JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1996, **29,** 437–450 NUMBER 4 (WINTER 1996)

FUNCTIONAL ANALYSIS AND TREATMENT OF CIGARETTE PICA

CATHLEEN C. PIAZZA, GREGORY P. HANLEY, AND WAYNE W. FISHER

KENNEDY KRIEGER INSTITUTE

JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

A series of analyses was conducted to assess and treat the pica of cigarette butts by a young man with mental retardation and autism. First, we demonstrated that pica was maintained in a condition with no social consequences when the available cigarettes contained nicotine but not when the cigarettes contained herbs without nicotine. Second, a choice assessment (Fisher et al., 1992) confirmed that tobacco was preferred over the other components of the cigarette (e.g., paper, filter, etc.). Third, an analogue functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) demonstrated that cigarette pica was maintained independent of social consequences. Fourth, a treatment designed to interrupt the hypothesized response–reinforcer relationship reduced consumption of cigarettes to zero. Finally, because cigarette pica occurred primarily when the individual was alone or under minimal supervision, a procedure based on stimulus control was developed to improve the effectiveness of the intervention in these situations.

DESCRIPTORS: developmental disabilities, pica, nicotine, autism, functional analysis, stimulus control

The ingestion of cigarette butts is a relatively common form of pica observed in persons with mental retardation (Danford & Huber, 1982). Pica has been described as a treatment-resistant behavior that is associated with a variety of medical risks such as intestinal blockages, parasites, surgery to remove objects, and death (Foxx & Martin, 1975). The ingestion of cigarette butts may be associated with the additional risks that occur when nicotine is consumed orally; these include oral cancer, gingival recession, periodontal disease, and elevation of blood pressure (Larsen, Haag, & Silvette, 1961; McMahon et al., 1986). Also, consumption of cigarette butts that have been previously smoked may result in exposure to communicable diseases. Identification of the factors that maintain cigarette consumption may further our understanding of this behavior and aid in the development of effective treatments designed to reduce the behavior.

Functional analysis is one method for identifying the variables that maintain many types of aberrant behavior, including the pica of cigarette butts. However, treatments for cigarette pica have been developed without the benefit of a functional analysis. For example, Donnelly and Olczak (1990) baited a room with "bogus" butts that did not contain nicotine to evaluate the cigarette pica of 3 individuals with mental retardation. Interestingly, for 1 participant, ingestion of the bogus butts declined to zero during baseline, suggesting that the consequence that was responsible for behavioral maintenance was not present in this baseline condition. It is possible that for this individual, cigarette pica was maintained by either social (e.g., attention) or automatic (e.g., physiological effects of nicotine consumption) consequences. If cigarette pica was maintained by the physiological effects of nicotine consumption, then placebo or bogus butts may

This investigation was supported in part by Grant MCJ249149-02 from the Maternal and Child Health Service of the U.S. Department of Health and Human Services.

Requests for reprints should be sent to Cathleen C. Piazza, Neurobehavioral Unit, The Kennedy Krieger Institute, 707 N. Broadway, Baltimore, Maryland 21205.

not have provided an adequate substitute for an actual cigarette when assessing this behavior.

From an operant perspective, it may be reasonable to hypothesize that cigarette pica may be acquired and maintained because it is associated with a potent (automatic) reinforcer, the effects of nicotine consumption. Nicotine has been demonstrated to function as a reinforcer in both animal and human studies, independent of other social consequences associated with smoking (Henningfield, 1984). The importance of nicotine in the maintenance of smoking is also evidenced by the commercial failure of nicotine-free substitutes (Jones, 1987). Nicotine can be delivered through a variety of routes, including inhalation (smoking), buccal absorption (chewed tobacco), intravenously, and transdermally (a patch). The physiological effects of nicotine have been well documented for the various delivery routes and are similar (Jones, 1987). By placing cigarette butts in the mouth and sucking on the tobacco (i.e., cigarette butt pica), the effects of the consumption of cigarette butts would be equivalent to those associated with chewing tobacco (J. E. Henningfield, personal communication, June 3, 1996).

A variety of alternative hypotheses may explain why individuals consume nonnutritive substances such as cigarette butts and other inedible items (e.g., cloth, string, soil). For example, Mace and Knight (1986) showed that for 1 individual, pica was affected by the amount of social interaction; higher levels of pica occurred in a no-interaction condition and lower levels of pica occurred with increased social interaction. Favell, McGimsey, and Schell (1982) hypothesized that the pica of 3 clients was maintained by oral stimulation. Consistent with this hypothesis, pica decreased when the investigators provided the participants with items that could be used to produce similar but benign forms of oral stimulation (chewable toys and popcorn). However, in both studies, the consequences hypothesized to maintain pica were not directly manipulated.

Responses maintained by social consequences can be directly manipulated during functional analysis, and the results can be used to develop treatments. When a response is hypothesized to be maintained by automatic reinforcement, it is often difficult (or impossible) to manipulate directly the stimulus thought to be responsible for behavioral maintenance (Iwata et al., 1994; Vollmer, 1994). That is, the reinforcing stimulus (e.g., oral stimulation) is generally inseparably tied to the target response (e.g., pica); hence the term *automatic* reinforcement. In such cases, hypothesis testing must be conducted using indirect methods (Kennedy & Souza, 1995).

Kennedy and Souza (1995) assessed and treated eye poking that was hypothesized to be maintained automatically by the visual stimulation produced by the response. Given that it was not possible to manipulate such stimulation, they conducted a series of analyses to provide indirect evidence for their hypothesis by (a) demonstrating that eye poking was not maintained by social consequences, (b) reducing eye poking by interrupting the response–reinforcer relationship (application of goggles), and (c) demonstrating that an alternative form of visual stimulation (a video game) reduced eye poking more than auditory stimulation (listening to music) did.

In the current investigation, we applied functional analysis methods with a young man with pica that consisted primarily of consumption of cigarette butts. We conducted a series of analyses in an attempt to delineate more clearly the potential automatic reinforcers that were hypothesized to maintain the behavior, to rule out alternative hypotheses, and to use this information to develop a treatment to reduce cigarette consumption.

GENERAL METHOD

Subject

Don was a 17-year-old male admitted to an inpatient unit specializing in the treatment of severe behavior disorders. He had been diagnosed with severe mental retardation and autism. Don was ambulatory, responded to simple one- and two-step instructions, used functional words in limited contexts (e.g., water, magazine), and was able to complete most activities of daily living, such as eating, dressing, and hygiene.

The reason for Don's admission to the inpatient unit was his ingestion of cigarette butts. Caregivers and teachers reported that Don had been eating cigarette butts for over 4 years. Don actively and persistently sought out cigarette butts such that he could not be safely managed anywhere cigarette butts might be available. When he was taken outside of his home or school, he would run away from caregivers and teachers to pick up and eat cigarette butts on the ground. He also dug through garbage cans and in toilets to find cigarette butts. At home he would crawl under the porch to retrieve cigarette butts. Caregivers and teachers reported that at times he displayed aggression (pushing and punching) if attempts were made to prevent him from picking up or eating cigarette butts. Previous treatments prescribed on an outpatient basis had been unsuccessful. This case was complicated by the fact that both caregivers were chronic smokers and had other drug addictions. Minimal supervision was provided in the home, family resources were limited, and Don had 4 siblings between the ages of 2 and 16 years.

Prior to assessing and treating Don's consumption of cigarette butts, approval from his mother (his primary caregiver), the hospital interdisciplinary team, and the hospital ethics committee was obtained to conduct these assessments. The primary negative effects of nicotine are a result of long-term chronic use. Therefore, these assessments were deemed to be warranted given the risks that the cigarette pica posed over the long term relative to the short-term risks that could be carefully monitored during the hospitalization. That is, Don's health was safeguarded by using clean, unsmoked cigarette butts during sessions, limiting the number of cigarette butts containing tobacco he consumed during sessions, clearing his pockets of any tobacco remaining after each session, conducting brief sessions, and providing continuous medical assessment to evaluate any negative side effects (e.g., respiratory distress, hypertension) that might occur as a result of the short-term tobacco consumption that occurred during the sessions.

PHASE 1: ASSESSMENT OF CIGARETTE TYPE: TOBACCO VS. HERBS

Method

An assessment of cigarette type was conducted to assess whether, in the absence of social consequences, pica was maintained when the room was baited with cigarettes containing nicotine, but not when the cigarettes contained herbs without nicotine. A second purpose of this phase was to determine if placebo cigarette butts, comprised of nicotine-free edible herbs, could be substituted for regular cigarette butts during the subsequent analyses so that Don's exposure to nicotine could be minimized. Sessions were 15 min in length and were conducted in a random order in a living area (6 m by 4 m) equipped with a one-way mirror. During all sessions, Don was given access to a magazine (a preferred stimulus) but was otherwise alone in the room. Two conditions were alternated, herbal butts and tobacco butts. In each condition, the room was baited with eight unsmoked cigarette butts containing the filter and 0.6 cm of either herbs

(herbal butts condition) or tobacco (tobacco butts condition). The cigarette butts were placed about the room in visible and specific locations so that Don could easily find them. At the beginning of each session, Don was told that the therapist would return after running some errands and that he should look at his magazine and wait quietly in the room until the therapist returned. At the end of each session, Don was checked for the presence of cigarette butts. Cigarette remains were removed from Don with minimal attention. No differential consequence was provided for the presence or absence of cigarette butts in the room or on Don's person.

Data collection and interrater agreement. During the assessment of cigarette type, trained observers used laptop computers to record rate (responses per minute) of cigarette butt pica. Cigarette butt pica was defined as placing any part of a cigarette butt or pieces of the cigarette (e.g., tobacco leaf) on or past the lips. (Don typically placed the cigarette butt in his pocket, broke the butt up into small pieces while it was in his pocket, then removed small portions of the tobacco leaf from his pocket and put it in his mouth.) Two independent observers scored the target responses simultaneously but independently during 81.3% of the sessions. Exact agreement coefficients were calculated by partitioning each session into 10-s intervals. In each interval, two observers could agree on the exact number of behaviors that occurred, agree that the behavior did not occur, or disagree about the exact number of behaviors that occurred (disagreement). Exact agreement coefficients were calculated by dividing the number of agreements by the sum of agreements plus disagreements and multiplying by 100%. Mean exact agreement for cigarette butt pica was 93.6% (range, 81.3% to 100%).

Experimental design. During the baited environment assessment, a multielement design was used to assess Don's consumption of cigarette butts in the two conditions. Sixteen sessions were conducted.

Results and Discussion

The top panel of Figure 1 shows the rates of pica in the tobacco and herbal butts conditions. For the first few sessions, Don consumed tobacco and herbal butts at similar rates. However, over the course of the assessment, consumption of the tobacco remained relatively stable ($M = 1.4$), but consumption of the herbal butts decreased ($M = 1.4$ for the first three sessions, $M = 0.1$ for the last five sessions). The results of this analysis suggested that tobacco was an essential component for the maintenance of Don's consumption of cigarette butts. In order to show that tobacco, rather than some other part of the cigarette butt (e.g., the paper), was the critical element of Don's pica, we conducted a choice assessment (Fisher et al., 1992) of his consumption of the individual components of tobacco and herbal cigarette butts.

PHASE 2: CHOICE ASSESSMENT WITH CIGARETTE COMPONENTS

Method

A choice assessment (Fisher et al., 1992) was conducted to identify the salient or preferred components of the cigarette butt. The five stimuli assessed were an unsmoked tobacco butt (0.6 cm of tobacco plus filter), an unsmoked herbal butt (0.6 cm of herbs plus filter), tobacco (0.6 cm of tobacco removed from the cigarette butt), herbs (0.6 cm of herbs removed from the cigarette butt), and cigarette paper (0.6 cm of cigarette paper without tobacco or herbs). The items were presented to Don in pairs. Each stimulus was presented three times with every other stimulus for a total of 30 pair presentations. The order of pair presentations was randomly assigned. Brief access (5 s) was

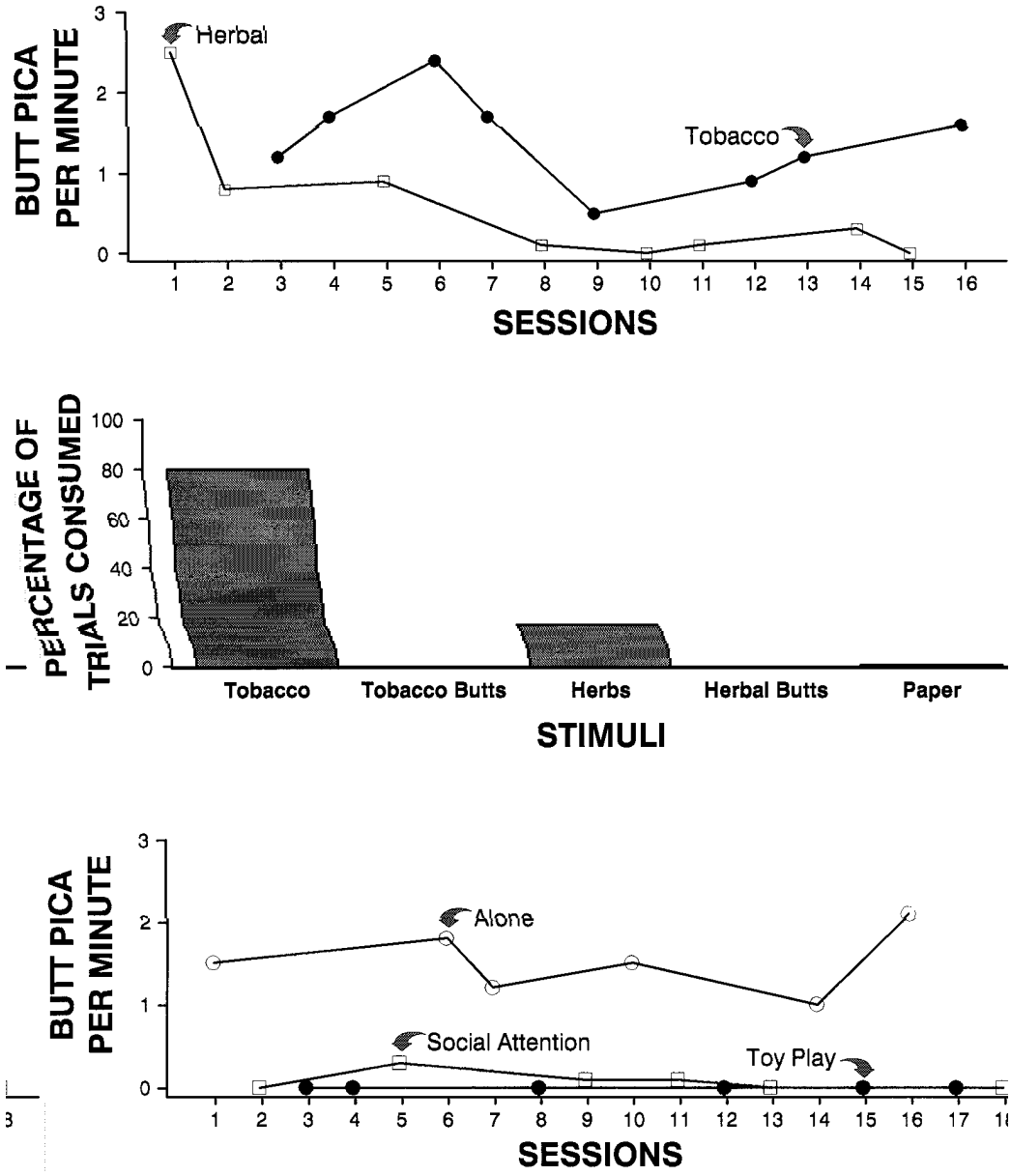

Figure 1. The number of responses per minute of cigarette butt pica during the assessment of cigarette type (herbal vs. tobacco, top panel); the percentage of trials in which the items were consumed (middle panel); and the number of responses per minute of cigarette butt pica during the analogue functional analysis (bottom panel).

given to the first stimulus the client approached (defined as moving his hand toward the item). Simultaneous approach to both stimuli was blocked, and the two stimuli were re-presented.

Data collection and interrater agreement. During all stimulus presentations, trained observers scored consumption responses, defined as putting the stimulus on or past the lips. The percentage of trials in which each stimulus was consumed was calculated by dividing the number of times the stimulus was

consumed by the total number of trials in which the stimulus was presented. Two independent observers scored consumption responses simultaneously but independently during 100% of the trials. Agreement coefficients were calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100%. The mean agreement coefficient was 93.3%.

Results and Discussion

The percentage of trials in which each stimulus was consumed is depicted in the middle panel of Figure 1. Don consumed tobacco during 80.0% of trials in which tobacco was presented. He consumed herbs on 17.0% of trials in which herbs were presented, and paper on 0.8% of trials in which it was presented. The consumption of herbs occurred during earlier trials in which herbs were presented. Over time, Don's consumption of herbs decreased to zero. This pattern of decreased responding for herbs and maintenance of tobacco consumption was consistent with the results from the assessment of cigarette type and again supported the hypothesis that tobacco contributed significantly to the maintenance of Don's pica of cigarette butts. The results of this analysis also suggested that placebos could not be substituted for regular cigarette butts to assess and treat the behavior. This assessment further indicated that the tobacco, rather than the other parts of the cigarette, was the preferred component of the cigarette for Don.

PHASE 3: FUNCTIONAL ANALYSIS

Method

The functional analysis of cigarette butt pica consisted of three analogue conditions similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994)—social attention, alone, and toy play. A demand condition was not conducted because cigarette butts were not available in the classroom, the only environment in which demands were placed on Don. The school reported that Don did not attempt to leave the classroom to find cigarette butts. Sessions were 10 min in length and were conducted in a random, counterbalanced order in an individual treatment room (3 m by 3 m) equipped with a one-way mirror and two chairs. During all sessions, six unsmoked cigarette butts containing a filter and 0.6 cm of tobacco were placed about the room in visible and specific locations. During the social attention condition, Don was given a magazine and was prompted to look at it. The therapist presented social attention in the form of a brief verbal reprimand contingent upon the target response of cigarette butt pica. During the alone condition, the client was alone in the treatment room containing the six cigarette butts. During the toy play condition, the client was given highly preferred stimuli, a "word find" workbook and a ball. The therapist played with Don and praised him approximately once every 30 s following 5 s of no cigarette butt pica. No programmed consequences followed pica.

Data collection and interrater agreement. During the functional analysis sessions, trained observers recorded responses per minute of cigarette butt pica (defined in the assessment of cigarette type) on laptop computers. Two independent observers scored the target responses simultaneously but independently during 50% of the functional analysis sessions. Mean exact agreement for cigarette butt pica was 97.1% (range, 93.4% to 100%) during the functional analysis.

Experimental design. During the functional analysis, a multielement design was used to assess the subject's behavior in the three conditions. Eighteen sessions were conducted.

Results and Discussion

The bottom panel of Figure 1 depicts the rate of cigarette butt pica during the analogue functional analysis. Consumption of cigarette butts was highest in the alone condition ($M = 1.5$), lower in the social attention condition ($M = 0.1$), and 0 in the toy play condition. The results of this assessment indicated that Don's consumption of cigarette butts was maintained independent of social consequences. These results were consistent with the hypothesis that Don's pica was maintained by automatic reinforcement.

PHASE 4: TREATMENT ASSESSMENT

Method

An assessment of the effects of preferred foods and a response-interruption procedure on Don's cigarette butt pick-up behavior and cigarette butt pica was conducted. All sessions were 10 min in duration and were conducted in a room (3 m by 3 m) equipped with a one-way mirror. A chair, a table, puzzles, and a workbook were provided across all conditions. Six unsmoked cigarette butts, each containing a filter and 0.6 cm of tobacco, were placed about the room in visible and specific locations. Don was otherwise alone in the room during all sessions.

During baseline, Don was told not to touch the cigarettes in the room and to play with his games prior to the session. No consequences were delivered for picking up or consuming cigarette butts.

A noncontingent food condition (NCF) was conducted to determine whether access to preferred foods would compete with the reinforcement resulting from consumption of cigarette butts. During the NCF condition, preferred edible items, selected based on the results of a choice assessment (Fisher et al., 1992), were placed on the table. Prior to each session, Don was told not to touch the butts in the room, to eat the food, and to play with his games. In this condition, no consequence was delivered by the therapist for picking up or consuming cigarette butts.

During the NCF plus interrupt condition, preferred edible items were placed on the table. Prior to each session, Don was told not to touch the butts in the room, to eat the food, and to play with his games. A piece of purple construction paper (8.5 by 11 in.) was taped on the wall so that the session contingencies would be associated with the purple paper. In addition, each time Don touched a cigarette butt, the therapist entered the room and delivered the reprimand "no butts." If Don did not comply with the verbal reprimand (which never occurred), the therapist would have physically guided him to drop the butt.

Data collection and interrater agreement. During the treatment assessment sessions, trained observers used laptop computers to record rate of cigarette butt pick-ups (defined as touching any part of a cigarette butt with any part of the hand), cigarette butt pica (as defined previously), and edible item consumption (defined as placing an edible object past the plane of the lips). Two independent observers scored the target responses simultaneously but independently during 60% of the treatment assessment sessions. Mean exact agreement was 98.5% (range, 93.4% to 100%) for cigarette butt pick-ups, 98.3% (range, 90.2% to 100%) for cigarette butt pica, and 99.1% (range, 98.4% to 100%) for edible consumption.

Experimental design. A multielement design was used to evaluate the NCF and NCF plus interrupt treatments. A baseline phase was conducted and was followed by the NCF condition. The third phase consisted of a multielement comparison of NCF and NCF plus interrupt. Functional control of the NCF plus interrupt procedure was established in this multielement phase. Fol-

lowing the multielement phase of NCF and NCF plus interrupt, a single phase of NCF plus interrupt was conducted to control for possible confounding effects of the multielement design. We were concerned that one reason for the effectiveness of the NCF plus interrupt procedure was that Don learned that he could continue to consume cigarette butts in the NCF condition. Thus, the effects of the interruption procedure may simply have been an artifact of the experimental design (he may have learned to wait to eat cigarette butts until the next session in which cigarette butt consumption was not interrupted). The subsequent phase of NCF plus interrupt demonstrated that the treatment was effective even when Don did not have access to cigarette butts in another condition.

Results and Discussion

Figure 2 depicts the rate of cigarette butt pick-ups (top panel) and pica (middle panel) during the assessment of the NCF and the NCF plus interrupt procedures. During baseline, the mean number of cigarette butts picked up was 1.5 per minute, and the mean number of cigarette butts consumed was 0.8 per minute. During the NCF condition, mean number of cigarette butts picked up was 1.9 per minute, the mean number of cigarette butts consumed was 1.0 per minute, and the mean number of edible items consumed was 0. When NCF was alternated with NCF plus interrupt, mean number of cigarette butts picked up was 1.6 per minute during the NCF condition and 0.1 during the NCF plus interrupt condition. The mean number of cigarette butts consumed was 0.8 per minute during the NCF condition and 0 during the NCF plus interrupt condition. The mean number of edible items consumed was 0.5 per minute during the NCF condition and 0.3 during the NCF plus interrupt condition. During the phase in which NCF plus interrupt was implemented alone, the mean number of cigarette butts picked up was 0.1, the mean number of cigarette butts consumed was 0, and the mean number of edible items consumed was 0.6.

Providing an alternative response—consumption of preferred foods—was not successful in decreasing Don's consumption of cigarette butts. Consumption of cigarette butts was decreased to zero by providing a verbal reprimand that interrupted the behavior (and presumably the response–reinforcer relation, if pica was maintained by automatic reinforcement). Although the NCF plus interrupt treatment was highly successful in preventing pica, Don periodically attempted to pick up cigarette butts. Thus, in the absence of adult supervision, it was likely that he would eat the cigarette butts if the behavior was not interrupted. Historically, Don's caregivers had been unable to provide the amount of supervision that would have been necessary to implement this treatment effectively. Therefore, in the next phase, a treatment based on stimulus control was evaluated in an attempt to reduce Don's cigarette butt pick-ups and pica to zero in the absence of adult supervision.

PHASE 5: STIMULUS CONTROL ASSESSMENT

Method

Training sessions. During all phases of the stimulus control assessment, approximately 10 training sessions were conducted each weekday to establish a purple card (an 8 cm by 12 cm piece of laminated purple construction paper) as an S^{Δ} (a stimulus correlated with a condition in which access to reinforcement was blocked) for the absence of pica. A total of 180 training sessions were conducted across 18 days. Training sessions were always conducted on days in which stimulus control assessment sessions (see below) were conducted such that approximate-

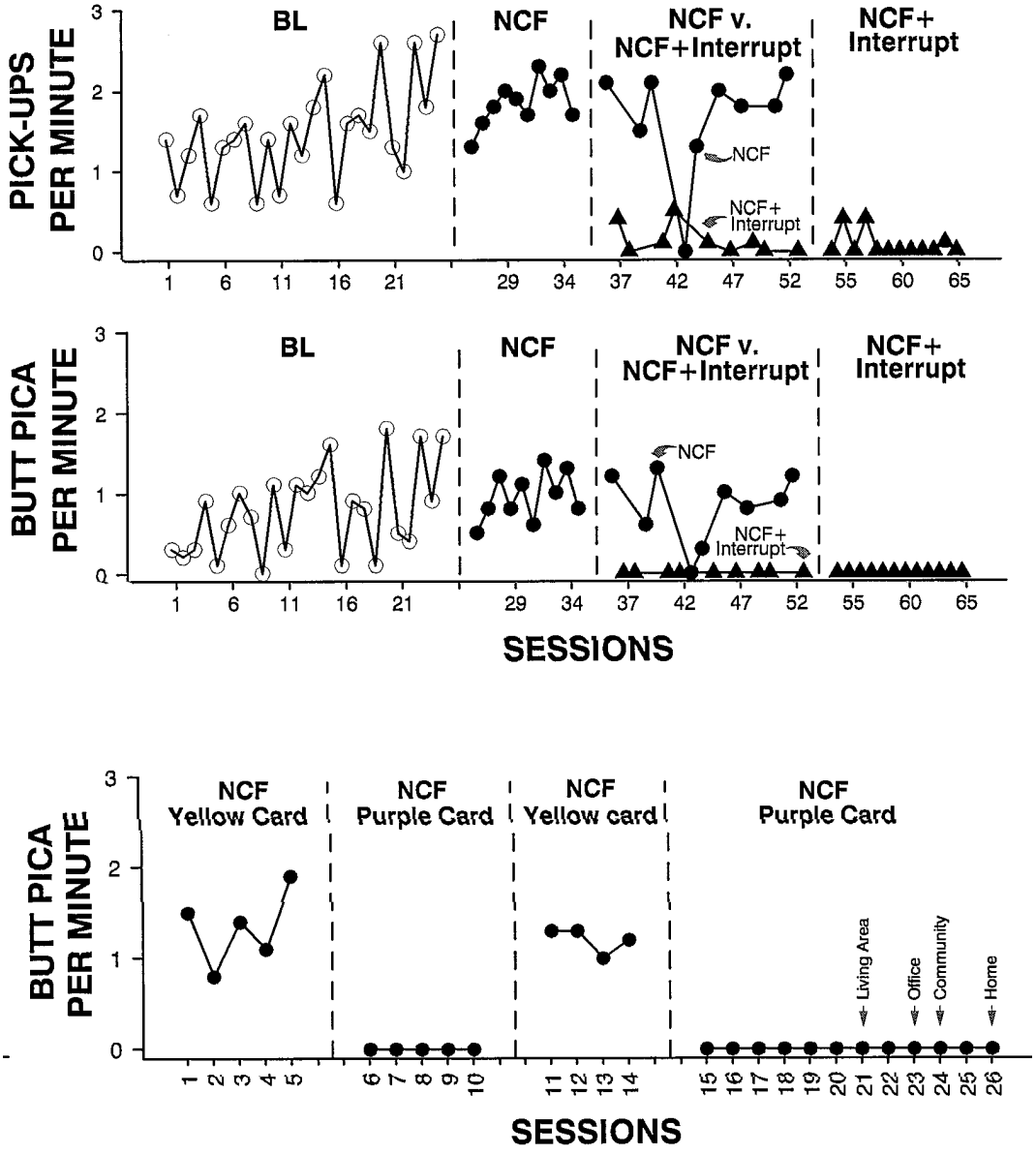

Figure 2. The number of responses per minute of cigarette butt pick-ups (top panel) and cigarette butt pica (middle panel) during the treatment assessment, and the number of responses per minute of cigarette butt pica during the stimulus control assessment (bottom panel).

ly five training sessions were conducted for every one stimulus control session. Training sessions were identical to the NCF plus interrupt condition. Sessions were 10 min in duration and were conducted in a variety of settings: a room (3 m by 3 m) equipped with a one-way mirror, the living area of the unit, private offices in the hospital, outdoors, his home, and other places in the community. A chair, a table, puzzles, a workbook, and preferred edible items were provided during sessions that were conducted in the treatment room. In sessions outside the treatment room, Don was given edible items and

access to activities appropriate to the setting (e.g., shredding paper in the office). Don was otherwise alone in the room or area. Prior to each session, he was given the purple card, told not to touch the butts, to eat the food, and to play with his games or to complete the assigned activity. In addition, each time he picked up a cigarette butt, the therapist entered the room or area and delivered the reprimand, "no butts."

Stimulus control assessment sessions. The conditions during the stimulus control assessment were identical to the NCF condition described above with the exception of the presence of either a yellow card or a purple card that was given to Don before each session and that he typically placed in his pocket. The response-interruption procedure was not implemented during any of these sessions, regardless of whether the yellow or purple card was present. The purpose of this assessment was to determine whether the purple card would be associated with low rates of pica without the response-interruption procedure in place.

Sessions were 10 min in duration and were conducted in a room (3 m by 3 m) equipped with a one-way mirror. A chair, a table, puzzles, a workbook, and preferred edible items were provided in all conditions. Six unsmoked cigarette butts containing a filter and 0.6 cm of tobacco were placed about the room in visible and specific locations. Don was otherwise alone in the room. Prior to each session, Don was told not to touch the butts in the room, to eat the food, and to play with his games. No consequences were delivered by the therapist for cigarette butt pick-ups or pica in either the yellow-card or purple-card sessions. During the NCF yellow-card phases, two yellow-card sessions were conducted per day, and during the NCF purple-card phases, two purple-card sessions were conducted per day.

In the second NCF purple-card phase, after it was established that the purple card occasioned the absence of pica in the treatment room, the purple card was used in other settings: the living unit, private offices, walks near the hospital and in a mall, and in Don's home. The conditions were similar to those during the NCF purple-card sessions. In the living area and office sessions, Don was either given work to do (e.g., shred paper) or was told to complete his workbooks. In the community sessions, Don engaged in the activity associated with the location (e.g., window shopping in the mall). In the home, Don was given the opportunity to watch television or look through his magazines. Each area was baited with six unsmoked cigarette butts containing a filter and 0.6 cm of tobacco in visible and specific locations. Don was given his purple card and was told not to touch the butts in the room. Each session was 10 min in length. No consequence was delivered by the therapist for cigarette butt pick-ups or pica in these sessions. Data collectors stood out of Don's vision during all sessions.

Data collection and interrater agreement. During the stimulus control assessment sessions, trained observers used laptop computers to record rate of cigarette butt pica. Two independent observers scored the target responses simultaneously but independently during 77% of the stimulus control assessment sessions. Mean exact agreement for cigarette butt pica was 99.1% (range, 86.9% to 100%) during the stimulus control assessment.

Experimental design. An ABAB design was used for the stimulus control assessment. A was NCF yellow-card sessions, and B was NCF purple-card sessions.

Results and Discussion

The data from the stimulus control assessment are depicted in the bottom panel of Figure 2. During the initial NCF yellow-card sessions, the mean rate of cigarette butt pica was 1.3. During the NCF purple-card

sessions, mean rate of cigarette pica was 0, even though the consequences for pica were identical during yellow- and purple-card sessions. During the return to the NCF yellow-card condition, Don's mean rate of pica was 1.3. When Don was again given the purple card prior to the session, mean rate of pica was 0. When the purple card was used in other areas of the hospital, the community, and the home, cigarette butt pica was maintained at 0.

Nicotine Assessment

To provide a measure of treatment integrity, biochemical analyses were conducted to assess the presence of nicotine in Don's urine and blood. A urine analysis was taken on the day of his admission to the hospital that was positive for nicotine. One month after admission, blood levels of cotinine (a by-product of nicotine) were assessed. Cotinine provides one of the most useful indices of nicotine intake (Henningfield, Schuh, & Jarvik, 1995). Don's level of cotinine was 193 ng/ml, a level consistent with that of an habitual smoker (levels of cotinine in habitual smokers range from 20 to 700 ng/ml). When the stimulus control treatment was conducted in other settings (i.e., office, home), Don's cotinine levels were less than 20 ng/ml, which is consistent with the cotinine levels of a nonsmoker.

DISCUSSION

One prevailing hypothesis regarding the function of pica is that the behavior is automatically maintained by the oral stimulation it produces (Favell et al., 1982). During the assessment of cigarette type (herbal vs. tobacco), the textural components of the two types of cigarettes were indistinguishable, and thus the oral stimulation produced by each type of cigarette was equivalent. However, only the tobacco cigarettes maintained the pica. In addition, providing Don with alternative oral stimulation in the form of preferred food was not successful in reducing his consumption of cigarette butts. A second, related hypothesis was that Don's pica was maintained by placing a component of the cigarette other than tobacco in his mouth. During the choice assessment, we showed that Don preferred tobacco over all the other assessed components of the cigarettes (paper, tobacco butts, herbs, and herbal butts). A third possible hypothesis was that Don's pica was maintained by social contingencies. However, during the functional analysis, cigarette pica occurred almost exclusively in the alone condition, indicating that it was maintained independent of social contingencies.

A fourth hypothesis was that Don's consumption of cigarette butts was maintained by the effects of nicotine consumption. This hypothesis was supported by the fact that (a) pica was limited almost exclusively to cigarettes, (b) the behavior was maintained only when he was provided with cigarettes containing tobacco with nicotine and not herbs without nicotine, (c) tobacco was the preferred component of the cigarette, (d) the behavior occurred in the absence of social consequences, and (e) a treatment designed to interrupt the response–reinforcer relation (i.e., eliminate the effects of nicotine consumption by preventing the response) was successful in eliminating the behavior. In addition, we were able to rule out a number of other competing hypotheses (i.e., oral stimulation, other components of the cigarette, social consequences) regarding the maintenance of Don's pica. However, we were not able to completely isolate nicotine as an independent variable. That is, nicotine-free tobacco cigarettes were not commercially available at the time of this investigation, and the herbal cigarettes differed from the tobacco cigarettes in multiple ways (presence or absence of tobacco, taste, smell, etc.). Nevertheless, the differential pattern of

responding that was observed with the tobacco and herbal cigarettes was similar to that observed in basic animal studies on self-administration of nicotine (e.g., Ando & Yanagita, 1981).

Given that nicotine was hypothesized to contribute to Don's cigarette butt pica, it might have been expected to occur during all functional analysis conditions. However, Don had a history of being intermittently reprimanded and interrupted from consuming cigarette butts and appeared to have developed a repertoire of covert behaviors surrounding cigarette butt consumption. Don would place himself near areas where cigarette butts were usually located, and he would pick up the butts when the caretaker's attention was diverted. He would place the cigarette butts and tobacco in the pockets of his pants, under his arms, and in his shoes (presumably to conceal them). He would then take small amounts of the tobacco leaf, suck on it, and eventually swallow it. The covert nature of the behavior also presented a dilemma with respect to treatment, in that caregivers were remiss in their responsiveness to eliminating cigarette butts in the environment and in their supervision of Don.

For dangerous behaviors that occur primarily when an individual is alone, the stimulus control assessment provides a preliminary analysis of an approach that may maintain low rates of such responses when parents or staff are not present to implement consequences. When responding is differentially controlled by antecedent stimuli, it is considered to be under stimulus control (Catania, 1992). The stimulus control assessment showed that the purple card had stimulus control over Don's cigarette pica. In the training sessions, the purple card (the discriminative stimulus) was paired with the interruption procedure several times per day, whereas the yellow card was not. Thus, the purple card set the occasion in which the behavior of picking up a cigarette butt would be interrupted. When the purple card was presented in the absence of the interruption procedure during the stimulus control assessment, the blocking procedure was no longer necessary because cigarette pica did not occur (the card suppressed pica). In the current investigation, an approach based on stimulus control was applied to a fairly benign procedure (response interruption). It is possible that this approach could also be applied to more intrusive punishment procedures to decrease the need for implementing those restrictive procedures over time.

The treatment—giving Don the purple card without providing consequences for cigarette pica—appeared to be effective in a variety of environments (community and home). The effects of the treatment were further confirmed in that no nicotine was present in Don's blood during the time in which sessions were conducted outside of the treatment room (i.e., office, home). The family and school personnel were trained to conduct training trials and were encouraged to do them on a regular basis, particularly in settings in which the natural cues indicated that adult supervision was absent (e.g., waiting at the bus stop). It is not clear how often a stimulus like the purple card would need to be paired with differential consequences like the interruption procedure in order to maintain stimulus control. However, these preliminary findings suggest that such procedures may be useful in the treatment of covert aberrant responses. Future research might address the conditions under which stimulus control could be maintained for longer periods of time.

REFERENCES

Ando, K., & Yanagita, T. (1981). Cigarette smoking in rhesus monkeys. *Psychopharmacology, 72,* 117–127.

Catania, A. C. (1992). *Learning*. Englewood Cliffs, NJ: Prentice Hall.

Danford, D. E., & Huber, A. M. (1982). Pica among

mentally retarded adults. *American Journal of Mental Deficiency, 87,* 141–146.
Donnelly, D. R., & Olczak, P. V. (1990). The effect of differential reinforcement of incompatible behaviors (DRI) on pica for cigarettes in persons with intellectual disability. *Behavior Modification, 14,* 81–96.
Favell, J. E., McGimsey, J. F., & Schell, R. M. (1982). Treatment of self-injury by providing alternate sensory activities. *Analysis and Intervention in Developmental Disabilities, 2,* 83–104.
Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe to profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.
Foxx, R. M., & Martin, E. D. (1975). Treatment of scavenging behavior (coprophagy and pica) by overcorrection. *Behavioral Research and Therapy, 13,* 153–162.
Henningfield, J. E. (1984). Behavioral pharmacology of cigarette smoking. In T. Thompson, P. B. Dews, & J. E. Barrett (Eds.), *Advances in behavioral pharmacology* (pp. 131–210). New York: Academic Press.
Henningfield, J. E., Schuh, L. M., & Jarvik, M. E. (1995). Pathophysiology of tobacco dependence. In F. Bloom & D. Kupfer (Eds.), *Psychopharmacology: The fourth generation of progress* (pp. 1715–1729). New York: Raven Press.
Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)
Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., Rodgers, T. A., Lerman, D. C., Shore, B. A., Mazaleski, J. L., Goh, H. L., Edwards-Cowdery, G., Kalsher, M. J., McCosh, K. C., & Willis, K. D. (1994). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27,* 215–240.
Jones, R. T. (1987). Tobacco dependence. In H. Meltzer (Ed.), *Psychopharmacology: The third generation of progress* (pp. 1589–1595). New York: Raven Press.
Kennedy, C. H., & Souza, G. (1995). Functional analysis and treatment of eye poking. *Journal of Applied Behavior Analysis, 28,* 27–37.
Larsen, P. S., Haag, H. B., & Silvette, H. (1961). *Tobacco-experimental and clinical studies*. Baltimore: Williams & Wilkens.
Mace, F. C., & Knight, D. (1986). Functional analysis and treatment of severe pica. *Journal of Applied Behavior Analysis, 19,* 411–416.
McMahon, B., Cataldo, M. F., Collier, M. E., Haggerty, R. J., Holford, T. R., Hulka, B. S., Leff, J., Leverett, D. H., Magee, P. N., Mirvish, S. S., Moore, C., Tanzer, J. M., & Thompson, T. I. (1986). Health applications of smokeless tobacco use. *Journal of the American Medical Association, 255,* 1045–1048.
Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities, 15,* 187–207.

Received March 11, 1996
Initial editorial decision May 15, 1996
Revision received June 14, 1996
Final acceptance June 25, 1996
Action Editor, Timothy R. Vollmer

STUDY QUESTIONS

1. Describe the types of reinforcement contingencies and specific reinforcing stimuli that might maintain cigarette pica.

2. Given that cigarette butts containing tobacco were used throughout the study, what safety measures were undertaken to minimize the risks associated with pica? Also, is it possible that risk could have been reduced even further by using a response measure different than rate of pica?

3. Phases 1 through 3 consisted of assessments. Briefly describe the purpose, procedures, and results of each assessment. What conclusions did the authors reach about the reinforcing function of pica?

4. According to the procedures described in Phase 1, eight butts were available during a 15-min session; hence, the rate of pica should not have exceed 0.53 per minute. Nevertheless, the top panel of Figure 1 shows that about half of all data points exceeded this rate. What further description of the topography of pica, noted by the authors, probably accounted for this result?

5. Two interventions were implemented during Phase 4: noncontingent food (NCF) and NCF plus interrupt. Briefly describe these procedures and the effects that were observed on cigarette pica.

6. Why did the authors include a separate NCF plus interrupt condition at the end of Phase 4?

7. What procedures were used (a) to establish and (b) to assess stimulus control over the absence of pica in Phase 5?

8. What feature of the training schedule in Phase 5 may have enhanced the stimulus control that was observed during the assessment sessions, and what are the implications of such scheduling for the maintenance of treatment effects?

Questions prepared by Han-Leong Goh and Eileen Roscoe, University of Florida