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Assessment and Treatment of Pica Within the Home Setting in Australia

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Pica is one of the most serious, life-threatening topographies of self-injurious behavior because a single instance can result in death. Despite this, there is a need for more research on teaching adaptive skills to replace pica, particularly outside of intensive specialized hospital admissions and with younger children. We present a case history of a 4-year-old male with autism spectrum disorder, pica, food selectivity, and food stealing in which assessment and treatment occurred in the family's home. A functional analysis suggested pica was maintained by automatic reinforcement. A competing stimulus assessment showed pica was highest without competing stimuli, lowest with highly preferred edibles, and lower with highly preferred tangibles. Response interruption and redirection with differential reinforcement was effective with and without competing stimuli across contexts. The participant learned to independently throw away, put away, and use appropriately some materials and to refrain from touching other items he previously consumed inappropriately. Pica decreased by 97%, independent discards increased by 100%, and 100% of admission goals were met. His mother and therapist were trained to high procedural integrity on the treatment procedures, and they continued testing for generalization and maintenance. His mother reported high satisfaction with the program and outcomes and acceptability of the treatment procedures. Gains were maintained for over 2 years.

Keywords: pica, pediatric feeding disorders, food selectivity, autism spectrum disorder, avoidant/restrictive food intake disorder

Pica, the persistent eating of nonnutritive substances, is a serious and life-threatening self-injurious behavior, as just one instance can result in death (American Psychiatric Association, 2013; Williams & McAdam, 2012). Examples of serious risks include choking, intestinal obstruction and perforation, toxicity (e.g., lead paint), and the ingestion of parasites (Matson, Belva, Hattier, & Matson, 2011; Stiegler, 2005). Physicians have published case examples of x-rays and surgical pictures depicting large hair balls, strings, and disposable gloves spanning the colon, requiring surgery and loss of tissue; glass or screws tearing or getting stuck in the gastrointestinal system; and batteries that have been swallowed (Matson et al., 2011; Stiegler, 2005).

Functional analyses of pica most often identify automatic reinforcement (Call, Simmons, Mevers, & Alvarez, 2015; Hagopian, Rooker, & Rolider, 2011). That is, individuals who engage in pica

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often do so when left alone and with lower levels of stimulation and engagement. Such functional analyses of pica are typically conducted in inpatient settings, in which a safe environment with simulated pica items (rather than dangerous materials) can be arranged (Finney, Russo, & Cataldo, 1982; Piazza et al., 1998; Piazza, Hanley, & Fisher, 1996). Inpatient settings also allow the individual to be observed while alone via a one-way mirror or video.

Behavior-analytic treatments of pica, including reinforcement and response-reduction procedures, are well-established and empirically supported (i.e., the highest level and category of evidence; Hagopian et al., 2011). These treatments are often highly effective, producing large effect sizes (Call et al., 2015). However, treatment procedures for pica have changed over the years. Historically, clinicians aimed to suppress pica by limiting opportunities and using punishment when pica occurred (Hagopian et al., 2011; Matson, Hattier, Belva, & Matson, 2013; McAdam, Sherman, Sheldon, & Napolitano, 2004). Current treatment procedures entail teaching appropriate eating in the right location (e.g., food on plate rather than off floor), providing other options for reinforcement and stimulation (e.g., food, toys), and teaching other actions with pica items, such as throwing them away (Hagopian et al., 2011).

As severe and dangerous as pica is, there is less research on pica than on other topographies of self-injurious and problem behavior (Matson et al., 2011). More research is needed with longer term follow-up (e.g., Busch, Saini, Zorzos, & Duyile, 2018) and with younger children and earlier intervention. More research is also needed on teaching multiple alternative skills that are adaptive in a variety of contexts to replace pica and increase independence (e.g., cleaning up, not handling pica items, engaging with other items appropriately, eating healthier foods), rather than simply limiting opportunities and using punishment.

Hagopian, González, Taylor Rivet, Triggs, and Clark (2011) described a comprehensive treatment of automatically reinforced pica for two participants in an inpatient setting. Treatment components included noncontingent access to competing stimuli and response interruption and redirection with differential reinforcement of alternative behavior. Participants had noncontingent and continuous access to preferred items that were associated with low levels of pica and high levels of engagement. Pica attempts were blocked, and the experimenters taught participants to discard pica items in the trash. The researchers then taught participants to discriminate which items were and were not appropriate to discard. They prompted participants to use items appropriately, put items away, comply with the next step of a demand sequence, or engage in an incompatible response (e.g., to put hands in pockets). The researchers taught one participant to clean the area when she changed locations to reduce pica opportunities. The experimenters later generalized the treatment to other trash receptacles and ensured the treatment effects maintained in school and community settings. Schmidt et al. (2017) also used response interruption and redirection (without competing stimuli) to treat the automatically reinforced pica of three participants in an inpatient setting. The researchers taught participants to discard and vacuum pica materials. The experimenters did not teach alternative responses for items not appropriate to discard or vacuum, nor did they provide community or follow-up data.

These studies were conducted in intensive, specialized, inpatient hospital settings with highly trained and experienced staff and supervisors, custom built rooms, a full interdisciplinary team, and 24-hr care. Pica treatment is labor, time, and resource intensive (McAdam et al., 2004) and has been largely limited to these types of inpatient settings (i.e., a handful of hospitals in the United States) to assess and treat pica safely, especially for more severe and older patients who also engage in other forms of severe problem behavior (e.g., aggression, property destruction; Williams & McAdam, 2012). Such treatments require constant and consistent implementation to be safe and effective because just one instance can cause significant harm. Hospitalizations for the assessment and treatment of pica can last over 6 months.

More treatment research is needed outside of specialized settings in the United States. Because pica may be covert and automatically reinforced, conducting assessment and treatment evaluations without a specialized room designed specifically for such evaluations can be challenging to maintain the individual's safety while allowing for unobtrusive observation. In addition, locations outside the United States may not have adequate or stable Internet

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connections for covert alternatives to in situ data collection (e.g., a video feed from which data collectors measure instances of pica). Also, the ingredients available in countries outside the United States may vary significantly and thus impact the recipes for creating simulated pica items. Additionally, access to adequate, reliable, and trained behavior-analytic staff to assist with conducting assessment and treatment evaluations can be limited outside the United States.

The present case history replicates and extends the study by Hagopian et al. (2011) in a home setting overseas and in a condensed time frame. We extended this research by evaluating treatment with and without competing stimuli in varied contexts, presenting data on compliance with discards and other instructions across various contexts, adding additional contexts (e.g., outside) and skills (e.g., avoiding items such as others' food and dangerous or unhygienic items), assessing caregiver satisfaction and social validity, and providing extended follow-up data and qualitative information on applying treatment over a longer period of time.

Method

Participant, Setting, and Materials

Hebert was a 4-year-old Caucasian male with autism spectrum disorder, pica, food selectivity, food stealing, and a history of iron deficiency requiring supplementation. Iron supplementation did not improve pica. Upon admission, Hebert's pica was significantly impacting his life and restricting his location, daily activities, independence, and adaptive functioning. He required continuous supervision and blocking of pica attempts. He could not go outside without continuous supervision because he ate leaves, sticks, and dirt. He also ate plastic, paper, cloth, hair, tape, wood, and paste. Pica limited Hebert's access to academic, therapeutic, and leisure activities. Hebert also mouthed and bit many household objects and toys, and he once attempted to chew an extension cord. Food stealing also significantly impacted his daily life and social engagement. Access to cupboards and the outdoors had to be restricted. Others could not eat around him, and they could not have family dinners. These behaviors significantly restricted him in community and social settings, too. Hebert consumed no vegetables, and he ate only three fruits. Hebert was ambulatory, did not speak, and was enrolled in an early intensive behavioral intervention program. Hebert's name was changed to protect confidentiality.

A trained, doctoral-level behavior analyst conducted sessions in the family's home. Initial sessions were conducted in a cleared-out bedroom with observers positioned against a wall and behind a barrier (i.e., a foldable picnic table). Later sessions were conducted in the dining room, living room, and backyard of the family's home. Materials included general session materials (e.g., laptop computers for data collection, a webcam, timers, child-sized table and chairs, tangibles for the assessments, preferred edibles, competing items) and materials specific to training various skills. Laminated icons depicted pictures similar to those produced by Boardmaker.

To teach Hebert to discard items, we used trash receptacles with laminated icons and large trash items for training. Due to safety concerns with ingestion of nonedible items, we identified and used materials that were safe for ingestion (i.e., simulated pica items that were as tasteless as possible) but appeared similar to items that Hebert had a history of ingesting. These items included ground brown rice (sand); ground flaxseed and brown rice (dirt); thin rice noodles, tapioca flakes in noodle form, thick rice noodles, and baked gelatin (plastic); uncooked black bean spaghetti (sticks); rice paper (paper); seaweed, lettuce strips, and grass blades (leaves, grass); arrowroot starch, black beans, and flavorless rice cakes (rocks); and nontoxic crayons and homemade play dough (made from flour, water, oil, and food coloring). We swept and sanitized the floor for indoor sessions prior to the placement of simulated pica items. The simulated pica items were scattered in the middle of the room. AQ: 1

To teach other skills for items that were not appropriate to discard, we used materials that Hebert previously chewed, mouthed, and ate (or attempted to) in the home. We taught Hebert to "put away" items (e.g., hairbrush, nightlight) into a large canvas box with laminated icon depicting putting items away. We used leisure and demand materials to teach Hebert to "use appropriately" (e.g., draw with crayon). We taught Hebert not to touch some materials, which we called "don't touch" materials. These items included other's food, dirt, electronics, and household cleaners with a "don't touch"

laminated icon on them or on the table on which the items were placed.

Response Measurement, Interobserver Agreement, and Procedural Integrity

A trained observer recorded child and therapist behavior live and via videos. Observers used an Excel spreadsheet for data collection during preference assessments and a program called BDataPro (Bullock, Fisher, & Hagopian, 2017) running on laptop computers for other sessions. We scored "pica success" as placing an inedible item or simulated pica item past the plane of the lips, "pica attempt" as a blocked attempt to place an inedible item or simulated pica item past the plane of the lips, "mouthing attempt" as a blocked attempt to place an inedible item larger than could fit into the mouth past the plane of the lips (excluding teether), and "independent discard" as placing an inedible item or simulated pica item in a rubbish receptacle without a prompt. We scored "independent compliance" as placing one of the objects in a "put away" receptacle and completing a "use appropriately" redirection without a prompt and "touch" as placing hands within 5.1 cm of a "don't touch" item.

During assessment and initial treatment sessions, opportunities for pica mostly involved manipulation of simulated pica materials. Once treatment was applied to more diverse settings and over longer periods of time, there were more varied opportunities for pica and mouthing to occur due to the wider array of materials naturally available. We scored duration (immediate onset, 3-s offset) of item engagement as touching, manipulating, and directing eye gaze toward competing stimuli and consuming a bolus of food larger than the size of a pea (including self-feeding and chewing). We converted frequency data to responses per minute (RPM) by dividing frequency by session duration. We calculated percentage of session with item engagement by dividing duration of item engagement by session duration.

We assessed interobserver agreement for 38% (range = 20%–62%) of sessions across all phases and conditions by having an independent second observer collect data from videotaped sessions. We separated sessions into 10-s intervals and calculated proportional agreement between the two observers within each interval. Interobserver agreement averaged 100% (range = 98%–100%) for pica attempt, 95% (range = 90%–100%) for pica success, 100% for mouthing attempt, 100% for touch, 93% (range = 81%–100%) for independent discard, 99% (range = 98%–100%) for independent compliance, and 96% (range = 89%–100%) for item engagement.

We assessed procedural integrity for 100% of sessions. Observers scored incorrect procedural integrity using BDataPro when the therapist failed to implement the target procedure within 3 s of when the procedure was programmed to be implemented and when therapists implemented procedures when they were not programmed. The rate of incorrect procedural integrity averaged 0.05 RPM (range = 0–0.6 RPM). For all sessions scored by a second observer (38%), that second observer also assessed interobserver agreement on procedural integrity, which averaged 100% (range = 98%–100%) across all procedural-integrity measures. We calculated characterizations of effect sizes using percentage reduction (Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Hagopian & Gregory, 2016) using the average of the last three sessions of the final treatment.

Procedure

A trained doctoral-level behavior analyst conducted sessions approximately 8 hr per day for 9 consecutive days. The number of sessions per day varied (n = 206 sessions; M = 22 sessions per day; range = 9–39). Sessions lasted 5 min and occurred consecutively within phases. We also took periodic short breaks as needed between sessions (e.g., at the end of an assessment or treatment phase, after three sessions in each condition, after an hour). A second person from Hebert's early intervention team (a bachelor-level program supervisor or a master-level board-certified behavior analyst clinic director) was present and either collected data or served as a session therapist during generalization contexts. Hebert's early intervention provider continued generalization, maintenance, training, expansion, and simplification of the treatment procedures for everyday life postdischarge.

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Functional Analysis

We conducted paired-stimulus tangible (16 items) and edible (13 items) preference assessments (Fisher et al., 1992) to establish a hierarchy of preferred stimuli. Our functional analysis was similar to that described by Piazza et al. (1996) and Iwata, Dorsey, Slifer, Bauman, and Richman (1982). The floor was baited with 16 simulated pica items. Sessions lasted until all items were consumed or 5 min elapsed. All sessions ended after 5 min. Conditions included ignore, toy play (control), and social attention. In the ignore condition, therapists were not in the session room area, but were in the bedroom in a mock observation area. We provided no differential consequences for pica. In the toy-play (control) condition, moderately preferred toys were available noncontingently, and the therapist in the session room delivered brief social attention (e.g., "That's a cool song you're playing") every 30 s and provided no differential consequences for pica. In the social-attention condition, moderate to low preference toys were available noncontingently, the therapist was in the session room but "busy" reading and writing in a notebook, and the therapist delivered brief attention (e.g., "That's gross," "You're not supposed to eat that," "You'll get sick") similar to what caregivers and therapists reported to occur commonly following instances of pica. Due to not having an observation room and concerns that Hebert would not engage in pica with others in the room due to a history of pica being interrupted, we started with consecutive ignore sessions and did not begin the social attention condition until after evaluating automatic reinforcement.

Competing Stimulus Assessment

We conducted a competing stimulus assessment (Piazza et al., 1998) to identify stimuli that competed with Hebert's pica. We evaluated five nonedible stimuli and one condition with continuous delivery of a variety of highly preferred edibles (i.e., one small piece of food placed on a plate at a time and then immediately replenished after being consumed). Simulated pica items were on the floor, as in the functional analysis. We presented each stimulus individually and on a child-sized table. We remained in the mock observation room but ignored pica. We also conducted a no-stimulus control condition. Conditions occurred in a randomized order, and we conducted three sessions per condition (n = 21). Sessions lasted 3 min. We identified and used within the treatment procedures those competing stimuli associated with low rates of pica and high percentages of item engagement.

Treatment Evaluation

A small (approximately 30-cm tall) rubbish receptacle with a visual icon and simulated pica items were present across all sessions. The rubbish receptacle was placed on the border of the scattered, simulated pica items.

Baseline ignore. Neither attention nor competing items was available.

Competing stimuli. Hebert had continuous and noncontingent access to nonedible competing stimuli. We told Hebert, "You can play with your toys" and ignored pica.

Treatment (response interruption and redirection). We conducted pretreatment training initially with 15 large trash items on the floor, then we mixed in simulated pica items until independent discards increased and zero physical prompting was needed. We taught Hebert to pick up and discard items into a rubbish receptacle to obtain reinforcement (i.e., verbal descriptive praise and a preferred edible). If Hebert did not pick up an item within 30 s, we prompted him using a least-to-most prompting procedure (i.e., verbal, gestural, and full physical prompts) to occasion compliance. We delivered an edible and descriptive praise following each discard, unless physical guidance was required. If Hebert held a simulated pica item, we blocked pica attempts by placing our hands between Hebert's hands and mouth. If he held the simulated pica item longer than 2 s or attempted pica, we blocked and redirected him to discard the item in a rubbish receptacle. We blocked attempts to discard competing stimuli and attempts to engage with the rubbish bin when not discarding, which did not occur.

Treatment with and without competing stimuli. After demonstrating initial efficacy of the treatment procedures, we then compared treatment effects when noncontingent competing stimuli were and were not available within a multielement design. We did this in preparation for future contexts in which treatment would be

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implemented without the availability of competing stimuli.

Generalization. We next took steps to generalize the treatment to better reflect the types of situations and contexts Hebert experienced routinely and to account for the increased opportunities for pica Hebert would encounter following discharge. Up to this point, Hebert had learned only to pick up and throw away bated pica materials; therefore, prior to this phase, we conducted sessions (not shown) to introduce new contexts (e.g., a leisure and an academic context) in which Hebert would interact with materials that were not appropriate to throw way. During these and all subsequent sessions, we introduced pica materials that Hebert had a history of mouthing or eating. We also discontinued edible reinforcement for compliance with prompts following pica and mouthing attempts.

Following instances of attempted or actual pica or mouthing, the therapist redirected Hebert in one of three ways (hereafter referred to as "use appropriately," "put away," and "don't touch"). For "use appropriately," we conducted treatment sessions in one of three contexts: demand (sort shapes, place objects in egg crate, insert popsicle sticks, put on lids), academic (glue paper, hole punch paper, draw, paint, mold play dough), and prompted leisure (place toy CD in player, place toy fish in bowl, place toy cookie in jar). Across these three contexts, the therapist used a least-to-most promoting sequence to occasion compliance with the task at hand. Attempted or actual pica or mouthing resulted in the therapist implementing the next prompt in the prompting sequence. For example, if Hebert was in a demand context and attempted to place demand materials in his mouth, the therapist initiated the next step in the prompting sequence until Hebert used the materials appropriately. For "put away," we intervened similarly by prompting Hebert to place items that were appropriate for him to have contact with at certain times (e.g., a hair brush, shoes, a night light, a stuffed animal) in a receptacle with a visual "put away" icon on it. For "do not touch," we placed "don't touch" laminated visual icons on all items or surfaces that Hebert should never touch (e.g., an extension cord, dishwashing liquid, his mother's purse, a wooden spoon, his sister's small plastic toys, others' mobile phones). Following attempts to touch these materials, we prompted Hebert to clasp his hands together as an incompatible response. We also arranged differential reinforcement of other behavior (starting with a 30-s resetting interval) using a small piece of a highly preferred edible for not touching these materials. Across these three contexts, we conducted 27 generalization sessions.

We then returned to the treatment evaluation and combined all contexts and ways of redirecting Hebert (i.e., use appropriately, put away, do not touch) into each session. We removed dirt and sand from simulated pica items, as we later taught broom/dustpan skills inside, and dirt and sand became do-not-touch materials when outdoors. During this phase, starting with Session 34, we removed descriptive praise for compliance to simplify the treatment procedures.

Treatment plus clean-up. We next taught Hebert to clean at the start of each session to make the area safer by decreasing pica opportunities. We prompted Hebert to clean up which included discarding all simulated pica items and putting away all put-away items. Hebert did not have access to competing stimuli during this clean-up period. Once this was complete, Hebert regained access to competing stimuli, and the resetting differential reinforcement of other behavior started. Following the clean-up period, the therapist did not interact with him unless he initiated interaction, but the therapist remained within arm's reach to block any pica attempts. In this phase, we added a portable rubbish receptacle (clip on canvas pouch with rubbish visual icon) and prompted him to empty it in the rubbish bin (this bin remained in place) after discarding all items. We also added a backpack to carry competing stimuli for portability and prompted him to unpack and pack it.

We conducted caregiver training with Hebert's mother using behavioral skills training. We provided a written protocol and cheat sheet for her to review, and she watched session videos of therapists modeling the treatment procedures. We reviewed the written protocol and cheat sheet with her and answered questions. We conducted a role play with her and gave feedback. We had her run sessions with us present, and we gave feedback if needed. To evaluate effectiveness in a more naturalistic setting, we conducted sessions in different settings including the dining room and lounge room. We varied session therapists to ensure treatment

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remained effective across caregivers and locations.

After the treatment evaluation was complete, we discontinued simulated pica items, as there were sufficient pica opportunities in the generalization contexts. To further generalize the treatment, we conducted separate sessions (not shown) for contexts hypothesized by caregiver and Hebert's treatment team report to be more difficult (i.e., have a higher frequency of pica) including when Hebert was outside in the backyard, while reading books, while eating with others, and when playing with Play-Doh. Across these contexts, we conducted 43 generalization sessions.

Caregiver Satisfaction and Social Acceptability

At the end of the intensive program, we gave caregivers a written discharge questionnaire (on a Likert-type scale ranging from 1 to 5) to assess program satisfaction (23 items similar to those listed in Table 1 in Hoch, Babbitt, Coe, Krell, & Hackbert, 1994) and social acceptability of treatment (16 items similar to the Intervention Rating Profile used by Martens, Witt, Elliott, & Darveaux, 1985).[1] We computed a score for each measure as an average (total summed score divided by the number of items).

Results

A hierarchy was established for tangible and edible stimuli. We used the top four edible items: cheese and bacon balls, Tic Toc biscuits, Twisties, and bread. Although books were highly preferred, we did not use books as competing stimuli due to the potential for pica with the paper.

Functional Analysis and Competing Stimulus Assessment

Pica was high in the initial ignore phase (M = 2.6). It decreased to low levels in the initial control/toy-play phase, which had a therapist present (M = 0.1). Pica increased again in the ignore condition (M = 1.1) and remained high and undifferentiated across conditions for the remainder of the analysis, suggesting that the behavior was maintained by automatic reinforcement. This interpretation of behavioral function was consistent with caregiver and treatment team reports. Figure 1 depicts these results.

In the competing stimulus assessment, pica was highest in the ignore condition (M = 3.4) and lowest (M = 0.1) in the edible condition. In the edible condition, he ate only one piece of pink crayon which he likely mistook for a pink cookie he had dropped. With the tangible stimuli, pica was lower than ignore, but pica remained variable (M = 2.0, range 0.9 to 3.0), and engagement was variable (M = 65%, range 17% to 98%). The teether was associated with the highest rate of pica and the lowest levels of engagement. Figure 2 depicts these results.

Treatment Evaluation

Pica was higher in baseline (M = 2.3) than when competing stimuli were available (M = 1.5), and independent discards were zero in the initial phase and replication. Independent discards increased with treatment (M = 4.3), and pica decreased. Pica was lower in the replication (M = 0.1) when compared to the initial treatment phase (no successes; M = 0.3 for attempts). In the final treatment phase when we expanded contexts, added clean-up, and did training and generalization, independent discards (M = 3.6) and compliance (M = 1.6) remained high, and pica (M = 0.1), mouthing (M = 0.02), and touch attempts (M = 0.04) remained low. Figure 3 depicts results of the treatment evaluation.

In comparing treatment with and without competing stimuli, pica was 0 without and low (M = 0.1) with, and independent discards were lower with competing stimuli available (M = 5.2 compared to 10.8) due to item engagement (taking time to play with competing stimuli rather than discard). This demonstrates that with or without competing stimuli, response interruption/redirection and differential reinforcement for discarding was effective; however, previous data from the treatment evaluation demonstrated that without response interruption/redirection and differential reinforcement,

[1] Please see https://survey.zohopublic.com/zs/AeCsbn for the satisfaction questionnaire and https://survey.zohopublic.com/zs/WZCsQv for the acceptability questionnaire.

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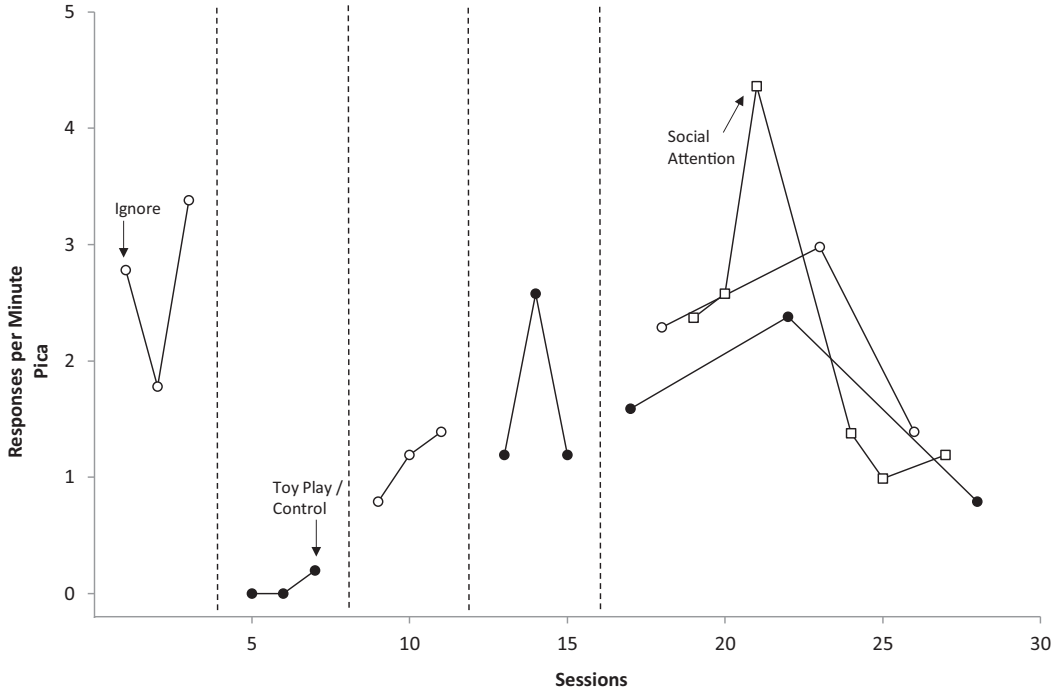

Figure 1. Functional analysis.

pica was lower with competing stimuli available when compared to baseline.

For contexts conducted separately, for "demand," pica, mouthing, and touch attempts were zero, and the reinforcement interval was increased to 45 s. For "outside," pica and mouthing were zero and touch attempts were low ($M = 0.04$), and the reinforcement interval was increased to 1 min. For "do not touch" with other's food/eating with others, pica successes and mouthing were zero, pica attempts were low ($M = 0.04$), and touch attempts were low ($M = 0.2$) and decreased to zero in the final three sessions. For Academics, pica successes were low ($M = 0.1$), as were pica attempts ($M = 0.2$), and mouthing and touch attempts were zero. With play dough, pica successes and touch attempts were zero, mouthing was low ($M = 0.03$), and pica attempts were higher than in other contexts ($M = 0.9$).

For characterizations of effect sizes of the treatment via percent reduction (Hagopian & Gregory, 2016), there was a 100% increase in independent discards and a 97% decrease in pica, mouthing, and touch attempts. Hebert met 100% of his individualized goals (in summary, identify preferences, identify function, identify competing stimuli, teach alternative responses to pica, formulate treatment package to reduce pica by 90% or greater, train caregivers to procedural integrity of <1/min incorrect RPM, and generalize the protocol). AQ: 4

Follow-Up

At a 3-month follow-up, the schedule of reinforcement for independent discards and redirection compliance had been increased to variable ratio 2. Independence remained high and pica, mouthing, and touch attempts remained low. Pica and mouthing attempts were zero, touch attempts were low ($M = 0.1$), and independent discards ($M = 2.8$) and independent compliance ($M = 3.0$) were high. Follow-up data are shown in Figure 3.

Caregiver Satisfaction and Social Acceptability

Hebert's mother reported high social treatment acceptability (4.44 out of 5) and program

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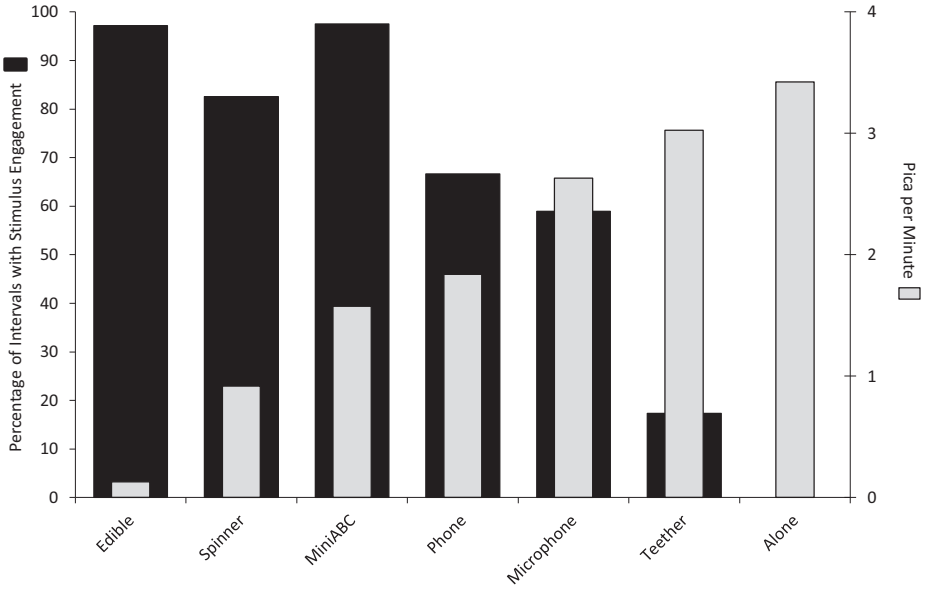

Figure 2. Competing stimulus assessment.

satisfaction (4.04 out of 5). At a 2-year, 3-month follow-up, Hebert's mother reported pica was much better than pretreatment (4/5) on a 5-point Likert-type question from 1 (*worse than pretreatment*) to 5 (*resolved*) on the satisfaction survey (Hoch et al., 1994), and she indicated that she would be highly likely to recommend this treatment to other families.

Discussion

We replicated Hagopian et al. (2011) including teaching multiple adaptive replacement skills to increase independence. Pica decreased by 97% and independence discards and appropriate alternative responses increased to 100%. We extended this research in several ways. We translated this process to a home setting overseas, condensing the treatment progression to less than a 2-week admission (compared to over 6 months), and maintained experimental control, while reporting interobserver agreement and procedural integrity data. Hebert learned to throw away pica materials, put away items okay for him to touch, use other materials appropriately, and refrain from touching materials he should never touch. Following treatment, he was able go outside with less supervision and eventually attend preschool. Gains maintained over 2 years, and his mother reported high satisfaction and acceptability.

Consistent with the literature, the functional analysis clarified that Hebert's pica was automatically reinforced. Competing stimulus assessment showed that pica was highest when Hebert was alone, lowest with highly preferred edibles (food), and lower with some highly preferred tangibles (toys). Response interruption/redirection with differential reinforcement was effective both with and without competing stimuli.

Hebert being able to more fully participate in his early intervention program and eventually go to preschool was a significant benefit. Prior to treatment, there was a wide range of items (e.g., paste, crayons, play dough) the early intervention team could not use in his program due to pica, and many other program materials (e.g., plastic, paper, wood) had chew marks and pieces missing due to pica. These are materials typically accessible and used in a preschool environment. Preschools in Australia also spend a large amount of time outdoors, including meals and outdoor playground time (with sandboxes). Prior to treatment, Hebert could not participate in these activities.

A significant strength of this case history was the early intervention team maintenance, gener-

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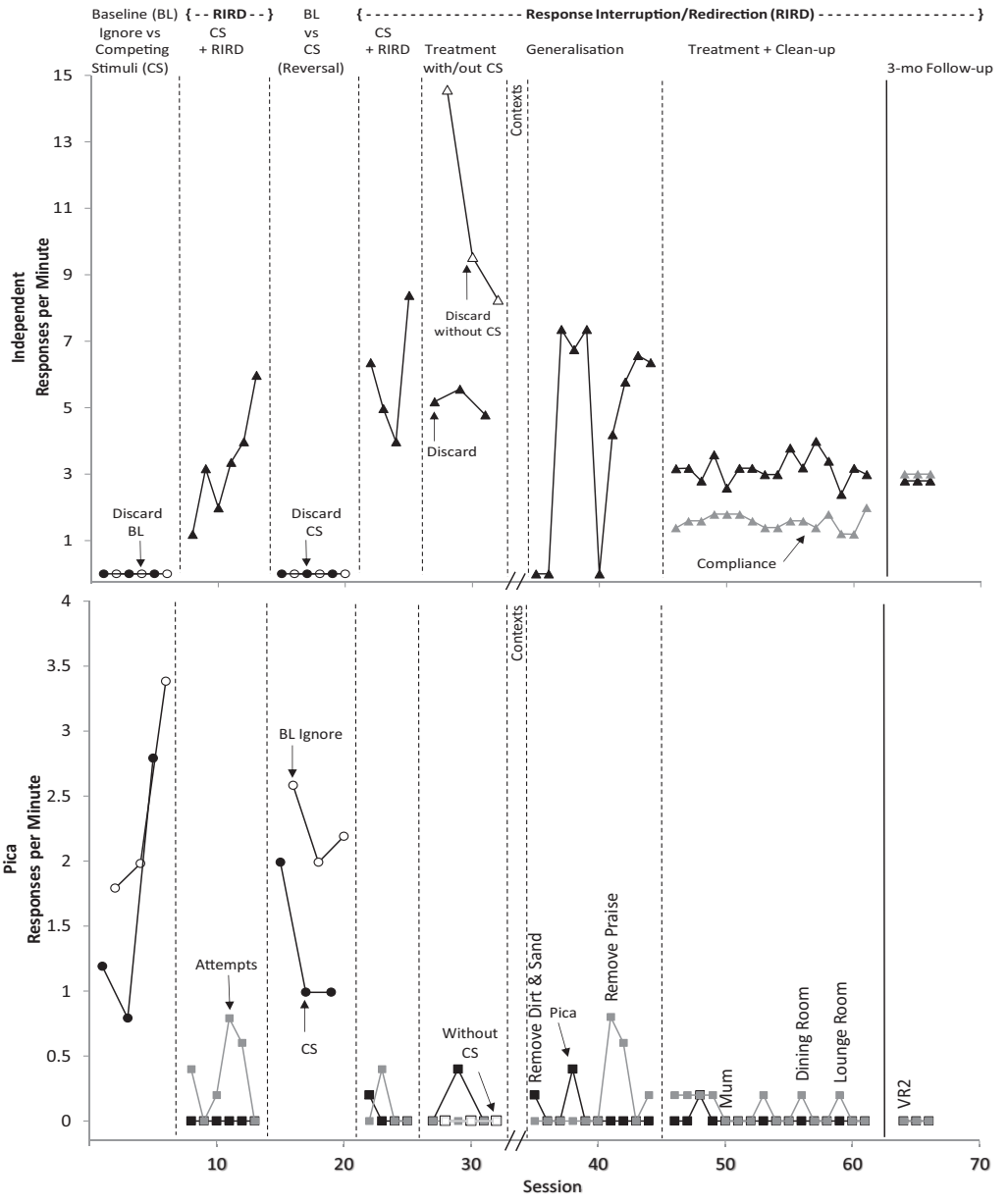

Figure 3. (Top panel) Independent discards and compliance per minute and (bottom panel) pica, mouthing, and touch attempts.

alization, and follow-up as well as caregiver dedication and involvement. The team continued monitoring by taking data, training Hebert's caregivers, conducting the program in various contexts, thinning schedules of reinforcement, and fading caregiver proximity in different contexts based on data. Hebert's treatment was labor intensive but critical. This intervention would not likely be successful long term without an adequate treatment team. The procedures must be carried out with high procedural integrity and by adequately trained, dedicated (1:1

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without other responsibilities or divided attention) caregivers/therapists. The assessment and treatment evaluations also have to be conducted intensively with adequate resources and therapists due to the significant risk and life-threatening nature of pica, and the necessity of eliminating and replacing automatically reinforced behavior.

Hebert's highly preferred foods were unhealthy foods. Additionally, the only competing stimuli that were effective at reducing pica to acceptable levels were these foods. Tangible items, including a teether that could be mouthed and chewed safely, did not reduce pica to clinically significant levels. With other tangible items that he manipulated with his hands, Hebert could still engage in pica while playing with these items.

Food stealing was also a significant problem for Hebert. We expanded the Do not-Touch context so that Hebert could eat with others without food stealing. This was significant for the household (e.g., family meals), in the community (e.g., food courts), and in preparation for eating with other children at preschool. Following the treatment of pica, we increased Hebert's food variety (to 13 vegetables, eight fruits, and five proteins). This potentially opened up a wide range of reinforcer options and the ability to provide more low-calorie foods to consuming instead of engaging in pica. Improved food variety may also help decrease pica by correcting and preventing nutritional deficiencies (e.g., iron, zinc). A limitation of the current case history is that we did not evaluate the impact of increased food variety on pica. Future studies could evaluate this, as well as the effectiveness using such foods later as competing stimuli for pica.

There are several limitations of the current case history worthy of discussion. We did not conduct a component analysis to determine which components were responsible for the therapeutic effects. We also did not assess the efficacy of blocking before conducting the treatment procedures described. It is also important to note that Hebert's age and severity of intellectual disability was lower than participants in Hagopian et al. (2011) and Schmidt et al. (2017). Hebert required substantially fewer training sessions than participants in these prior studies, and he learned the incompatible response after a single model of the response. Hebert also did not engage in other topographies of problem behavior (e.g., aggression, self-injury), which could have extended the assessment and treatment evaluation.

Much more research is needed on teaching multiple adaptive skills to replace pica and increase independence, and this is a needed replication and extension of the literature. We extended to a home setting overseas, added additional contexts and skills (e.g., outside, avoid items), and provided extended follow-up data. Behavior-analytic treatments for pica are well-established and empirically supported. However, most families (and professionals) internationally may be unaware or unable to access such treatments. This case history is a significant step toward translating and condensing specialized hospital admissions to the home setting and increasing availability of effective treatment for pica abroad. Future research should continue to expand this treatment to be more readily accessible to practitioners and families.

References

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Alexandria, VA: American Psychiatric Publishers.

Bullock, C. E., Fisher, W. W., & Hagopian, L. P. (2017). Description and validation of a computerized behavioral data program: "BDataPro." *The Behavior Analyst, 40,* 275–285. http://dx.doi.org/10.1007/s40614-016-0079-0

Busch, L. P., Saini, V., Zorzos, C., & Duyile, L. (2018). Treatment of life-threatening pica with 5-year follow-up. *Advances in Neurodevelopmental Disorders, 2,* 335–343. http://dx.doi.org/10.1007/s41252-018-0053-9

Call, N. A., Simmons, C. A., Mevers, J. E. L., & Alvarez, J. P. (2015). Clinical outcomes of behavioral treatments for pica in children with developmental disabilities. *Journal of Autism and Developmental Disorders, 45,* 2105–2114. http://dx.doi.org/10.1007/s10803-015-2375-z

Finney, J. W., Russo, D. C., & Cataldo, M. F. (1982). Reduction of pica in young children with lead poisoning. *Journal of Pediatric Psychology, 7,* 197–207. http://dx.doi.org/10.1093/jpepsy/7.2.197

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 and profound disabilities. *Journal of Applied Behavior Analysis, 25,*

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491–498. http://dx.doi.org/10.1901/jaba.1992.25-491

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31,* 211–235. http://dx.doi.org/10.1901/jaba.1998.31-211

Hagopian, L. P., González, M. L., Taylor Rivet, T., Triggs, M., & Clark, S. B. (2011). Response interruption and differential reinforcement of alternative behavior for the treatment of pica. *Behavioral Interventions, 26,* 309–325. http://dx.doi.org/10.1002/bin.339

Hagopian, L. P., & Gregory, M. K. (2016). Behavior analytic approaches to problem behavior in intellectual disabilities. *Current Opinion in Psychiatry, 29,* 126–132. http://dx.doi.org/10.1097/YCO.0000000000000232

Hagopian, L. P., Rooker, G. W., & Rolider, N. U. (2011). Identifying empirically supported treatments for pica in individuals with intellectual disabilities. *Research in Developmental Disabilities, 32,* 2114–2120. http://dx.doi.org/10.1016/j.ridd.2011.07.042

Hoch, T., Babbitt, R. L., Coe, D. A., Krell, D. M., & Hackbert, L. (1994). Contingency contacting. Combining positive reinforcement and escape extinction procedures to treat persistent food refusal. *Behavior Modification, 18,* 106–128. http://dx.doi.org/10.1177/01454455940181007

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982). Toward a functional analysis of self-injury. *Analysis and Intervention in Developmental Disabilities, 2,* 3–20. http://dx.doi.org/10.1016/0270-4684(82)90003-9

Martens, B. K., Witt, J. C., Elliott, S. N., & Darveaux, D. X. (1985). Teacher judgments concerning the acceptability of school-based interventions. *Professional Psychology, Research and Practice, 16,* 191–198. http://dx.doi.org/10.1037/0735-7028.16.2.191

Matson, J. L., Belva, B., Hattier, M. A., & Matson, M. L. (2011). Pica in persons with developmental disabilities: Characteristics, diagnosis, and assessment. *Research in Autism Spectrum Disorders, 5,* 1459–1464. http://dx.doi.org/10.1016/j.rasd.2011.02.006

Matson, J. L., Hattier, M. A., Belva, B., & Matson, M. L. (2013). Pica in persons with developmental disabilities: Approaches to treatment. *Research in Developmental Disabilities, 34,* 2564–2571. http://dx.doi.org/10.1016/j.ridd.2013.05.018

McAdam, D. B., Sherman, J. A., Sheldon, J. B., & Napolitano, D. A. (2004). Behavioral interventions to reduce the pica of persons with developmental disabilities. *Behavior Modification, 28,* 45–72. http://dx.doi.org/10.1177/0145445503259219

Piazza, C. C., Fisher, W. W., Hanley, G. P., LeBlanc, L. A., Worsdell, A. S., Lindauer, S. E., & Keeney, K. M. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis, 31,* 165–189. http://dx.doi.org/10.1901/jaba.1998.31-165

Piazza, C. C., Hanley, G. P., & Fisher, W. W. (1996). Functional analysis and treatment of cigarette pica. *Journal of Applied Behavior Analysis, 29,* 437–449. http://dx.doi.org/10.1901/jaba.1996.29-437

Schmidt, J. D., Long, A., Goetzel, A. L., Tung, C., Pizarro, E., Phillips, C., & Hausman, N. (2017). Decreasing pica attempts by manipulating the environment to support prosocial behavior. *Journal of Developmental and Physical Disabilities, 29,* 683–697. http://dx.doi.org/10.1007/s10882-017-9548-y

Stiegler, L. N. (2005). Understanding pica behavior: A review for clinical and education professionals. *Focus on Autism and Other Developmental Disabilities, 20,* 27–38. http://dx.doi.org/10.1177/10883576050200010301

Williams, D. E., & McAdam, D. (2012). Assessment, behavioral treatment, and prevention of pica: Clinical guidelines and recommendations for practitioners. *Research in Developmental Disabilities, 33,* 2050–2057. http://dx.doi.org/10.1016/j.ridd.2012.04.001

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