

*MULTICOMPONENT ASSESSMENT AND
TREATMENT OF CIGARETTE PICA*

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We conducted a multicomponent assessment and treatment for 4 individuals who engaged in cigarette pica. During Phase 1, three stimulus preference assessments were conducted to identify (a) the reinforcing component of the cigarette, (b) potential alternative reinforcers that may be used during treatment, and (c) whether the alternative reinforcer would compete effectively with cigarettes. Results were successful in identifying the reinforcing component of the cigarette and suggested the feasibility of using alternative reinforcers during treatment to eliminate cigarette pica. During Phase 2, the effects of two treatment procedures were evaluated. Noncontingent reinforcement (NCR) with the alternative edible reinforcer reduced the pica of 2 of the participants, but effects were not maintained when the initial dense schedule of NCR was thinned. Subsequently, differential reinforcement of alternative behavior with the alternative edible reinforcer was effective in reducing pica for 3 participants. An evaluation of nine treatment procedures failed to identify an effective intervention for the remaining participant; consequently, preventive measures were designed to minimize occurrences of cigarette pica.

DESCRIPTORS: functional analysis, pica, differential reinforcement, noncontingent reinforcement, reinforcer assessment, punishment, tobacco ingestion

Pica is defined as the ingestion of inedible substances (Gutelius, Millican, Layman, Cohen, & Dublin, 1962), and cigarette pica involves exclusive ingestion of cigarette products. Danford and Huber (1982) conducted a survey over a 2-year period among a population of 991 institutionalized individuals who had been diagnosed with mental retardation and found the prevalence of cigarette pica to be approximately 9%. Lewander et al. (1997) reported that children aged 6 years and younger who engaged in ciga-

rette pica exhibited acute symptoms including vomiting, nausea, lethargy, pale or flushed appearance, and gagging that required medical attention; however, full recovery was attained typically within 12 hr. Ingestion of tobacco also may result in several chronic debilitating conditions, such as oral cancer, gingival recession, and periodontal disease (Piazza, Hanley, & Fisher, 1996). Of more immediate concern is exposure to saliva-borne pathogens that may spread communicable diseases, as well as exposure to incidental pathogens (i.e., substances that come into contact with cigarettes lying on the ground). Finally, intestinal blockage may occur as a result of ingesting large amounts of cigarettes (Danford & Huber, 1982). Because cigarette pica produces both acute and chronic health risks, it is a form of self-injurious behavior (SIB) that warrants treatment.

Very little research has focused specifically on the assessment and treatment of cigarette pica. In two early investigations (Foxy & Martin, 1975; Matson, Stephens, & Smith,

This research was supported in part by a grant from the Florida Department of Children and Families, and is based on a dissertation submitted by the first author in partial fulfillment of the requirements for the PhD degree. We thank Juliet Conners, Iser DeLeon, Sonya Fischer, Dorothea Lerman, Jana Lindberg, Eileen Roscoe, Bridget Shore, and Michele Wallace for conducting various aspects of the study, and Marc Branch for his helpful comments of an earlier draft of this paper. Han-Leong Goh is now at Arlington Developmental Center, Arlington, Tennessee, and SungWoo Kahng is now at the New England Center for Children, Southborough, Massachusetts.

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1978), pica was treated with punishment in the form of overcorrection. Contingent on each occurrence of cigarette pica, participants were required to engage in repetitive activities, which included oral hygiene training (toothbrushing), personal hygiene training (handwashing), or household chores (cleaning ashtrays, sweeping the floor, emptying garbage). Results of both studies indicated that overcorrection was effective in eliminating cigarette pica.

Donnelly and Olczak (1990) examined the effects of a differential-reinforcement-of-alternative-behavior (DRA) contingency on ingestion of placebo stimuli. Due to potential risks involved in using actual cigarettes during the course of the study, the authors manufactured and used placebos, which were made of bread and altered to resemble cigarette butts (see Donnelly & Olczak, 1994, for details). The DRA procedure consisted of reinforcing an alternative response (gum chewing) with coffee and was shown to be effective. However, a limitation of the study was that the dependent variable was not cigarette pica (i.e., no cigarettes were consumed at any time during the study). Hence, it is unclear whether the DRA procedure would have produced similar effects on cigarette pica, because the programmed reinforcer (coffee) may not have competed with the availability of actual cigarette products.

Piazza et al. (1996) reported a case study on the assessment and treatment of cigarette pica that included three assessment and two treatment phases. Results of the assessment phases showed that (a) cigarettes containing tobacco were preferred over nontobacco cigarettes, (b) tobacco was the preferred component of the cigarette, and (c) cigarette pica occurred most often during the alone condition of a functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). During the treatment phases, it was observed that cigarette pica decreased when

preferred edible items were freely available throughout the session and when verbal reprimands plus response interruption were delivered when pica attempts occurred (Phase 4), and that it was possible to achieve stimulus control over pica (Phase 5).

Of the four studies published on cigarette pica to date, two involved the use of punishment in the absence of assessments that may have identified alternative treatments (Foxy & Martin, 1975; Matson et al., 1978), and one (Donnelly & Olczak, 1990) evaluated the effects of a reinforcement component but provided no data on actual cigarette pica. The study by Piazza et al. (1996) illustrated the use of both comprehensive assessment and a reinforcement-based intervention, but treatment effects were demonstrated with only 1 individual, and it is unclear whether those effects would be maintained in the absence of continuous access to food. The purpose of this study was to extend the findings of Piazza et al. through additional behavioral assessment and more extended evaluation of reinforcement-based treatments with 4 individuals who engaged in cigarette pica.

GENERAL METHOD

Participants and Setting

Four individuals participated. All lived in a state residential facility for persons with developmental disabilities and had been referred to a day-treatment program for assessment and treatment of cigarette pica. Rob, a 40-year-old man, had been diagnosed with profound mental retardation, was ambulatory, occasionally responded to one- or two-word requests, displayed no expressive language, and received no psychotropic medication during the course of the experiment. Helen, a 49-year-old woman, had been diagnosed with severe mental retardation, was ambulatory, complied with multiple requests, displayed echolalia but exhib-

ited some speech (e.g., "Can I have coffee?"), and received Mellaril® (25 mg bid). Andy, a 44-year-old man, had been diagnosed with profound mental retardation, was ambulatory, complied with one- or two-word requests, displayed no expressive language, and received Mellaril® (50 mg bid) as well as a prescribed medication to control seizures. Larry, a 46-year-old man, had been diagnosed with profound mental retardation, was ambulatory, was visually impaired, complied occasionally with one- or two-word requests, and received Mellaril® (100 mg bid).

All sessions were conducted either in therapy rooms located at the day program or at two outside locations (adjacent to either the day program or the participants' residences or work sites). Session times varied in length depending on the experimental condition. Two to eight sessions were conducted per day, at least 4 days per week.

General Experimental Design

A pretreatment functional analysis (Iwata et al. 1982/1994) was not conducted. This decision was based in part on reports from residential staff that cigarette pica occurred regardless of whether or not social consequences (e.g., verbal reprimands) were delivered contingent on the behavior. In addition, informal observations conducted outside the grounds of the participants' residence or at the day-treatment center prior to the study indicated that cigarette pica occurred when participants were alone (i.e., observers were present to record the occurrence of pica, but no social consequences were provided contingent on pica). Thus, it seemed unlikely that cigarette pica was maintained by social reinforcement. The underlying assumption made during the course of the experiment was that cigarette pica was maintained by direct access to cigarette products.

Thus, the experiment was designed to

identify the specific reinforcer that was responsible for behavioral maintenance, as well as competing reinforcers, and to evaluate the effects of treatment on pica. Phase 1 consisted of three stimulus preference assessments that were designed to identify preference for cigarette components, edible or leisure items, and preferred cigarette components versus preferred edible items, respectively. Phase 2 consisted of an evaluation of two treatment procedures, noncontingent reinforcement (NCR) and differential reinforcement of alternative behavior (DRA), and a condition designed to promote and assess extensions of treatment effects. Baseline and treatment conditions were conducted in a multiple baseline across subjects design (Baer, Wolf, & Risley, 1968) for Rob, Helen, and Andy. Larry's treatments and design differed from those used with other participants because he was exposed to a series of additional interventions (described below).

Response Measurement and Interobserver Agreement

Stimulus preference assessments. The dependent variable was an approach response, defined as reaching for and grasping or holding (i.e., selecting) the stimulus. Interobserver agreement was assessed by having a second observer simultaneously but independently collect data with the primary observer. A sampling procedure in which agreement data were gathered on a subset of participants was used to assess interobserver agreement throughout stimulus preference assessments because it was easy to discern an approach response to distinctly discriminable items used throughout the preference assessments. An agreement was defined as both observers having scored the same selection or no selection on the same trial. Percentage agreement on item selection was calculated by dividing the number of trials scoring agreements by the total number of trials in the

session. During the cigarette component preference assessment, agreement was assessed during 33.3% of Helen's sessions, with an agreement score of 100%. During the edible or leisure item preference assessment, agreement was assessed for 40% of sessions for each participant. Agreement scores for Helen, Andy, and Larry were always 100%; the mean agreement score for Rob was 97.6% (range, 95.2% to 100%). During the preferred cigarette component versus preferred edible item preference assessment, agreement was assessed during 50% of sessions for both Andy and Larry, and scores were 100%.

Treatment. The dependent variables were cigarette pica, defined as placement of a cigarette product into the mouth past the plane of the upper and lower lips, and a correct cigarette exchange, defined as handing a cigarette product to the therapist prior to physical prompting. Due to health concerns, a restriction was placed on the number of cigarette products that participants could be allowed to ingest. The medical staff of the residential facility determined that a maximum of two whole cigarettes could be safely ingested per day during sessions at the day-treatment program. Therefore, a measure of cigarette pica based on frequency would not accurately reflect participants' free-operant rate of responding. Thus, latency to the first pica response was used as the dependent measure of cigarette pica throughout the study. Frequency of correct exchanges was recorded on a handheld computer (Assistant, Model AST 102) during continuous 10-s intervals, converted to percentage of trials in which responding occurred, and was calculated by dividing the number of trials containing correct exchanges by the total number of trials; a counter was used to record the total number of trials elapsed during the DRA training phase. Percentage agreement on cigarette pica was calculated by dividing the number of sessions in which both ob-

servers' latency measures fell within ± 1 s of each other by the total number of sessions in which agreement data were collected. Percentage agreement for exchanges was calculated by dividing the number of intervals containing scoring agreements by the total number of intervals in the session. The percentage of sessions in which agreement was assessed for each participant ranged from 17.9% to 45.0%. The mean percentage agreement score for cigarette pica was 99.0% (range, 85.7% to 100%), and the mean percentage agreement score for correct exchange was 96.9% (range, 82.5% to 100%).

PHASE 1: STIMULUS PREFERENCE ASSESSMENTS

There were three purposes for assessing preference. First, given the assumption that cigarette pica was maintained by automatic reinforcement (i.e., direct access to cigarette products), a related assumption was that some stimulus characteristic of the cigarette was the specific maintaining reinforcer. Thus, one purpose was to identify the reinforcing component of the cigarette. The second purpose was to identify potential alternative stimuli (reinforcers) that might be used during treatment to compete with the target behavior (cigarette pica). The third purpose was to determine whether a preferred alternative stimulus would actually compete with the reinforcing component of the cigarette when both were available concurrently. If so, delivery of the alternative stimulus on either a noncontingent or contingent basis might suppress pica. Three separate preference assessments were conducted in a sequential fashion to identify preference for (a) cigarette components, (b) edible or leisure items, and (b) preferred cigarette components versus preferred edible items.

PROCEDURE

Cigarette Component Assessment

During this condition, preference for three cigarette (Marlboro Light 100s®) components was assessed: an unsmoked filter, an unsmoked cigarette, and a smoked cigarette butt. The unsmoked filter contained only the filter portion of the cigarette (approximately 3 cm in length) devoid of tobacco. Each unsmoked filter was divided into equal portions, approximately 1 cm in length. The unsmoked cigarette (approximately 6.5 cm in length) contained the tobacco portion of the cigarette encased in paper minus the filter. Each unsmoked cigarette was divided into five equal portions, approximately 1.3 cm in length. To ensure that smoked cigarette butts were free of saliva-borne and incidental pathogens, cigarette butts were manufactured in the following manner. A needleless syringe (10 ml or 20 ml capacity) was inserted into the filter portion of an ignited cigarette, and cigarette smoke containing combusted tobacco (nicotine) was drawn through the filter by the upward and downward action of the syringe plunger. The resulting "smoked" cigarette butt measured approximately 1.2 cm after the manufacturing process and was divided into three equal portions of approximately 0.4 cm. In order to comply with the limit of two whole cigarettes consumed per day, sessions were terminated following the ingestion of an amount of a cigarette component that was equivalent to two whole cigarettes (i.e., six unsmoked filters, 10 unsmoked cigarettes, or six cigarette butts).

Preference for cigarette components was assessed in a paired presentation format described by Fisher et al. (1992), in which the participant was allowed to choose between two concurrently available cigarette components. Each cigarette component was paired six times with the other two components in a random order, yielding a total of 18 paired

presentations (one paired presentation per trial). A session consisted of six trials. One or two sessions were conducted per day, depending on when the limit of cigarette ingestion was attained. This assessment was completed within 3 days. Prior to the beginning of the first session, participants were given a sample of each cigarette component to ingest. For each trial, two different cigarette components were placed on a table approximately 30 cm apart and 20 cm in front of the participant. An approach response to a cigarette component resulted in access to that stimulus and removal of the unselected component. If no approach responses occurred within 5 s, the therapist prompted the participant to sample (i.e., pick up and ingest) each stimulus. The same two stimuli were then replaced in front of the participant for 5 s. If approach responses to the replacement stimuli occurred, they resulted in access to the selected stimulus and removal of the unselected stimulus. Alternatively, no approaches to the replacement stimuli resulted in removal of both stimuli and initiation of the next trial. A trial was defined as unprompted selection of an item during the first or second presentation or no selection during the second presentation.

Edible or Leisure Item Assessment

The purpose of this assessment was to identify participants' preferences for edible (food or drink) or leisure items. Items selected for assessment were based on staff reports of participants' preferences and similarity in mode of consumption (i.e., chewing or ingestion) with that of pica. Although chewing gum would appear to be a logical choice to include in the preference assessment, it was not used because the medical staff raised a concern that ingestion of large amounts of chewing gum may pose a health hazard (gastrointestinal distress). A paired presentation format similar to that described above was used for Rob, except that seven

items were assessed (each stimulus was paired once with every other stimulus, yielding a total of 21 paired presentations). While conducting Rob's assessment, we observed that an alternative arrangement produced rankings similar to those obtained with the paired procedure, but in less time. Therefore, the edible or leisure item assessments for Helen, Andy, and Larry were conducted using a multiple-stimulus format described by DeLeon and Iwata (1996). Five sessions were conducted for all participants. Prior to the beginning of the first session, participants were given a sample of each item. During the multiple-stimulus format condition, each session began with an array of items ($n = 7$) sequenced randomly along a straight line on a table, approximately 5 cm apart. While a participant was seated approximately 0.3 m from the stimuli, the therapist instructed the participant to select one item. After an item was selected, it was not replaced. Prior to the next trial, the sequence of the remaining items was rotated by taking the item on the left end of the line and moving it to the right end, then shifting the items to ensure again that they were equally spaced apart. The second trial then began immediately. This procedure continued until all items were selected or until no selection was made within 30 s from the beginning of a trial.

Assessment of Preferred Cigarette Component Versus Preferred Edible or Leisure Item

Based on results of the two previous assessments, a third assessment was conducted to identify preference between the cigarette component and an edible or leisure item (alternative stimulus) that were most frequently selected in previous assessments. Preference for the alternative stimulus would suggest that the alternative stimulus might compete with cigarette pica when used as a reinforcer during treatment. Procedures used during this condition were similar to those of the

Table 1
Results of Cigarette Component Preference Assessment

| Participant | % trials selected | | |
|-------------|-------------------|--------------------|----------------|
| | Unsmoked filter | Unsmoked cigarette | Cigarette butt |
| Rob | 0 | 100 | 33.3 |
| Helen | 0 | 100 | 50.0 |
| Andy | 50.0 | 33.3 | 66.7 |
| Larry | 0 | 91.7 | 58.3 |

cigarette component preference assessment, except that only two stimuli (a cigarette component and an alternative stimulus) were used. The number of paired presentations ranged from 20 (Helen, Andy, and Larry) to 30 (Rob). In addition, preference between unsmoked cigarettes coated with a distasteful substance (hot sauce, henceforth called "spiked" cigarettes) and the most preferred food item was assessed for Larry using similar procedures across 30 trials. This second assessment was conducted because of negative results obtained during Larry's first assessment (see below).

RESULTS AND DISCUSSION

Table 1 shows results obtained during the cigarette component assessment. Rob, Helen, and Larry selected the unsmoked cigarette most often (100% of trials for Rob and Helen and 91.7% for Larry). Preference was not as marked for Andy, although he selected the cigarette butt (66.7%) more often than he selected either the unsmoked filter (50.0%) or the unsmoked cigarette (33.3%). Thus, results indicated that Rob, Helen, and Larry preferred unsmoked cigarettes, whereas Andy preferred cigarette butts. Participants' relative preferences for cigarette components also showed some degree of consistency (data available from the authors upon request). Rob, Helen, and Larry exclusively preferred unsmoked cigarettes to unsmoked filters, and exclusively (Rob and Helen) or strongly (Larry) preferred unsmoked ciga-

Table 2
Results of Edible Item and Leisure Item Preference Assessment

| Item | % trials selected | | | |
|---------------------|-------------------|-------|------|-------|
| | Rob | Helen | Andy | Larry |
| M & M® | 100 | | 33.3 | |
| Cookie | 83.3 | | | |
| Pretzel | 56.7 | | 21.7 | 22.7 |
| Coffee | 46.7 | 100 | | 11.4 |
| Sliced beets | 43.3 | 14.7 | 45.5 | |
| Vibrator | 13.3 | | | |
| Koosh Ball® | 6.7 | | 12.5 | |
| Diet Coke® | | 41.7 | | 31.3 |
| Cheese cracker | | 31.3 | | |
| Pudding | | 25.0 | | 41.7 |
| Spree® | | 21.7 | | |
| Jello | | 16.7 | | |
| Plain cracker | | | 41.7 | |
| Juice | | | 35.7 | |
| Bead necklace | | | 8.8 | |
| PB & cheese cracker | | | | 25.0 |
| Kit Kat® | | | | 45.5 |
| Skittles® | | | | 20.8 |

Note. A paired presentation format was conducted for Rob, whereas a group presentation format was conducted for the other participants.

rettes to cigarette butts. Andy showed exclusive preference for cigarette butts over unsmoked cigarettes; however, he did not exhibit exclusive preference for unsmoked filters over either unsmoked cigarettes or cigarette butts.

Table 2 shows results obtained during the edible or leisure item assessments. Rob selected M&M® candy during 100% of trials when it was available, which represented a higher overall preference relative to the next most frequently selected item (cookie, 83.3%). Helen also selected one item (coffee) on 100% of trials when it was available. By contrast, Andy showed only a slight overall preference for sliced beets (45.5%) over plain crackers (41.7%), and Larry showed a slight overall preference for Kit Kat® candy (45.5%) over pudding (41.7%). Thus, the preference assessment identified edible items that were preferred by each participant, but

Table 3
Results of Cigarette Component Versus Edible Item Preference Assessment

| Participant | Preferred cigarette component | Preferred edible item |
|--------------------|-------------------------------|-----------------------|
| Rob | 16.7 | 83.3 |
| Helen | 20.0 | 80.0 |
| Andy | 5.0 | 95.0 |
| Larry | 95.0 | 5.0 |
| Larry ^a | 36.7 | 63.3 |

^a These data reflect preference when a cigarette spiked with hot sauce was substituted for Larry's preferred cigarette component. See text for details.

preference was marked only for Rob and Helen.

Table 3 shows participants' choices between their preferred cigarette component and their preferred edible item. Rob, Helen, and Andy showed strong preference for the edible item. By contrast, Larry almost always selected the cigarette component. Therefore, another assessment was conducted to see if stimulus characteristics of the cigarette could be altered such that the edible item would be preferred; this assessment compared preference between spiked cigarettes and the preferred edible item. Results indicated that Larry selected the edible item on 63.3% of the trials. Although this margin of preference was smaller than that observed for the other participants, it suggested that the edible item might compete with spiked cigarettes.

PHASE 2: TREATMENT EVALUATION PROCEDURE

Baseline

The participant was brought into a therapy room and sat at or stood beside a table. There were no other materials in the room. The therapist placed a cigarette (the preferred component from the previous assessment) on the table but did not otherwise

interact with the participant during the session. Thus, baseline sessions were similar to those of the alone condition described by Iwata *et al.* (1982/1994). An observer started a timer when the cigarette was placed on the table and stopped the timer when cigarette pica occurred. If cigarette pica did not occur within 300 s (5 min), the timer was stopped, the cigarette was removed, and the session was terminated. Thus, the criterion for the absence of cigarette pica was arbitrarily set at 300 s.

NCR (Edible Item)

Data from two recent studies (Fischer, Iwata, & Mazaleski, 1997; Lalli, Casey, & Kates, 1997) indicated that NCR was effective in suppressing target behaviors even when reinforcement was available contingent on their occurrence (*i.e.*, extinction was not in effect). In the Lalli *et al.* study, 1 participant was exposed to a condition in which the maintaining reinforcer was delivered independent of the occurrence of the target behavior (NCR) as well as contingent on each occurrence of the target behavior. In the Fischer *et al.* study, an alternative reinforcer (food) was delivered on a fixed-time (FT) 10-s schedule, while each occurrence of the target behavior produced access to the maintaining reinforcer. Results of both studies showed marked reductions in the target behaviors, suggesting that dense schedules of NCR may effectively compete with contingent reinforcement for the target behavior. These results also suggest that NCR reduced the target behaviors through attenuation of their establishing operations (Michael, 1982) because extinction was absent. Based on these data, we explored the possibility that delivery of the preferred edible item on a dense NCR schedule would effectively compete with cigarette pica when the preferred cigarette component was available. Because both responses are consummatory in nature, access to food might produce satiation to the

point at which consumption of cigarette products ceases.

Procedures for the NCR (edible item) condition were as follows. The preferred edible item (pieces of M&M[®], sips of coffee, small slices of beet, and small pieces of Kit Kat[®] for Rob, Helen, Andy, and Larry, respectively) was delivered on an FT 10-s schedule for 5 min prior to the start of the session. This schedule amounted to almost continuous delivery of a food item following its consumption. At the end of 5 min, the session began (as in baseline) when the therapist placed the cigarette on the table. The FT 10-s delivery of the edible item continued throughout the session. If pica did not occur, the session was terminated after 300 s. If pica did occur, the session was terminated, but the therapist continued to deliver food for an additional 60 s to avoid the possibility of inadvertently introducing a contingency in which the edible item was no longer forthcoming following cigarette pica. An observer started the timer as soon as the cigarette was placed on the table and stopped it when pica occurred or was absent for 300 s. The criterion for successful treatment was absence of pica for 300 s for five consecutive sessions. To control for potential satiation, access to the preferred edible item was withheld between sessions (at least 15 min) and for at least 60 min prior to the start of sessions and following the final session of the day.

Data from the Lalli *et al.* (1997) study showed that a dense NCR schedule without extinction was effective in reducing the participant's target behavior, and thinning the NCR schedule maintained initial treatment effects. Thus, for participants in the present study for whom a dense NCR schedule was effective in deterring pica for 300 s, a schedule-thinning procedure was implemented to determine whether treatment effects could be maintained under more practical conditions. The procedures were similar to those

of the NCR (edible item) condition, except that food delivery decreased in the presence of the cigarette. Schedule thinning was based on the mean latency to cigarette pica during separate probe sessions (12 to 14 probe sessions were conducted). During these probes, the cigarette was not available for 5 min while food was delivered on an FT 10-s schedule. Then, the cigarette was placed on the table and food was no longer delivered. The NCR schedule for the first three sessions during schedule thinning was set at 75% of the mean latency to cigarette pica during these probe sessions. Subsequent NCR schedules (i.e., from the fourth session of schedule thinning) were set at 75% of the mean latency to responding during the previous three sessions. A restriction was imposed while setting all NCR schedules such that the value of each schedule would not exceed that of the previous schedule by more than 25%. This limitation ensured a gradual increase in the NCR schedules. The criterion for successful treatment was absence of pica for 300 s for five consecutive sessions.

DRA plus Response Interruption

Because results of the third preference assessment indicated that food or drink items were preferred over cigarettes, there was reason to believe that delivery of the more preferred reinforcer contingent on an alternative response might compete effectively with cigarette pica. Thus, the purpose of this condition was to teach participants to exchange a found cigarette for the preferred edible item. However, assessment results (see Table 3) did not indicate exclusive preference for the alternative reinforcer; thus, there was some probability that cigarette pica would occur under a differential reinforcement condition. To eliminate potential reinforcement for engaging in cigarette pica, a response-blocking component was included.

Each session consisted of 20 training trials and a final test trial. During each training

trial, the therapist placed the cigarette on the table, extended a hand with palm facing upwards a few inches above and to the side of the cigarette, and instructed the participant to hand the cigarette to the therapist (the alternative response) in exchange for the edible item. If no response occurred within 10 s, the therapist repeated the instruction and modeled the alternative response. If no response occurred within 10 s, the therapist repeated the instruction and physically prompted the participant to engage in the alternative response. The edible item was delivered only if the participant engaged in the alternative response without a physical prompt. If cigarette pica was attempted (defined as picking up and bringing the cigarette within 6 in. of the participant's mouth), the therapist prevented the participant from ingesting the cigarette by placing his or her hand between the cigarette and the mouth and removing the cigarette from the participant's hand. The therapist then repeated the instruction and physically prompted the participant to engage in the alternative response.

The purpose of the final test trial was to determine whether an independent (unprompted) exchange would occur when a cigarette was available. During the test trial, the cigarette was placed on the table. No prompts were delivered other than the therapist extending his or her hand out to allow the participant to independently engage in the alternative response. The edible item was delivered if the alternative response occurred independently, but pica was not prevented. The criterion for success was five consecutive test trials (sessions) in which a correct exchange occurred, or, if an exchange did not occur, the participant nevertheless refrained from engaging in cigarette pica for the entire test trial (300 s). That is, the common goal of deterring pica could be achieved by either exchanging the cigarette for an edible item or by not picking up the cigarette in the first

place. Access to the preferred edible item was withheld between sessions (at least 15 min) and for at least 60 min prior to the start of sessions and following the final session of the day.

Extensions of DRA plus Response Interruption

Because the eventual treatment components would be implemented under varying conditions, we programmed and assessed the effectiveness of treatment across two extraexperimental parameters (therapists and settings). Procedures were similar to those under DRA plus response interruption. During Phase 1, a novel therapist (T2) implemented the DRA training trials in a novel therapy room (S2) at the day-treatment program, and treatment effects were assessed during the final test trial. During Phase 2, another novel therapist (T3) implemented the procedures outside but close to the vicinity of the day-treatment program (S3). During Phase 3, various novel therapists implemented the procedure in a variety of settings (varied S-T), such as outside the grounds of the participants' residences and work sites. The criterion for completing each phase was five consecutive test trials in which either a correct exchange occurred or pica was absent for 300 s.

Additional Procedures for Larry

Results of Larry's preferred cigarette component versus preferred edible item assessment showed a preference for cigarettes, suggesting that the NCR or DRA procedures used for the other participants were unlikely to be effective. Thus, Larry was exposed to a series of NCR and DRA conditions in which the preferred cigarette component was altered, a variety of stimuli were used as competing reinforcers, and several punishment contingencies were used. These additional procedures are described in detail because they are unique to Larry and follow

one another in a logical sequence. That is, we hoped to conduct a systematic analysis of the effects of these additional manipulations with Larry in an attempt to treat his cigarette pica.

NCR. Dense schedules of NCR were used throughout this phase with a variety of stimuli. Following the NCR (edible item) condition, herbal cigarettes and nicotine-based products, which represented safer alternatives to pathogen-laden cigarettes, were substituted for food. The assumption here was that these alternative items might compete because they shared some features with actual cigarettes (e.g., visual similarities, presence of nicotine). In the NCR (herbal cigarettes) condition, pieces of herbal cigarette were delivered on an FT 30-s schedule for 5 min prior to the start of the session. An FT 30-s schedule was used instead of a denser schedule to allow sufficient time to chew each piece of herbal cigarette. The session started when the therapist placed a tobacco cigarette on the table. Subsequent to cigarette availability, delivery of herbal cigarettes continued (FT 30 s) until 300 s had elapsed without pica or until 60 s following the occurrence of cigarette pica. Following this condition, several nicotine-based products were delivered to determine whether free access to alternative sources of nicotine (which may or may not be the maintaining reinforcer) could compete effectively with cigarette pica. During all procedures involving the use of nicotine-based products, none of these items was delivered following cigarette availability due to a medical concern that Larry would be ingesting a large amount of nicotine. During the NCR (nicotine pouch) condition, one Skoal[®] pouch was given to Larry to chew for 30 s prior to cigarette availability. During the NCR (nicotine gum) condition, one piece of Nicorette[®] gum (2 mg) was given to Larry 30 s prior to cigarette availability. In a subsequent phase, a piece of nicotine gum was provided 30 min

prior to cigarette availability. The 30-min pre-session delay was based on information provided by the manufacturer indicating that peak levels of nicotine absorption are reached 30 min after chewing the gum.

DRA plus spiked cigarettes. Results of Larry's assessment (Phase 1) showed preference for the cigarette component over the edible item but also showed preference for the edible item over spiked cigarettes (see Table 3). Thus, it was possible that the alternative response of exchanging a cigarette component for the edible item could be initially shaped by using spiked cigarettes, and that the response might be maintained when unaltered cigarettes were later introduced. Hot sauce was used because it was a nontoxic method for altering the taste properties of a cigarette and medical approval was obtained for this procedure. During informal probes in which a spiked cigarette was freely available, Larry exhibited behaviors (turning away from or spitting out the spiked cigarette, or facial grimaces or loud vocalizations following its ingestion) indicating that the hot sauce rendered the cigarette less palatable. Procedures for the DRA plus spiked cigarettes phase were identical to those of the DRA plus response interruption phase described for Rob, Helen, and Andy. The only difference was that spiked cigarettes were used in lieu of unaltered cigarettes during Larry's training trials. The purpose of the final test trial was to determine whether Larry would independently exchange an unaltered cigarette for food after having been exposed to 20 training trials in which he had to exchange a spiked cigarette for food.

DRA plus response interruption plus overcorrection. Procedures were similar to those described in the DRA plus spiked cigarettes condition except that, contingent on each pica attempt (a) the response was blocked and (b) an overcorrection procedure was implemented, in which the therapist physically

prompted Larry to practice handing the cigarette to the therapist for 5 min.

DRA plus response interruption plus water mist. Rojahn, McGonigle, Curcio, and Dixon (1987) showed that a fine mist of water sprayed on the face was effective in treating pica of a young woman diagnosed with severe mental retardation; these data served as the basis for an additional change in Larry's treatment. Procedures used were similar to those during DRA plus response interruption plus overcorrection, except that a water mist was used in lieu of overcorrection. Contingent on each attempted occurrence of cigarette pica, the therapist blocked the response and, holding a plant sprayer containing room temperature water and set on spray mode approximately 6 in. from Larry's face, sprayed Larry once.

DRA plus response interruption plus hot sauce (in mouth). The only procedural difference between this phase and the previous one was that, contingent on each pica attempt, the therapist squirted 2 ml of hot sauce into Larry's mouth.

RESULTS AND DISCUSSION

Figure 1 shows the results obtained during treatment for Rob, Helen, and Andy. Rob engaged in cigarette pica at very short latencies during baseline ($M = 3.3$ s). During NCR (edible item) at the FT 10-s schedule, Rob met the criterion for completion at the outset of treatment because pica did not occur for 300 s during the first five sessions. Prior to schedule thinning, results of 12 probe sessions (data not shown) indicated that Rob's mean latency to cigarette pica was 197 s; hence, the initial NCR schedule for the first three sessions during schedule thinning was set at FT 148 s. During schedule thinning, Rob's pattern of responding was variable. There were only two sessions in which pica was absent for 300 s (Session 14, NCR = FT 148 s; and Session 20, NCR = FT 88 s), so Rob did not meet criterion for

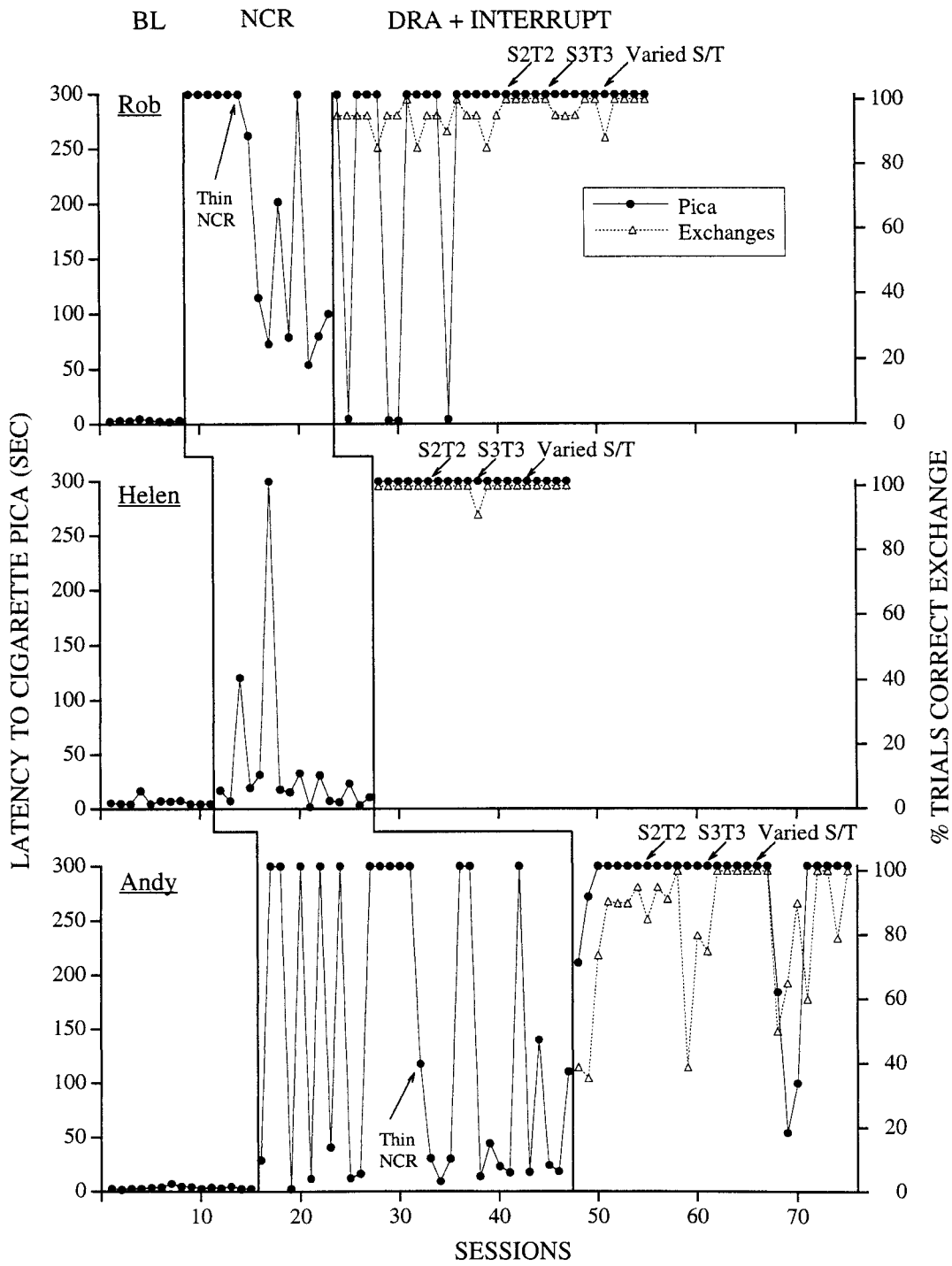


Figure 1. Latency (seconds) to cigarette pica during test trials and percentage of training trials with correct cigarette-food exchanges for Rob, Helen, and Andy.

successful completion of treatment under NCR. Two responses were measured in the DRA plus response interruption condition: (a) correct exchanges during the training trials, and (b) latency to cigarette pica during the test trials (a correct exchange during a test trial was scored as absence of pica for 300 s). Rob typically engaged in a high percentage of correct exchanges during training trials ($M = 93.5\%$). Abstinence from cigarette ingestion on the test trial was initially inconsistent, but he reached the five-session criterion after 17 treatment sessions. When sessions were moved to different settings and were conducted by different therapists, Rob's correct exchanges during training trials were maintained at a high level ($M = 98.2\%$), and cigarette pica did not occur during any of the test trials.

Helen also showed very short latencies to cigarette pica ($M = 6.9$ s) during baseline. During the NCR (edible item) condition, latency to pica increased somewhat but was still rather short ($M = 40.6$ s), and pica was absent for only one session during the FT 10-s condition. Because this dense schedule of NCR was ineffective in competing with pica, no attempt was made to thin the NCR schedule. During DRA plus response interruption, Helen engaged in correct exchanges during 100% of the training trials, and took the minimum number of sessions to meet criterion for successful completion of treatment (i.e., cigarette pica never occurred for 300 s in each of the first five test trials). Her pattern of responding was similar when sessions were conducted under varied conditions: Correct exchanges occurred on 100% of training trials in all but one session, and pica never occurred during any of the test trials.

Andy's mean latency to pica was 4.3 s during baseline. During the NCR (edible item) condition, his pattern of responding was extremely variable (Sessions 16 to 26) before the five-session criterion was met on

the FT 10-s schedule. Prior to schedule thinning, results of 14 probe sessions (data not shown) indicated that Andy's mean latency to cigarette pica was 93 s; hence, the initial NCR schedule for the first three sessions of schedule thinning was FT 70 s. During schedule thinning, his responding once again became variable and there were only three sessions in which pica was absent for 300 s (Session 36, NCR = FT 18 s; Session 37, NCR = FT 22 s; and Session 42, NCR = FT 21 s). During DRA plus response interruption, Andy's correct exchanges during training trials and his cigarette pica during test trials showed similar patterns. Initially, correct exchanges were inconsistent and cigarette pica occurred within 300 s, but both measures showed rapid improvement, and Andy reached the five-session criterion after seven sessions. When treatment was implemented under varied conditions, periodic variability was observed, particularly under the varied S-T condition. Andy eventually met criterion for successful completion of treatment.

Figure 2 shows the results of treatment for Larry. During baseline, Larry's mean latency to pica was 10 s. During the NCR (edible item) condition, his latency to pica was slightly longer than it was during baseline, but his mean latency only reached 18.5 s. Similar results were obtained for the remaining NCR conditions, during which mean latencies to pica were 16.6 s (herbal cigarettes), 4.5 s (nicotine pouch), 34.6 s (nicotine gum), and 5.8 s (nicotine gum, 30-min delay). Thus, results indicated that NCR with a variety of alternative stimuli, including nicotine-based products, did not deter Larry's pica.

During the DRA (with spiked cigarettes) condition, an increase in correct exchanges during training trials was seen toward the middle half of the phase, but little improvement was observed during test trials. His mean latency to cigarette pica on test trials

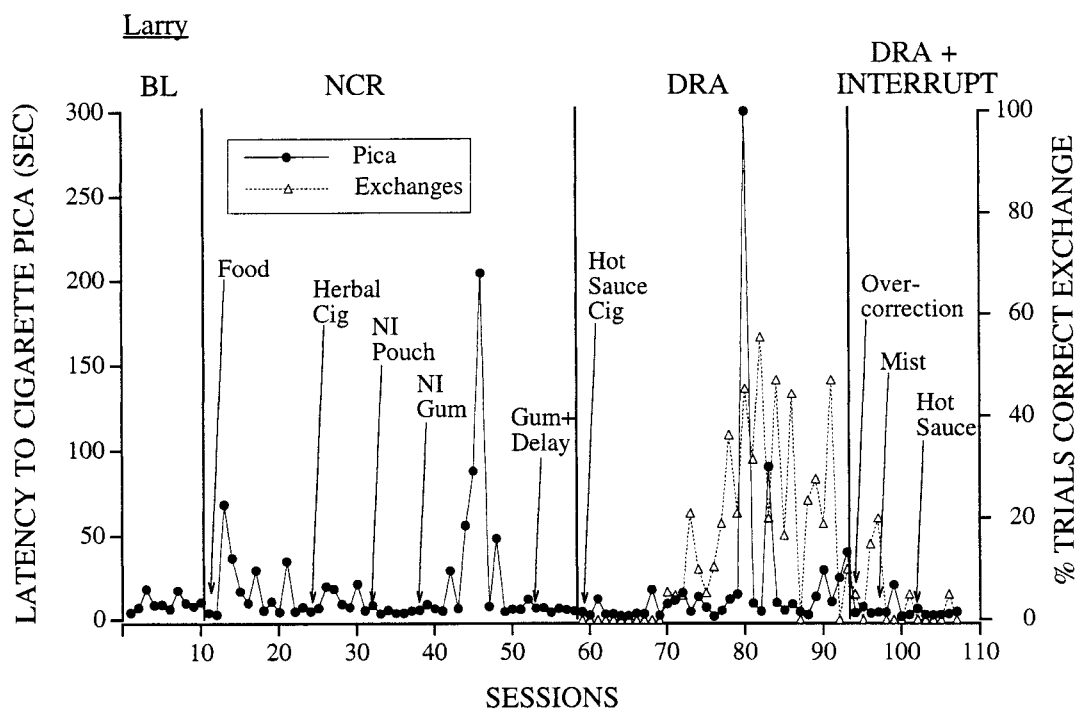


Figure 2. Latency (seconds) to cigarette pica during test trials and percentage of training trials with correct cigarette-food exchanges for Larry.

was 20.3 s, and cigarette pica was absent on only 1 of 42 test trials during this condition. During the final three DRA conditions, Larry's mean latencies to pica on test trials were 5.1 s (DRA plus response interruption plus overcorrection), 3.6 s (DRA plus response interruption plus water mist), and 3.2 s (DRA plus response interruption plus hot sauce squirted into the mouth).

In summary, results obtained during treatment conditions indicated that a dense schedule of NCR (edible item) was an effective procedure only for Rob and Andy; however, maintenance of treatment effects was not observed for either individual when the schedule of NCR was thinned. By contrast, DRA proved to be effective for Rob, Helen, and Andy. For 3 participants, treatment effects were extended across multiple therapists and settings. At the conclusion of the study, facility staff were trained to implement the DRA procedure with the partici-

pants, and informal follow-up data indicated that the procedures were effective in maintaining very low levels of cigarette pica. None of the interventions attempted with Larry, including NCR, DRA, and punishment, was effective in consistently reducing his pica, and further attempts to eliminate pica using reinforcement or punishment contingencies were abandoned. Instead, supervision procedures were implemented to minimize occurrences of cigarette pica. Briefly, these consisted of having staff continually keep Larry within view outside so that pica attempts could be blocked, and of having staff frequently clean the area surrounding Larry for cigarette products.

Results obtained during the treatment phases suggest that marked preference for alternative reinforcers may be somewhat predictive of treatment effects. That is, Rob, Helen, and Andy showed marked preference for edible items over cigarettes, whereas Lar-

ry showed only a marginal preference for the edible item even when cigarettes were spiked. Based on these results, one might expect a higher likelihood of success with either NCR or DRA for Rob, Helen, and Andy, and this prediction was supported by the treatment data. However, it is possible that additional attempts to identify preferred edible items, or other means of altering the taste of cigarettes to make them less palatable, may have resulted in the development of a more effective reinforcement-based intervention for Larry. Alternatively, more intrusive forms of punishment than those used in the study may have been effective. However, these procedures were not evaluated because the severity of the behavior problem did not seem to warrant such interventions.

GENERAL DISCUSSION

The purpose of this study was to evaluate a systematic approach to the assessment and treatment of cigarette pica, a topic that has received scant attention in the literature. The methodology consisted of a series of stimulus preference assessments, interventions based on the outcome of those assessments, and steps to extend and maintain treatment effects under naturalistic conditions. The assessments identified preferred cigarette components, as well as competing reinforcers, for 4 participants, and effective assessment-based treatments were developed for 3 of the participants.

There were several noteworthy features of the study. First, the dependent variable was actual cigarette pica, which contrasts with the simulated measure used by Donnelly and Olczak (1990), who published the only other study demonstrating the effectiveness of DRA as a treatment procedure. Second, steps were taken to minimize health risks associated with ingestion of cigarettes. We limited the number of cigarettes ingested per day, used latency to pica as the response

measure due to restrictions placed on frequency of cigarette ingestion, and manufactured "smoked" cigarette butts that were free of saliva-borne and incidental pathogens. The use of a latency measure and the manufacturing process are both novel to the assessment and treatment of cigarette pica. Third, the assessment procedures were helpful in identifying the presumed preferred component of the cigarette (which probably contributed to the maintenance of pica), as well as in selecting edible items that were preferred over cigarettes. In essence, results of the stimulus preference assessments provided the basis for developing the NCR and DRA interventions. More generally, the cigarette component assessment used in the present experiment and in the Piazza et al. (1996) study involved direct manipulation of stimulus characteristics of objects consumed during pica. Although the cigarette components (unsmoked cigarettes, cigarette butts, unsmoked filters) assessed during the study contained finer elements themselves (e.g., nicotine, tobacco, cigarette paper, etc.), identification of a particular cigarette component as preferred represents an initial step in isolating finer stimulus characteristics of the cigarette that may be responsible for behavioral maintenance. Finally, the systematic implementation of the DRA procedure by multiple therapists across multiple settings provided a means of extending treatment effects under naturalistic conditions.

One feature missing from the study was an attempt to rule out the effects of social consequences as possible maintaining reinforcers. A pretreatment functional analysis was not conducted because all participants were observed to engage in pica when alone, suggesting that the behavior was maintained by automatic reinforcement; in addition, there were no data suggesting that cigarette pica was maintained by social reinforcement. Thus, the approach taken was to identify cigarette components that were preferred, as

well as alternative reinforcers that might effectively compete with pica. However, it is possible that cigarette pica could be maintained by social reinforcement, and additional research is needed to determine the extent to which this occurs. One way to gather evidence for or against the contribution of social consequences would be simply to conduct a functional analysis of cigarette pica similar to that used by Piazza *et al.* (1996).

Several additional limitations in the present study should be noted. First, during the cigarette component assessment, the sizes of different stimuli were not held constant. Similarly, it is unknown if the concentrations of nicotine were equivalent in the unsmoked cigarette and smoked cigarette butt. Thus, differences in size or concentration of nicotine may have affected the outcome of the cigarette component assessment, and it would be desirable to hold these factors constant to the extent that it is possible. Another potential factor limiting the cigarette preference assessment is rate of nicotine absorption, which, if variable across individuals, may influence the outcome of a paired choice comparison between cigarette components.

Second, the NCR interventions were not practical. Our rationale was to satiate participants with near-continuous delivery of edible items in an attempt to reduce cigarette pica, then maintain control over responding via schedule thinning such that treatment could be implemented under naturalistic conditions. Because NCR was ineffective for all participants under experimental conditions, there was no reason to believe that it would gain control over behavior under naturalistic conditions. However, it is possible that schedule thinning could have been more effective for both Rob and Andy. Although the FT schedule thinning was based on performance during probes, the initial value during thinning (FT 148 s and FT 70

s for Rob and Andy, respectively) represented an abrupt increase relative to the original FT 10-s schedule. Because both participants showed increases in pica at the outset of schedule thinning, gradual changes from the original FT 10-s schedule may have been more effective.

Third, although DRA was effective, the alternative response (exchanging a cigarette for another reinforcer) shared some topographical features with the target response (*i.e.*, picking up the cigarette). Thus, the initial part of the chain leading to pica remained intact and, in the absence of consistent reinforcement by staff, pica may be more likely to recur.

Fourth, data collected during test trials of the DRA plus response interruption procedure did not differentiate between correct exchange and absence of cigarette pica. In order to definitively demonstrate that treatment effectiveness was attributed to the critical feature of the DRA procedure (*i.e.*, correct exchange for the edible item) and not to the interruption component, a more sensitive data-collection system could have been designed.

Fifth, Larry was exposed to identical assessment and treatment procedures as those experienced by the other 3 participants, yet the interventions had no effect on Larry's pica. In an attempt to analyze his treatment failure, we then examined the effects of a series of related and more progressively intrusive interventions (nicotine-based reinforcer, alteration of the reinforcing properties of cigarettes, punishment). None of these interventions yielded a desirable outcome. Nevertheless, Larry's procedures and data are instructive in several respects. First, they offer empirical data based on the same methodology that limit the external validity of results reported for the other 3 participants, whose behavior change showed some degree of replicability (across participants and, within participants, across therapists

and locations). Second, descriptions of the additional procedures to which Larry was exposed may be helpful to researchers or clinicians who encounter difficulties with NCR or DRA procedures similar to those reported here. Finally, the fact that Larry's pica was resistant to change following multiple forms of intervention based on both reinforcement and punishment provides clear evidence that cigarette pica may be a highly intractable problem in some individuals.

Finally, because NCR always preceded DRA, it is possible that results obtained during the DRA conditions for Rob, Helen, and Andy were due partially to multiple-treatment interference (sequence effects). This seems unlikely because the NCR and DRA procedures were quite different; furthermore, in all three cases, treatment failure under NCR was observed prior to implementing DRA. Also, although exposing one or more participants to DRA in the absence of prior exposure to NCR would have eliminated the potential influence of sequence effects, this approach was inconsistent with our general treatment strategy of evaluating less intrusive interventions prior to using more intrusive ones.

Results obtained in the present study suggest a number of avenues for future research on the assessment and treatment of cigarette pica. For example, the methodology we used to identify preferred cigarette components focused on three stimulus characteristics of the cigarette (unsmoked filter, unsmoked cigarette, and smoked cigarette butt), and preference was identified for two of these (unsmoked cigarettes and cigarette butts). It is possible that additional characteristics of cigarettes, which were not manipulated in the study, may also contribute to the maintenance of cigarette pica. Specifically, all three of the components we examined differ along several dimensions, such as taste, texture, presence or absence (or different concentrations) of nicotine, shape, and size, to

name a few. Thus, although the presence of tobacco (in the unsmoked cigarette) and nicotine (in the smoked cigarette butt) were important determinants of pica in our participants, extensions of this methodology may identify other controlling variables. For example, one way to determine if nicotine per se were responsible for behavioral maintenance would be to assess preference for one of two cigarettes that differed only in the presence and absence of nicotine (i.e., all other stimulus characteristics of both cigarettes would be held constant). Alternatively, if the taste of raw tobacco is hypothesized to be the maintaining reinforcer, comparison stimuli would consist of unsmoked cigarettes, one of which would be altered so that its tobacco was relatively tasteless.

A second avenue for future research would be to conduct a more thorough examination of the conditions under which NCR effectively reduces pica. Data for 2 of our participants and those presented by Piazza et al. (1996) for 1 participant indicated that NCR suppressed pica when reinforcement was delivered on a near-continuous basis. However, we observed a recurrence of pica when the NCR schedule was thinned. But it is possible that other arrangements may have been more effective in deterring pica. For example, perhaps the 5-min pre-session NCR procedure with edible items was insufficient to alter the establishing operation for pica. There is some evidence suggesting that satiation may require access to reinforcers at a level far exceeding baseline levels. For example, Rast, Johnston, Drum, and Conrin (1981) found that providing food that exceeded the baseline breakfast quantity by five to eight times and the baseline lunch quantity by three to six times eliminated rumination; however, delivery of food quantity twice that of baseline levels produced no effect. In light of these data, it is possible that unlimited access to food until consumption ceased may have more effective

with our participants. As noted previously, a more conservative thinning schedule may also have been more effective than the one we used.

A third avenue for future research would be to examine the basis of treatment failure in cases such as Larry's to arrive at an effective intervention for highly intractable cigarette pica. Altering the stimulus characteristics of the cigarette to shift Larry's preference in favor of food did not yield an effective intervention. That is, although he showed preference for the edible item over the spiked cigarette, the DRA contingency was ineffective: Although he exchanged some spiked cigarettes for food, he ingested many of the cigarettes, indicating that distasteful cigarettes still retained reinforcing properties. It is possible that alterations of the cigarette other than that used in the present study (hot sauce) may have been more effective in deterring pica. For example, adding chemicals to the cigarette such that ingestion of a small amount produces an adverse physiological reaction (i.e., vomiting) might actually establish a learned aversion to the ingestion of cigarettes (Garcia & Koelling, 1966). However, the use of such an intrusive procedure requires careful consideration of the severity of cigarette pica. If the potential for physical harm is great should cigarette pica remain untreated, and if punishment procedures pose no risk of physical harm, then perhaps such interventions may be clinically justified. A number of punishment procedures were used during the course of Larry's treatment, but because he had experienced no illness as a result of cigarette pica, induction of vomiting was not considered. Instead, close supervision, which in the long run may have been more intrusive than short-term discomfort from engaging in pica, was chosen as a means of preventing pica.

Whereas other topographies of SIB have been the subject of extensive research, ciga-

rette pica has been examined in very few studies. In spite of some limitations in our methodology, it establishes a useful model by illustrating (a) a systematic approach to the assessment of reinforcers that maintain and compete with cigarette pica, (b) the relevance of assessment to the process of treatment development, and (c) a means of extending treatment effects across varied stimulus conditions. Further refinements and extensions of this methodology may prove to be helpful in developing a wide range of treatments for the elimination of cigarette pica. Given the labor-intensive nature of this undertaking, however, we must emphasize the importance of early intervention. In other words, it is possible that immediate steps taken to eliminate occasional cigarette pica, which is often viewed as a relatively innocuous behavior problem, may preclude the need for more complex and protracted intervention after cigarette pica has acquired reinforcing properties.

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Received March 5, 1998

Final acceptance March 31, 1999

Action Editor, James W. Halle

STUDY QUESTIONS

1. What are some of the limitations of previous research on cigarette pica?
2. What was the rationale for conducting the three-preference assessment? Also, why were “spiked” cigarette butts used for one participant?
3. What procedures were used to allow measurement of actual cigarette pica under conditions that minimized its harmful effects?
4. Why was noncontingent reinforcement (NCR) evaluated as treatment, and how was it implemented?
5. Briefly describe the DRA contingency. What was the difference between the training and test trials during the DRA sessions?
6. Make a table summarizing the effects of NCR (dense and lean schedules) and DRA on Rob’s, Helen’s, and Amy’s cigarette pica.

7. What additional procedures were used with Larry, and what results were obtained?

8. Although effective, what is a potential limitation of the DRA contingency as used in this study? What alternative procedure does not contain this limitation?

Questions prepared by Juliet Conners and Michele Wallace, The University of Florida