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FUNCTIONAL ANALYSIS AND TREATMENT OF EYE POKING

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In four studies we analyzed the eye poking of a youth with profound disabilities. In Study 1, a functional analysis showed that eye poking occurred during the no-attention condition, but not during demand, attention, or recreation conditions. The analysis did not identify socially mediated variables involved in the maintenance of eye poking; rather, eye poking may have been maintained by consequences produced directly by the response. In Study 2 we had the student wear goggles to prevent potential reinforcement from finger–eye contact. The results of Study 2 indicated that eye-poking attempts were reduced when the student wore goggles. We then tested in Study 3 the effects of two alternative topographies of stimulation. Study 3 demonstrated that eye poking was reduced when a video game was provided as a competing source of visual stimulation, and that music was less effective in reducing eye poking. In Study 4, a contingency analysis using the video game was conducted in an attempt to (a) reduce the frequency of eye poking and (b) study whether the video game functioned as a reinforcer. The results of Study 4 demonstrated substantive reductions in the frequency of eye poking, and suggested that the video game served as a reinforcer.

DESCRIPTORS: self-injury, functional analysis, maintaining variables, private events, students with severe disabilities

Identification of the condition(s) maintaining self-injury has become the sine qua non of programming for behavior change (Carr, 1977; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; O'Neill, Horner, Albin, Storey, & Sprague, 1990). Once these reinforcers are identified, interventions can focus on manipulating reinforcement contingencies (Iwata, Pace, Cowdery, Kalsher, & Cataldo, 1990; Mace & Lalli, 1991) and/or establishing competing responses for reinforcement (Carr & Durand, 1985; Horner & Day, 1991; Steege, Wacker, Berg, Cigrand, & Cooper, 1989). Often the consequences identified as maintaining self-injury are mediated by others in a person's social environment. Such social mediation facilitates the manipulation of variables maintaining responding and the development of interventions to reduce problem behavior.

In some cases of self-injury, however, the consequences maintaining responding may not be readily identifiable (Derby et al., 1992; Iwata et al., 1994). Such instances present a challenge for behavior analysts, because the absence of an identified maintaining variable makes intervention selection ambiguous (Favell, McGimsey, & Schell, 1982; Vollmer, Marcus, & LeBlanc, 1994). For example, when a student repeatedly strikes her face in the absence of others, the consequences maintaining responding are unclear. If such a student's self-injury occurs independent of her social environment, analysis should include nonsocial variables that may be associated with behavioral maintenance. Identifying and manipulating possible reinforcers in such cases are difficult because responding may directly produce the reinforcing consequence (Skinner, 1982). However, if some aspect of the reinforcer can be identified as part of a public environment (e.g., the sound produced by manipulating an object; Rincover, Cook, Peoples, & Packard, 1979), then that dimension of stimulation can be directly manipulated (e.g., eliminating the sound produced by the object).

The goal of any functional analysis is to identify events related to the maintenance of responding.

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When no clear socially mediated reinforcer is identified as a result of an initial functional analysis, continued analyses are warranted in an attempt to discover other maintaining conditions. The goal of additional functional analyses is either to identify a controllable dimension of the maintaining reinforcer or, at a minimum, to eliminate as many other plausible reinforcement hypotheses as possible. The result of extended analyses should be the identification of a plausible source of reinforcement upon which to base intervention. The resulting intervention can then serve as a test of the validity of the hypothesis.

In the current series of four studies, we sought to analyze a persistent case of self-injury that had proven to be difficult to treat because the response appeared to be unrelated to the student's social environment. The logic of the experimental sequence was that if the variable maintaining self-injury was not readily demonstrated to be socially mediated, additional analyses were needed to identify a plausible source of reinforcement (Studies 1 through 3). Once a plausible source of reinforcement was indicated, we arranged for a topographically similar source of reinforcement to be used as an intervention (Study 4).

GENERAL METHOD

Student, Response Definition, and Settings

Geoff was a 19-year-old male classified as having a profound disability. He was supported in a community-based special education program by his teacher (the second author) and an educational assistant. He communicated using a combination of gestural signs and verbalizations for a vocabulary of approximately 15 "words." He could walk independently, but his gait was slow and unsteady. Geoff received no prescription medication during the investigation. He was diagnosed as having astigmatism and partial ptosis in his right eye, and a suspected visual impairment involving both eyes (myopia of an undetermined extent). Geoff had a 12-year history of eye poking that was defined as a digit from either hand making contact with his eyelid for 1 s or more. Typically, his eye poking occurred for several seconds using a forefinger from either hand to press against his closed right or left eye. During the past 12 years, Geoff's eye poking repeatedly resulted in minor abrasions and bruising to his eyelid. Several interventions (e.g., differential reinforcement of alternative responses, contingency contracting, and reprimands) had been used to reduce Geoff's eye poking, with limited and sporadic effects.

The analogue analyses of Studies 1 and 2 were conducted in a classroom at a neighborhood school. The classroom was 10 m square and contained several tables, chairs, and materials for life-skills instruction. During Studies 1 and 2 the instructor, student, and a second observer were the only individuals present. For Studies 3 and 4, data were collected throughout the school day in settings related to his community-based objectives. Settings included an employment site, shopping malls, restaurant, and bus stops (for transportation between sites). His daily routine included (a) arriving at a shopping mall and purchasing breakfast in a coffee shop, (b) grocery shopping, (c) riding public transportation, (d) busing tables in a restaurant, (e) eating lunch, (f) riding public transportation, and (g) cleaning floors in a shoe store.

Measurement

Observers used a stopwatch or wristwatch to time the duration of eye poking in Studies 1 and 2. During Study 2, the onset and offset of each occurrence of eye poking was recorded to permit a cumulative record of seconds of eye poking. An event recording system was used during Studies 3 and 4. Although an event recording strategy represents a more conservative estimate of eye poking, it was easier to use than duration measures throughout the day.

Interobserver Agreement

Interobserver agreement was obtained by having a second person independently observe and record Geoff's eye poking. For duration-based agreement, a frequency-ratio formula was used (Kazdin, 1982): The smaller total was divided by the larger total

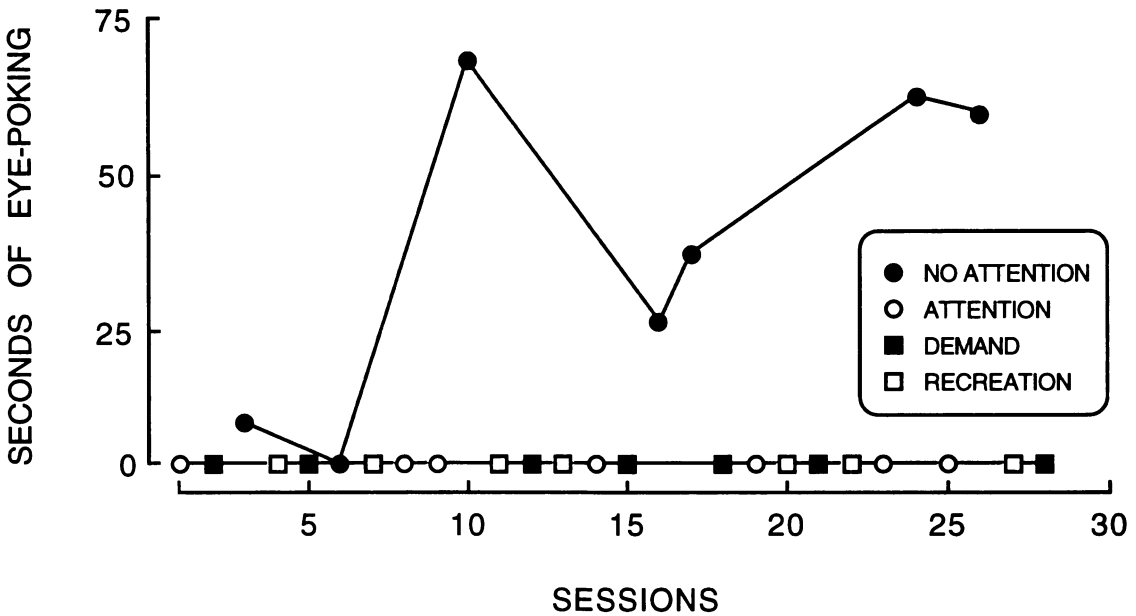

Figure 1. Total seconds of eye poking per 10-min session during four assessment conditions of the fuctional analysis.

and multiplied by 100%. For frequency-based agreement, a point-by-point formula was used (Kazdin, 1982): The total number of agreements was divided by agreements plus disagreements and multiplied by 100%. Agreement measures were collected during 29%, 100%, 29%, and 33% of observations across each of the four experiments, respectively. Studies 1 through 4 produced mean agreement scores of 99% (range, 98% to 100%), 94% (range not applicable), 97% (range, 92% to 100%), and 99% (range, 97% to 100%), respectively.

STUDY 1: FUNCTIONAL ANALYSIS OF EYE POKING

Method

Design and Procedure

A multielement design (Sidman, 1960) was employed to assess the duration of eye poking across four conditions: (a) no attention, (b) attention, (c) demand, and (d) recreation (cf. Iwata et al., 1982). During the no-attention condition, Geoff was seated at a table and received no social interaction or activities (an observer stood 8 m away). During the attention condition, the instructor and Geoff sat next to each other at a table. When seated the instructor engaged in paperwork, and Geoff was provided with several activities (see recreation condition). If eye poking occurred, the instructor provided 10 s of social comments to Geoff and told him that he should not poke his eye. After the 10 s of social comments elapsed, the next occurrence of eye poking occasioned a similar consequence. During the demand condition, the instructor delivered a verbal request every 10 s to sweep the floor. Geoff's correct responding was praised, and his incorrect responding resulted in a full physical prompt. Any occurrence of eye poking resulted in a 15-s cessation of task demands. During the recreation condition, Geoff was provided with various activities (e.g., a family photo album, magazine) and was praised every 15 s in the absence of eye poking (occurrences of eye poking were ignored). Each condition was presented once per day for 10 min, with a random sequence occurring across each day. Sessions were conducted between 12:00 p.m. and 1:00 p.m. each school day by Geoff's teacher.

Results and Discussion

Figure 1 presents the results of Geoff's functional analysis. Following low levels of eye poking across

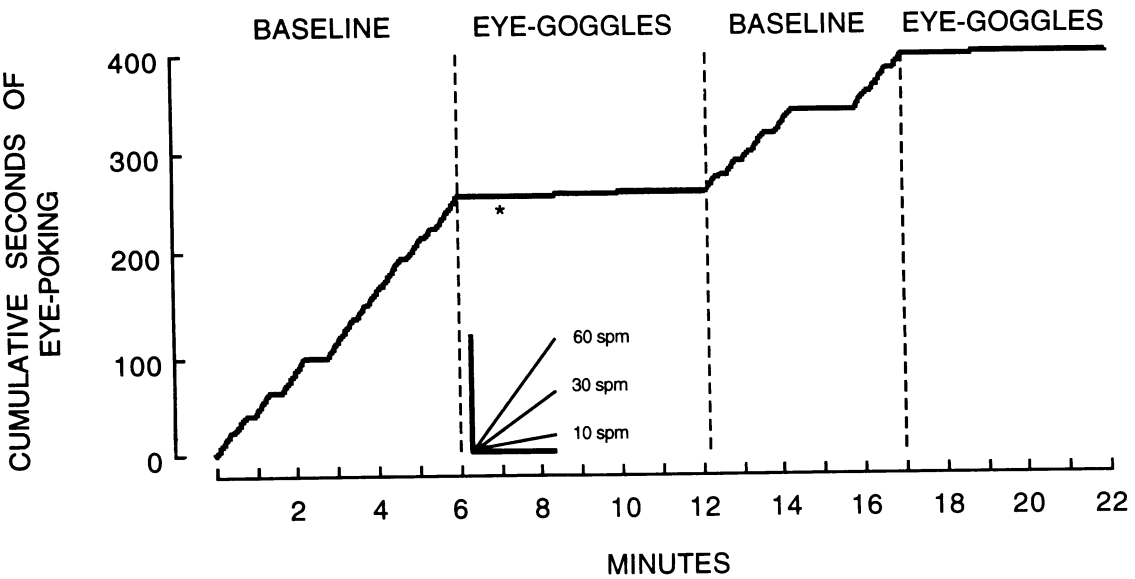

Figure 2. Cumulative seconds of eye poking across baseline and goggles conditions. Spm = seconds per minute. The asterisk indicates the occasion when Geoff briefly removed the goggles. The goggles were replaced within 5 s by his teacher, who reminded him to continue to wear them.

all conditions during Sessions 1 through 9, a pattern emerged in which Geoff engaged in eye poking only during the no-attention condition. During the following 19 sessions, no instances of eye poking were observed in the attention, demand, and recreation conditions, whereas a mean of 50 s (range, 24 s to 68 s) was observed for eye poking in the no-attention condition. The data in Figure 1 indicate that the procedures used in the demand and attention conditions did not occasion eye poking. Instead, eye poking occurred only in the absence of social interaction.

The results of Study 1 suggest the hypothesis that the reinforcer(s) (positive and/or negative) maintaining eye poking were not produced by Geoff's social environment, and may have been produced directly by the response. To test this hypothesis further, we sought in Study 2 to interrupt the source of stimulation produced by eye poking to see if the response would decrease in frequency (Rincover et al., 1979). In Geoff's case, it was hypothesized that some aspect of the eye poking topography (i.e., a finger touching the eyelid) produced reinforcing stimulation. If the response itself directly produced reinforcement by contacting the eyelid, then blocking finger–eye contact should suppress the frequency of eye poking and attempts at eye poking. However, some other source of stimulation could have maintained eye poking (e.g., visual stimulation from holding his hand in front of his face). To test our hypothesis and to aid in the development of an intervention, we attempted to interrupt Geoff's eye poking by having him wear transparent goggles. If finger–eye contact produced the source of reinforcing stimulation, then wearing goggles should suppress eye-poking attempts. However, if eye poking was maintained by some other aspect of the eye-poking topography, the goggles should be less effective in reducing the frequency of responding.

STUDY 2: IDENTIFYING A PLAUSIBLE SOURCE OF REINFORCEMENT

Method

Design and Procedure

A withdrawal design (Barlow & Hersen, 1984) was used to study the effects of wearing goggles

on the cumulative duration of eye poking. Recording of eye poking during Study 2 was done continuously, except for 30-s interruptions between phase changes to place or remove the goggles from Geoff's face.

Baseline. A baseline condition similar to the alone condition in Study 1 was used to assess the free-operant rate of eye poking. Throughout Study 2, Geoff was seated at a table with no social interaction.

Response interruption. In this phase, Geoff wore transparent plastic safety goggles (Sears Model 7185707). The goggles surrounded his eyes approximately 3 cm away from the top, bottom, and sides of his eyes, with the front shield approximately 5 cm from his face. The goggles were held in place by an elastic band that wrapped around the back of Geoff's head and attached at the sides of the goggles. Wearing the goggles allowed Geoff to press the goggles with his finger and put his hand in front of his eyes, but did not allow any part of his hand to come into direct contact with his eye or eyelid. Prior to Study 2, Geoff (a) was told he would be asked to wear goggles and that he should keep them on his face and (b) was allowed to try the goggles on. Each time the goggles were placed on his face, he was reminded to continue wearing them. Because finger–eye contact could not occur during this phase, a modification in the definition of eye poking was made so that any contact between Geoff's hand and the goggles was scored as an instance of eye poking.

Results and Discussion

The cumulative seconds of eye poking during Study 2 are shown in Figure 2. High levels of eye poking occurred during the initial baseline phase (72% of the time). When goggles were introduced, an immediate cessation in eye poking occurred, with only two responses observed (for a total of 6 s). This pattern of responding was replicated in the subsequent return to baseline and reintroduction of the goggles.

A clear relation between wearing the goggles and the cessation of eye poking was demonstrated in Study 2. The results of the second study support the hypothesis that some type of reinforcement produced by direct finger–eye contact served to maintain Geoff's eye poking. Although a pattern typical of extinction was not observed (i.e., responding stopped immediately), having Geoff wear goggles clearly altered the rate of responding. Perhaps the goggles were discriminative of nonreinforcement along with interrupting reinforcement (e.g., as in a multiple schedule). However, because a pattern of responding consistent with extinction was not obtained, care should be exercised when interpreting the specific operant process underlying response suppression. Although we were not able to document the specific nature of the stimulation serving to maintain eye poking (e.g., visual phosphene, the optical stimulation produced by applying pressure to the eyeball), our results appear to implicate finger–eye contact as a plausible source of reinforcement.

Based on the results of Studies 1 and 2, we sought to test the visual stimulation hypothesis further and to begin designing an intervention for Geoff's eye poking focusing on a competing source of visual stimulation. The indication from scatter plot analyses (O'Neill et al., 1990; Touchette, MacDonald, & Langer, 1985) was that his eye poking typically occurred during periods of low activity (consistent with the functional analysis results). Inactive periods of time occurred primarily when he was waiting for public transportation or following lunch. That is, Geoff was typically engaged in a variety of activities during his day, but waiting for public transportation or the period following lunch seemed to provide less stimulation.

In Study 3, we assessed the effects on eye poking of providing Geoff with a hand-held video game. If visual stimulation was related to the maintenance of eye poking and the alternative provided higher quality stimulation (Catania, 1966; Herrnstein, 1970; Horner & Day, 1991; Neef, Mace, Shea, & Shade, 1992), reductions in self-injury should result because of changes in response allocation. In addition, we analyzed a second type of alternative stimulation (music) to study its effects on the frequency of eye poking.

STUDY 3: ANALYSIS OF COMPETING STIMULATION

Method

Design and Procedure

An ABCBCACAC design was used to assess the effects of competing stimulation on the frequency of Geoff's eye poking. Condition A provided no competing stimulation (i.e., baseline); Condition B provided Geoff with music via a portable radio; Condition C provided Geoff with a hand-held video game. Eye-poking frequency was measured throughout his participation in educational programming (8:30 a.m. to 2:30 p.m.) each weekday. Interventions were primarily targeted for the time Geoff spent waiting for public transportation and following lunch. These waiting periods occurred a total of three times per day and lasted approximately 15 min each. In addition, during the B and C conditions, Geoff was given access to the stimulus item associated with the respective condition during any period of low activity (defined as at least 3 min of inactivity). No teacher attention was provided if he engaged in eye poking at any time during Study 3.

Baseline. In this condition, Geoff participated in his typical educational programming (see General Method) and did not receive any form of intervention during the school day.

Music. In this condition, Geoff was provided with a Sony Walkman® radio while waiting at the bus stop, following lunch, and during other periods of low activity. The radio was tuned to a radio station that his friends, family, and teacher perceived to be preferred. He listened to the music through a pair of headphones. During this condition, Geoff was provided with continual access to the radio, and no contingency was in place regarding the presentation or removal of the music.

Video game. Geoff was provided with a hand-held video game while waiting at the bus stop, following lunch, and during periods of low activity. The video game was approximately 15 cm long by 12 cm wide by 4 cm deep and weighed 0.45 kg. The video game allowed Geoff to hold the stimulus item and observe various images on the screen in a variety of visual patterns (with no sound). Typically, Geoff held the video game with one hand in front of his face. During this condition, he was provided with continual access to the video game, and no contingency was in place regarding the presentation or removal of the game (i.e., he could discontinue use at any time).

Results and Discussion

The number of eye pokes per hour across the conditions in Study 3 are presented in Figure 3. During the first 5 days of baseline, a mean of four eye pokes occurred per hour (range, 3 to 5.3). Initial exposure to the music condition resulted in a mean of 2.8 eye pokes per hour (range, 2.5 to 3). Initial exposure to the video game condition resulted in a mean of 1.1 eye pokes per hour (range, 0.8 to 1.3). Subsequent reintroduction of the music and video game sequence resulted in a replication of the previous behavior pattern in the respective conditions. Two subsequent returns to baseline occasioned a mean of 4.3 eye pokes per hour during Days 21, 22, 26, and 27 (range, 3.8 to 4.7); two additional exposures to the visual stimulation condition (Days 23–25 and 28–29) resulted in a mean of 1.0 eye poke per hour (range, 0.8 to 1.5).

The findings of Study 3 indicate that Geoff's eye poking was less frequent when he was provided with a video game, relative to baseline and music conditions. The video game effectively competed with the consequence of eye poking, whereas music was less effective. The results of Study 3 lend support to the hypothesis developed from Studies 1 and 2 that eye poking was maintained by the visual consequences the response produced. However, this observation is offered tentatively because no response–reinforcer relation was demonstrated in Studies 1 and 2 regarding the effects of eye poking, nor in Study 3 regarding the competing visual stimulation. Caution is also warranted in interpreting the results of Study 3, because multiple examples of visual and auditory stimuli were not analyzed (thus not permitting a general conclusion to be drawn regarding sensory modality). Because of these concerns and the observation that eye pok-

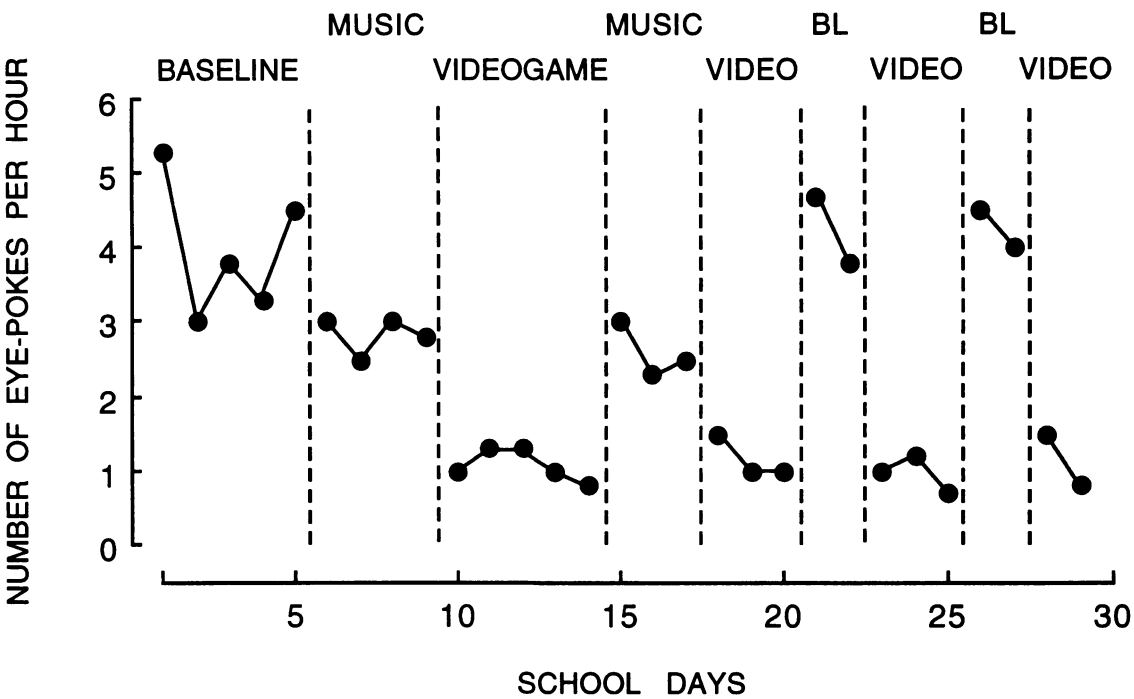

Figure 3. Number of eye pokes per hour across the baseline, noncontingent music, and noncontingent video game conditions.

ing was still occurring at low levels, Study 4 was developed (a) to attempt to reduce the frequency of eye poking to near-zero levels and (b) to ascertain whether the competing video game functioned as a reinforcer.

STUDY 4: CONTINGENCY ANALYSIS OF VIDEO GAME ACCESS

Method

Design and Procedure

The effects of baseline, video game presentation, and video game removal contingencies on the frequency of eye poking were analyzed using a multielement design (Sidman, 1960). Procedural arrangements were the same as in Study 3, with data collected from 8:30 a.m. to 2:30 p.m. each day of the week. No teacher attention was provided for eye poking.

Baseline. During baseline, Geoff participated in his typical educational programming (see General Method) and did not receive any form of intervention while waiting for public transportation, following lunch, or other periods of low activity.

Video game presentation. Video game presentation was comprised of the delivery of the video game for 30 s contingent upon the occurrence of an eye poke while waiting for public transportation, following lunch, or other periods of low activity.

Video game removal. During this condition, Geoff was provided with noncontingent access to the video game while waiting for public transportation, following lunch, or other periods of low activity. If Geoff poked his eye, the video game was removed for 30 s with no other consequence occurring.

Results and Discussion

During baseline (Figure 4), Geoff poked his eye an average of 5.3 times per hour (range, 4.5 to 6.2). In the following contingency analysis, he poked his eye an average of 4.1 (range, 3.7 to 4.3), 5.5, and 0.9 times (range, 0.7 to 1.2) per hour during

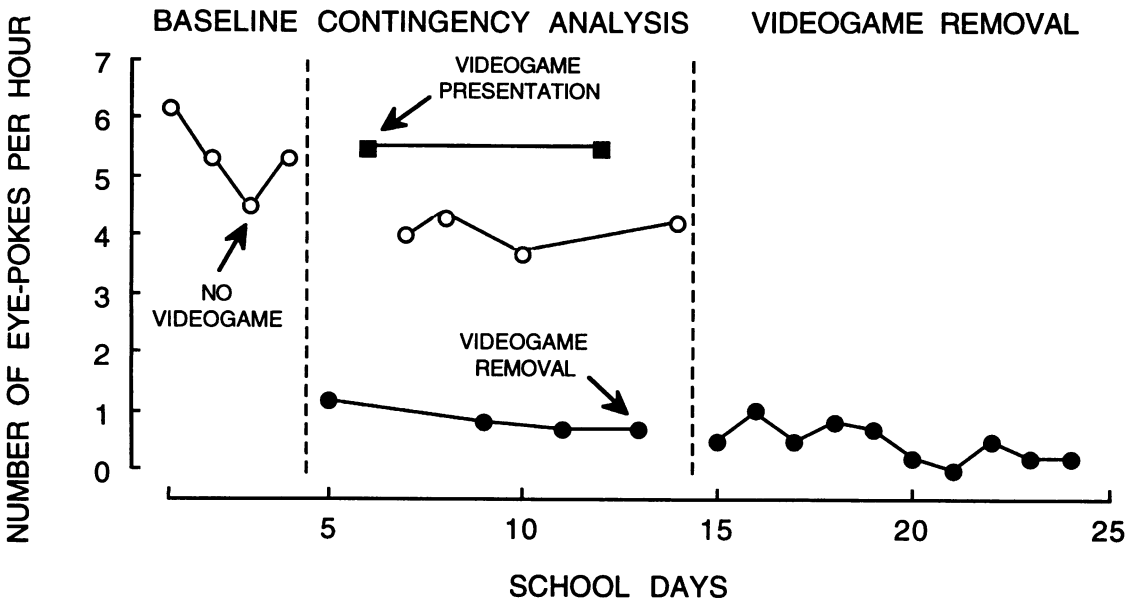

Figure 4. Number of eye pokes per hour across conditions of no video game, video game presentation following eye poking, and video game removal following eye poking.

the baseline, video game presentation, and video game removal conditions, respectively. Because of the low levels of self-injury during the video game removal condition, this condition was selected for the final phase of the study and resulted in an average of 0.5 eye pokes per hour (range, 0 to 1.0).

Two outcomes are of interest in Study 4. First, by the end of the study, Geoff's eye poking was reduced to an average of less than 0.5 instances of self-injury per hour (compared to a baseline mean of 5.3 eye pokes per hour). Second, the video game may have functioned as a reinforcer. This second observation is supported by the reduced levels of eye poking during the video game removal condition (i.e., the contingency may have functioned as negative punishment). In addition, the increased levels of eye poking during the video game presentation condition compared with the no-stimulus condition further support this view. However, because rates of eye poking were similar across baseline and video game presentation conditions in Study 4, no definitive demonstration of a positive reinforcement function was obtained. Therefore, our statements regarding the reinforcing effect of the video game should be interpreted with caution.

GENERAL DISCUSSION

We demonstrated that a functional analysis and treatment strategy for studying the variables associated with eye poking was effective in reducing the self-injury of a youth with profound disabilities. Following the results of an inconclusive functional analysis, our methodology permitted (a) the identification of a plausible source of reinforcement, (b) the assessment of a competing topography of stimulation consistent with the hypothesized maintaining variable, and (c) the development of a contingency arrangement that substantially reduced eye poking. Although the current experimental sequence was neither exhaustive of all possible variables maintaining eye poking nor demonstrated direct replication across individuals with this form of self-injury, our findings are offered as a step toward a functional analysis and treatment of eye poking.

The effective analysis of self-injury maintained

by nonsocial contingencies presents an important challenge for behavior analysts attempting to understand the environmental control of problem behavior. The importance of identifying the variables associated with nonsocial reinforcement are twofold: (a) It may allow a greater number of instances of self-injury to be effectively treated using a functional analysis technology, and (b) it may allow for the further development of our understanding of variables associated with behavioral maintenance. Of utmost importance in cases in which self-injury is not associated with socially mediated variables is the continuation of a functional analysis to identify possible maintaining conditions.

In the present case, the series of functional analyses indicated that self-injury may have been maintained by a private event. We say this with caution, however, because of the need for important analytical qualifications. Instances in which environmental analyses lead to the postulation of an internal event (e.g., a headache, bladder infection, endorphin release, or vestibular stimulation) associated with self-injury cannot be studied in the sense typically employed in the experimental analysis of behavior (Donahoe, 1993; Hayes, 1993; Skinner, 1953), because experimental analyses may not be technologically feasible (as in the current investigation). Instead, analyses of such cases may need to focus on the conditions associated with a number of plausible competing hypotheses regarding the source of stimulation. Optimally, the result of such analyses is the identification of a source of stimulation that assists in the specification of some form of intervention that can be publicly derived from functional analyses.

Although the current series of analyses dealt with a behavior that was maintained apart from the social environment, nonsocial reinforcement and private events are not equivalent. Conceptualizing reinforcement that is not socially mediated in this manner may allow for the development of a broader assessment technology for cases of self-injury maintained by unidentified variables. In instances in which self-injury does not appear to be related to the social environment following a functional analysis (i.e., problem behavior occurs in the absence of social contingencies), further analyses are warranted in an effort to discover the source of reinforcing stimulation. If additional analysis indicates that the source of stimulation is a publicly accessible event produced by the response, then interventions can be focused on manipulating the reinforcer, the reinforcement contingency, or alternative responses to reduce self-injury.

However, if prolonged functional analyses produce only negative results (i.e., they are consistent with the null hypothesis), further analytic efforts are necessary to begin to isolate other plausible sources of stimulation (e.g., potential private events; Moore, 1984; Place, 1993; Schnaitter, 1979). In such analyses, the types of relations between variables are necessarily correlational in nature, but can provide information regarding what are, and are not, the conditions associated with behavioral maintenance. A desirable focus for initial efforts is on isolating publicly available events relating to plausible sources of reinforcement as potential intervention variables. The research of Rast and colleagues (e.g., Rast, Johnston, Allen, & Drum, 1985) provides an illustration of one such analysis. These authors have focused on the chronic rumination of clients with profound disabilities. Over a series of analyses, they have found particular aspects of food intake (a publicly manipulable set of variables) that are associated with the occurrence or nonoccurrence of rumination (e.g., starch content, esophageal stimulation, amount of stomach distention). By publicly manipulating such variables as starch content, rumination has been substantially reduced.

Although the most desirable outcome of such extended functional analyses is the identification of socially mediated events associated with the maintenance of problem behavior, such results may not always be the outcome of analysis because of the topography of self-injury. The eye poking that was the focus of the current series of studies illustrates these concerns. Unlike problem behaviors (e.g., chronic rumination) that depend in part on public events (e.g., food preparation, food content), Geoff's eye poking seemed to produce some type of stim-

ulation that functioned to maintain his responding. Because his responding appeared to produce some type of continuously available stimulation (cf. Williams & Johnston, 1992), manipulating some aspect of the behavior–environment relation to study specific aspects of it would prove to be difficult and invasive, if possible at all. In such cases, assessment of a plausible source of reinforcement may provide indications for potentially reinforcing stimulation consistent with the consequence maintaining self-injury (e.g., a video game in the current series of studies).

Although these suggestions for extending functional analyses are preliminary in nature, they may provide researchers with a framework for extending analyses in cases that do not appear immediately amenable to control by socially mediated reinforcement contingencies. When initial analyses of self-injury do not readily identify a socially mediated reinforcer maintaining problem behavior, researchers should consider additional analytical tactics to further study potential maintaining conditions (Kennedy, in press). Such instances of self-injury, for which our initial analyses do not identify relevant variables, should be considered as invitations for further analysis to assist in developing a more complete understanding of the conditions maintaining self-injury.

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