno in 2002, she moved to Atlanta, Georgia to work for two years at the Marcus Institute with children with behavior and feeding disorders. In 2004, Amanda moved back to Fargo, ND to attend graduate school at North Dakota State University, where she received her Master of Science in clinical psychology in 2006. Amanda lived in Gainesville, Florida for five years, working on her Ph.D. under the mentorship of Tim Vollmer. She received her Ph.D. from the University of Florida in the summer of 2011. After graduation, Amanda moved to Lubbock, Texas to be a Visiting Professor and Postdoctoral Intern at Texas Tech University.