Pica in Individuals with Developmental Disabilities

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Pica is the consumption of nonfood, nonnutritive substances (American Psychological Association [APA], 2013) and is the most commonly observed feeding disorder among children and adolescents with developmental disabilities (Barrett, 2008). Pica has historically been treated as a feeding and eating disorder specific to infancy or early childhood (APA, 2000). More recently though, pica was reclassified under the "Feeding and Eating Disorders" category in the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5; APA, 2013), which broadened the onset criteria to individuals of all ages. Pica is a significant challenging behavior in that it can lead to serious medical problems and, in some cases, even death. Due to the severe medical consequences of pica, some researchers have classified pica as self-injurious behavior (SIB; Call, Simmons, Lomas Mevers, & Alvarez, 2015; Williams & McAdam, 2016).

According to the DSM-5, symptoms must persist for over a period of at least 1 month, be inappropriate to the developmental level of the individual, and not part of a culturally supported or socially normative practice (APA, 2013). Commonly reported types of pica include geophagy (consumption of earth; Johnson, 1990), chthonophagy (consumption of dirt; Johnson, 1990), lithophagy (consumption of stone or gravel; Johnson, 1990), coprophagy (consumption of feces; Foxx & Martin, 1975), and other nonfood items (e.g., chalk, paper, paint chips, cigarette butts). Although the DSM-5 states that pica is of "nonfood" items, some researchers have broadened pica topography to include nonnutritive food consumption, such as amylophagy (consumption of raw starches; Johnson, 1990) and pagophagy (consumption of ice; Miao, Young, & Golden, 2015), or to include food items

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that are retrieved from inappropriate places (e.g., floor, trash; Hirsch & Smith-Myles, 1996).

Pica is common among certain cultures. An individual does not meet the DSM-5 criteria for pica if feeding behaviors are supported by cultural practices (APA, 2013). For example, children in sub-Saharan Africa (Nchito, Geissler, Mubila, Friis, & Olsen, 2004) and pregnant women across Africa commonly engage in geophagy (28–100%; Young et al., 2010). In areas where geophagy was less common, amylophagy was much more frequently reported (Young et al. 2010). In the United States, pica is more common in rural (Johnson, 1990) and underdeveloped areas, with reports of pagophagy among pregnant, African-American women (Edwards et al., 1994) and geophagy among pregnant women in the rural South (Johnson, 1990).

Pica is sometimes considered not to be a major behavioral or medical problem (McAlpine & Singh, 1986; Williams & McAdam, 2012). Consequently, this behavior is commonly missed, and individuals with this disorder engage in this potentially dangerous behavior for several years before it is detected (McAlpine & Singh, 1986). Pica has many medical consequences including intestinal obstruction or puncture, acute weight loss, poisoning, dental health problems, infection, and gastrointestinal parasites (Call et al., 2015; Foxx & Martin, 1975). These complications may result in emergency surgery and even death (APA, 2013; Bell & Stein, 1992; McAdam, Sherman, Sheldon, & Napolitano, 2004). In addition, ingestion of certain nonfood items (e.g., paint chips, soil) can impair intellectual and physical development. Thus, detection of pica and subsequent treatment should be a high priority.

Pica affects people across ages, gender, geographic location, and socioeconomic status (Sayetta, 1986; Young et al., 2010). Pica is frequently reported among pregnant women and less frequently among young, typically developing children. In very young children, the behavior is not considered true pica but rather a habitual mouthing behavior, which diminishes with age and is virtually nonexistent by age 2 (Barrett, 2008; Johnson, 1990). Pica is commonly comorbid with autism spectrum disorder (ASD) and ID and less commonly comorbid with schizophrenia and obsessive-compulsive disorder (OCD; APA, 2013). Kinnell (1985) found that 60% of the ASD group engaged in pica, while only 4% of the Down's syndrome group engaged in pica. Individuals with profound ID are most likely to be affected by pica (Ali, 2001; APA, 2013), and prevalence among individuals with ID appears to increase with severity of ID. Although pica is not commonly reported among individuals with ID in the community, high rates of pica are found in clinics and institutions (5.7–25.8%; Ashworth, Hirdes, & Martin, 2009), with one report finding the prevalence of pica to be as high as 25.8% in institutionalized people with ID (Danford & Huber, 1982). It should be noted that pica is commonly missed and underreported (Rose, Porcelli, & Neale, 2000), thus, the prevalence is difficult to ascertain (APA, 2013). Underreporting is a problem and difficult to control. Fear of chastisement may contribute to this underreporting (Young et al., 2010). When pica occurs in the context of other mental disorders, particularly ASD, it is imperative to seek clinical and/or behavioral treatment (APA, 2013).

Several theories regarding the etiology of pica, including behavioral or nutritional causes (Bugle & Rubin, 1993; Chisholm & Martin, 1981; Lofts, Schroeder, & Maier, 1990), have been evaluated. Some research has indicated that pica may be caused due to micronutrient deficiencies (e.g., iron, zinc), hunger, gastrointestinal distress, and protection from pathogens and toxins (e.g., Rose et al., 2000; Young et al., 2010). One meta-analysis found that compared to individuals without pica, those with pica were more likely to have anemia, low hemoglobin concentration, low hematocrit concentration, and low plasma zinc concentration (Miao et al., 2015). Researchers have hypothesized that these factors result in nutritional deficiencies. Further, they theorize that individuals experience cravings and engage in inappropriate feeding behavior in order to satisfy the cravings and eliminate the nutritional deficiencies (reviewed by Barrett, 2008). However, it is unclear if the nutritional deficien-

cies were the cause or the result of the pica. Nonetheless, among young children without intellectual impairments, a nutritional-deficiency approach was found to be the most common treatment applied (McAdam et al., 2004). However, Rose and colleagues (2000) found no significant differences in nutritional deficiencies between children and adolescents with pica and those without. Overall, there is some evidence to support this theory; however, data are limited and much more research needs to be conducted.

While the direct causes of pica remain unclear, there has been significant support for a behavioral etiology (Favell, McGimsey, & Schell, 1982; Smith, 1987). Pica is found to be most commonly maintained by automatic reinforcement (Hanley, Iwata, & McCord, 2003; Williams & McAdam, 2012). Further, there is support for pica to be maintained by social variables. In a study of institutionalized adults with ID (N = 1008), Ashworth and colleagues (2009) found that pica was significantly associated with the absence of a strong and supportive relationship with family and reduced social contact with family and/or friends (i.e., visit, overnight stay, or other types of interaction within the last 30 days). These participants had spent an average of 41.6 years in an institutional setting, and 71.7% of participants had left their family home before the age of 10. The inverse relationship between pica and social interaction suggests that decreased levels of social interaction were associated with increased rates of pica (Ashworth et al., 2009). These findings warrant further investigation of the behavioral and social variables that maintain pica.

Assessment

Professionals who treat individuals with developmental disabilities are recommended to screen for pica by reviewing medical history, interviewing caregivers, observing behavior, and/or implementing challenging behavior screening scales (Williams & McAdam, 2012). However, well-developed assessment scales designed to detect pica are limited but include the Screening Tool of Feeding Problems (STEP; Matson & Kuhn, 2001), the Autism Spectrum Disorders-Comorbidity for Children (ASD-CC; Matson & Gonzalez, 2007), and the Behavior Problems Inventory (BPI; Rojahn, Matson, Esbensen, & Smalls, 2001).

The STEP (2001) is a 23-item questionnaire that screens for feeding problems presented by persons with ID. The questions are designed using a Likert-type format and assess for the frequency and severity of feeding problems. This screening tool represents five categories of feeding problems. These categories include aspiration risk, selectivity, skills, food refusal-related behavior problems, and nutrition-related behavior problems. Items that may be associated with pica such as "he/she eats or attempts to eat items that are not food" are included in the nutrition-related behavior problems category.

The ASD-CC (2007) is an 84-item questionnaire that screens for comorbid conditions with ASD, including depression, conduct disorder, attention-deficit hyperactivity disorder (ADHD), tic disorder, OCD, specific phobia, and eating difficulties. In regard to pica, informants are instructed to rate the feeding item (i.e., eats things that are not meant to be eaten [e.g., eats paint chips, dirt, hair, cloth, etc.]) for the extent that it is a recent problem. While this tool is not a screening tool specific to the assessment of pica, it may be an important first step in assessing pica in individuals with ASD.

The BPI (2001) is 52-item questionnaire that screens for problem behaviors (i.e., SIB items, stereotypic behavior items, and aggressive/destructive behavior items) in individuals with ID. Pica is included within the SIB section and is defined as the "mouthing or swallowing of objects which should not be mouthed or swallowed for health or hygiene reasons (non-food items such as feces, grass, paper, garbage, hair)." The BPI is one of the few instruments that specifically assesses for the frequency and severity of pica.

The STEP, ASD-CC, and BPI are efficient tools for assessing pica in individuals with ID or ASD. All of these scales have demonstrated good reliability and validity (Gonzalez et al., 2009;

Kuhn & Matson, 2002; Matson, LoVullo, Rivet, & Boisjoli, 2009). These indirect methods of assessment can be useful in identifying the presence of pica.

Treatment of Pica

The treatment of pica has received significant attention over the years and has been the subject of a number of reviews (Hagopian, Rooker, & Rolider, 2011; Matson, Hattier, Belva, & Matson, 2013; McAdam et al., 2004). Overall, most studies have focused on behavioral treatments; however, some few researchers have address biological treatments such as nutritional supplements. These treatments are discussed in turn.

Biological Interventions

A number of researchers have discussed biological variables in regard to the etiology of pica (Barrett, 2008; McAdam, Briedbord, Levine, & Williams, 2012). However, studies that have evaluated biological treatment based upon these etiological explanations have been scarce. In general, biological treatments have exclusively focused on the use of nutritional supplements to treat the hypothesized cause of the challenging behavior (Matson et al., 2013; McAdam et al., 2012).

Biological interventions such as providing nutritional supplements (e.g., iron supplement, multivitamins) have received some attention from researchers (e.g., Bugle & Rubin, 1993; Gutelius, Millican, Layman, Cohen, & Dublin, 1962; Pace & Toyer, 2000); however, empirical evaluations of these treatments have not found evidence to support their use. For example, in a controlled trial, Gutelius and colleagues (1962) found that iron supplementation did not yield any clinically significant differences between groups. More recent studies have had significant limitations such as an uncontrolled research design (Bugle & Rubin, 1993), small sample size (Pace & Toyer, 2000), and variable results (Pace & Toyer, 2000). Due to these issues, biological interventions have insufficient evidence to support their use as treatments for pica (reviewed by Matson et al., 2013).

Behavioral Interventions

A key aspect of most behavioral interventions is to first identify the operant function of the challenging behavior. Functional analysis procedures are typically categorized as either direct or indirect (Dixon, Vogel, & Tarbox, 2012). Once the function of the behavior is identified, the clinician is able to choose the most appropriate intervention to address the variables that maintain the behavior.

Indirect functional analysis methods consist of gathering information about the person and potential environmental factors that may be serving to reinforce the behavior. Typically, a clinician may distribute a questionnaire or interview the caretaker of the individual with pica regarding the frequency, severity, and contexts of behavior. An indirect functional analysis can help identify the topography and function of behavior, but some researchers have argued that they may not always be sufficient for determining the operant function of a challenging behavior (Williams & McAdam, 2016). It should also be noted though that indirect functional analyses may be more effective at identifying the function of behavior when the behavior is of a low frequency and unlikely to be observed within typical observation periods.

Direct methods of functional assessment include experimental approaches to identifying the variables that maintain the SIB (i.e., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982). During a direct functional analysis, a clinician will take an experimental approach to identify the variables that maintain the behavior. By using safe, baiting methods (i.e., presentation of food and nonfood items) to manipulate the antecedents and consequences of behavior, researchers can identify under which contingencies the behaviors

are maintained. A direct functional analysis may provide more detailed information regarding the function of a behavior. However, an experimental functional analysis may require several hours per day, over a period of 2–3 weeks, across clinicians (Matson, Bamburg, Cherry, & Paclawskyj, 1999). Therefore, conducting an experimental functional analysis can be very time and resource intensive and also may yield results lacking in reliability and validity (Matson et al., 1999; Sturmey, 1995). Instead, practitioners may utilize reliable, indirect functional analyses such as the Questions About Behavioral Function (QABF; Matson & Vollmer, 1995), which was found to predict the function of behavior in 75% of cases (Hall, 2005). Following the functional analysis, the contributing variables are altered during treatment to reduce the challenging behavior (Hanley et al., 2003).

The application of functional analyses has led to significant advancements in the assessment and treatment of pica in individuals with developmental disabilities. Studies have found that pica is most commonly maintained by sensory or automatic reinforcement (e.g., oral stimulation; Delaney et al., 2015; McAdam et al., 2004) and less commonly maintained by social variables, such as access to tangible items and/or attention, or physiological variables, such as the addictive effect of nicotine in cigarettes (Piazza et al., 1998).

Once the function of the behavior is identified, treatment may be implemented to reduce pica and generalize results across settings. Meta-analyses have found that comprehensive behavioral interventions are well-established and have been highly effective in treating pica (Call et al., 2015), with several studies reporting more than a 90% reduction of pica (Hagopian et al., 2011). Behavioral treatments that have been effective in reducing or eliminating pica will be described in turn. Interventions have been categorized under (a) antecedent modification interventions, (b) response-contingent interventions, and (c) punishment-based interventions.

Antecedent Modification Interventions

Noncontingent reinforcement (NCR) is the most commonly used intervention for pica (McAdam et al., 2004). NCR is a well-established treatment that can be useful for interrupting or preventing automatically maintained behavior by providing alternative sources of reinforcement (Favell et al., 1982). During NCR procedures, a reinforcer (e.g., toy, food, attention) is presented independent of a response (Cooper, Heron, & Heyward, 2007). Reinforcement can be delivered on a fixed-time schedule (e.g., reinforcement provided every 5 min) or variable-time schedule (e.g., reinforcement provided on average of every 5 min; Huete, Schmidt, & Lopez-Arvizu, 2014). In addition, the reinforcer does not need to be functionally related to the challenging behavior. NCR has been effective in reducing challenging behaviors maintained by automatic reinforcement (e.g., oral self-stimulation) because alternative sources of reinforcement are provided (Favell et al., 1982).

Several studies have found that NCR was successful in reducing pica. The noncontingent presentation of food or toys that can be safely mouthed have been effective in reducing pica because the alternative objects provides access to the same source of stimulation and thus provides the same, or similar, reinforcement (McAdam et al., 2004). Favell and colleagues (1982) provided popcorn and toys to three adolescent participants with profound ID, whose behavior was hypothesized to be maintained by gustatory reinforcement. Pica was reduced to 0% in two study participants and to 5% in one study participant. In another study, the cigarette pica of a 17-year-old male with severe ID and ASD was hypothesized to be maintained by physiological variables (i.e., nicotine). Piazza, Hanley, and Fisher (1996) found that the participant's pica was maintained when the environment was baited with cigarettes that contained tobacco with nicotine but was not maintained when baited with cigarettes that contained herbs without nicotine. Treatment consisted

of the noncontingent presentation of preferred foods and a contingent verbal interruption, "no butts." Following treatment, the participant's pica was reduced to 0 responses per min (Piazza et al., 1996). In a separate study by Piazza and colleagues (1998), a functional analysis of pica was conducted for three participants with intellectual disabilities. For two of the three study participants, a 5-year-old male with moderate ID and a 4-year-old female with profound ID, pica was found to be maintained by social and automatic reinforcement. The noncontingent presentation of attention and continuous access to tangible reinforcement led to significant reduction of pica.

Environmental enrichment procedures utilize the participant's environment to reduce pica by ensuring the environment includes items hypothesized to compete with pica (e.g., preferred food, toys, and activities; Call et al., 2015). By increasing the available preferred items in the environment, the potential for reinforcement is maximized (Williams & McAdam, 2016). In a participant group of young children, the addition of play and other recreational activities resulted in decreased levels of pica (Madden, Russo, & Cataldo, 1980). Similar results were found when leisure activities were provided for an adult male participant with developmental disabilities (Burke & Smith, 1999). Enrichment of foods (e.g., using highly spiced, flavored foods with meals/snacks, teaching participants to exchange nonfood items for preferred food items) was also found to reduce pica (Baker, Valenzuela, & Wieseler, 2005).

Discrimination training procedures aim to prevent pica by teaching individuals to correctly discriminate edible versus nonedible food items. However, discrimination training alone cannot eliminate pica and thus are applied in conjunction with a response-contingent intervention following pica attempts. Johnson, Hunt, and Siebert (1994) taught two male teens with profound ID to only eat food placed on a specific placement. When pica occurred, the participants were required to spit out the nonfood item and wash their faces for 15 s. Pica was reduced across settings (e.g., dining room, alone, group activity room) in both participants. In another study, a 21-year-old female with profound ID and epilepsy was taught to discriminate between food and nonfood items and subsequently place the nonedible items in the trash (Bogart, Piersel, & Gross, 1995).

Response effort manipulations have been found to be effective in reducing pica. Piazza, Roane, Keeney, Boney, and Abt (2002) manipulated response effort among three participants whose pica was maintained by automatic reinforcement. When response effort to engage in pica was low or medium, with no access to alternative items, pica level was the highest. When response effort to engage in pica was high, with no access to alternative items, pica was still reduced. When response effort for alternative items was increased, pica increased and effort to engage with alternative items decreased. Lowest levels of pica were found when response effort to engage in pica was high and alternative, preferred items were available. These findings indicate that increasing the effort required to engage in pica, in addition to NCR, may reduce the behavior.

Response-Contingent Interventions

Differential reinforcement (DR) is used to increase desired behaviors through reinforcement and to decrease challenging behaviors through extinction (Cooper et al., 2007). In differential reinforcement of incompatible behavior (DRI), behaviors that are incompatible with, or cannot occur at the same time as, the problem behavior are reinforced. In differential reinforcement of alternative behavior (DRA), alternative, appropriate behaviors are reinforced (Huete et al., 2014). Typically, during DRI and DRA procedures, the challenging behavior is placed on extinction. In some cases, extinction may not be possible depending on the severity of the challenging behavior and may require additional manipulation of the environment to increase opportunities for appropriate behavior (Athens & Vollmer, 2010).

Studies have found that DRI and DRA procedures led to a reduction of pica (Call et al., 2015; Donnelly & Olczak, 1990; Goh, Iwata, & Kahng,

1999; Smith, 1987). Contingent on an attempt of pica, Smith (1987) provided a verbal prompt not to ingest the inedible object (e.g., paper clip, paper, bottle caps) and instructed the participant to remain on task. Verbal praise and tokens were provided when the participant performed the incompatible behavior (i.e., keeping hands on work materials). Following DRI intervention, pica occurrence decreased from 21.3 occurrences of pica per day to 3.7 occurrences per day. In DRA procedures to treat pica, alternative behaviors (e.g., handing pica item to a clinician, discarding pica item in the trash, engaging in a leisure activity) were reinforced (Call et al., 2015). DRA was found to be effective in reducing cigarette pica in 38-year-old and 44-year-old males with profound ID. Attempts of pica were interrupted, and a reinforcer was provided contingent upon alternative behavior (i.e., chewing sugarless mint gum).

Response-blocking procedures are time and staff intensive in that they require a caregiver to provide constant supervision and remain in close proximity to the participant in order to physically block access to pica items. Response blocking can only reduce pica if each attempt of pica is consistently interrupted (McCord, Grosser, Iwata, & Powers, 2005). Consequently, response-blocking procedures are rarely used as a sole intervention and instead are included as part of an intervention package (Williams & McAdam, 2016). Mechanical restraint (i.e., face mask, helmet, and arm restraints) and response blocking (i.e., pica item pushed down before entry into the mouth) were both found to be effective in reducing pica in a 4-year-old girl with profound ID (LeBlanc, Piazza, & Krug, 1997). LeBlanc and colleagues (1997) concluded that response blocking was the preferable intervention since it was less restrictive, resulted in fewer negative vocalizations, and increased opportunities for social interaction. In a study evaluating the effectiveness of a protective equipment (i.e., helmet) as a response-blocking tool, Mace and Knight (1986) found that the helmet alone did not prevent or reduce pica. Rather, lower levels of interaction (i.e., staff-participant interaction) with no helmet resulted in the lowest levels of pica. These findings suggest that both social interaction and response-blocking equipment may influence the reduction of pica (Mace & Knight, 1986).

During visual screening procedures, a type of blindfold is placed over the participant's eyes immediately following the pica attempt. Singh and Winston (1984) found that visual screening for 1 min resulted in significant reduction of pica in a 24-year-old female with profound ID. In another study of three toddlers with profound ID and pervasive developmental disorders, pretreatment assessments suggested that facial screening would be an effective intervention (Fisher et al., 1994). Participants were verbally reprimanded following each occurrence of pica and his/her eyes covered for 30 s. Pica was reduced and, further, remained at low levels at a 9-month follow-up. Contingent upon pica, visual screening (i.e., covered face with bib) and physical restraint (i.e., held hands to side for 15 s) were implemented. Pica decreased from 25 occurrences per month to 12 occurrences per month (Bogart et al., 1995).

Punishment-Based Interventions

In punishment-based procedures, an environmental stimulus is either provided following a behavior (i.e., positive punishment) or removed following a behavior (i.e., negative punishment; Lerman & Vorndran, 2002). Positive punishment procedures include overcorrection, aversive stimuli, and physical restraint. Negative punishment procedures include response cost and time-out. A limitation of punishment-based procedures is that they do not teach appropriate or replacement behaviors (Huete et al., 2014). As a result, punishment-based interventions should be implemented in conjunction with an antecedent-based intervention, which reinforces and teaches appropriate behavior.

In a review by McAdam and colleagues (2004), overcorrection was the most commonly used punishment-based intervention. However, a study using overcorrection treatment methods has not been published in almost 30 years. Overcorrection, a type of "work and effort" procedure, is considered a mild punishment procedure that once was favored because it required

the participant to make restitution for the challenging behavior and to exhibit more appropriate behaviors (Matson et al., 2013). Overcorrection procedures vary across studies and range from simple overcorrection procedures (e.g., spit object out and wash the mouth with washcloth for 15 s; Kalfus, Fisher-Gross, Marvullo, & Nau, 1987) to multistep, complex procedures. In an overcorrection procedure created by Foxx and Martin (1975) to eliminate coprophagy, contingent on a pica attempt, the trainer manually guided the participant toilet bowl and verbally instructed the client to spit the feces into the toilet. Next, the participant was required to brush their mouth, teeth, and gums with a toothbrush soaked in oral antiseptic. The participant was then required to wash their hands and scrub fingernails for 10 min. In addition, the participant was required to clean their anal area with a cloth and then briefly wash their hands. Lastly, the participant was guided back to the area where they were discovered engaging in pica and required to either mop up the area with a disinfectant. If the participant had obtained feces from an unflushed toilet, the participant was required to flush all unflushed toilets. This overcorrection procedure created by Foxx and Martin (1975) took approximately 30 min to complete. After just 2 weeks of this overcorrection intervention, the target behaviors had decreased to 0%. In addition, the elimination of pica was maintained at the 7-week follow-up. Although overcorrection methods are effective, they are time and staff-intensive and thus limited to institution or hospital settings.

The presentation of aversive stimuli has also been used as a punishment-based intervention to limit and reduce pica. Aversive stimuli are provided contingent upon the occurrence of problem behavior. Commonly reported aversive stimuli included a squirt of water mist on face or a squirt of lemon juice in mouth (Paisey & Whitney, 1989; Rojahn, McGonigle, Curcio, & Dixon, 1987). These methods have been viewed as controversial but were effective in the reduction of pica. Following aversive stimuli treatment of squirting lemon juice in his mouth, a 16-year-old male with profound ID no longer engaged in the ingestion of nonedible objects (e.g., broken glass, pins, cigarette butts; Paisey & Whitney, 1989). In a 16-year-old female with multiple disabilities, the presentation of water mist in the face or sniff of aromatic ammonia resulted in a significant reduction in pica occurrence. In spite of these successes, treatment of pica has moved away from aversive stimuli to more socially accepted interventions (Matson et al., 2013).

Physical and mechanical restraints are also controversial methods of treatment but are still implemented given the high potential for serious medical complications following each instance of pica (Matson et al., 2013). Physical restraint procedures (e.g., holding down arms to side) had high rates of success (up to 97.3% reduction of pica; Call et al., 2015) when applied in conjunction with other reinforcement-based interventions. In a comparison study between physical restraint and overcorrection interventions, physical restraint was found to be more effective in reducing pica than overcorrection (Singh & Bakker, 1984). Several studies found that implementing physical restraint procedures for various time intervals (e.g., 10 s, 15 s, 30 s; 1 min; Williams & McAdam, 2016) reduced pica. However, it is unclear whether brief intervals or longer intervals of physical restraint are most effective in reducing pica or if treatment outcomes maintain over time.

Time-out procedures have not been commonly implemented to treat pica. Therefore, there is insufficient evidence for the efficacy of this intervention to reduce pica. However, a study by Ausman, Ball, and Alexander (1974) found that pica was reduced to 0% following a time-out procedure. Contingent on the behavior, the study participant, a 14-year-old male with severe ID, was told “don’t eat that” and required to wear a time-out helmet for 15 min.

A number of behavioral interventions are effective to reduce pica. These interventions have been grouped as (a) antecedent modification interventions, (b) response-contingent interventions, and (c) punishment-based interventions. Well-established interventions include NCR (Favell et al., 1982; Mace & Knight, 1986), environmental enrichment (Madden et al., 1980), and overcorrection (Foxx & Martin, 1975).

Interventions such as response effort manipulations (Piazza et al., 2002) and response blocking (McCord et al., 2005) have limited evidence but warrant additional research.

Discussion

As previously noted, pica is a challenging behavior that can lead to severe medical complications, including death. There are many different types and forms of pica, including geophagy, amylophagy, chthonophagy, lithophagy, pagophagy, and coprophagy. Some types of pica, including geophagy and amylophagy, are culturally accepted practices and as such, do not meet the criteria for the diagnosis of pica. However, the ingestion of a nonfood or inappropriate food items should be considered a major medical and behavioral problem because it can lead to medical complications and impair intellectual and physical development.

A continued issue is that the prevalence of pica is difficult to ascertain because pica is commonly undetected and underreported. Pica is commonly comorbid with ID and ASD, with prevalence of pica increasing with severity of ID. The majority of the study participants in the existing literature included individuals with ID. For example, Kinnell (1985) found that as many as 60% of individuals with ASD engaged in pica. However, McAdam and colleagues (2004) found that only 4 of the 44 participants included in their review had ASD, while 32 participants had profound ID. Additional research is needed to evaluate the effects on behavioral treatments of pica in individuals with ASD and other comorbid disorders. In addition, the sample size of study participants should be increased. In a review of treatments for pica, Hagopian and colleagues (2011) found that the average number of participants per study was 1.92 (range 1–4). Due to the underreporting of pica, it may be challenging for researchers to increase the number of study participants per study. Consistent use of screening tools such as the STEP, ASD-CC, and BPI should improve the accuracy of these prevalence estimates.

Some researchers have hypothesized that the etiology of pica is due to nutritional deficiencies, such as anemia or low iron and zinc levels, and that individuals engage in pica to eliminate the nutritional deficiencies. However, there is insufficient evidence to support a nutritional explanation. From a behavioral perspective, pica is most commonly maintained by automatic reinforcement, followed by social variables (Matson et al., 2013). Several behavioral interventions are well-established and have been found to reduce pica in individuals with ID and ASD.

Another limitation of current research is that there are few standardized assessments available to screen and detect pica. While there are a limited number of assessments available, the STEP, ASD-CC, and BPI are well-established tools for the detection of pica. Given that pica is commonly comorbid with ID and ASD, all clinicians treating individuals with ID and ASD should routinely screen for pica. The existing screening assessments for pica can be conducted relatively quickly; screening should not be overly burdensome.

Given the lack of empirical support for the biological causes of inappropriate feeding behavior, researchers have focused on developing function-based treatments for pica (Piazza et al., 1998). As noted, it is essential to identify the variables that maintain the challenging behavior (Iwata et al., 1982). Direct and indirect functional analyses have both strengths and weaknesses, and no one approach is recommended over the other (Tarbox et al., 2009). Following the assessment, the clinician should determine the appropriate behavioral intervention based upon the nature and function of behavior. There is no single method of treatment that most effectively eliminates pica. Rather, an individualized, comprehensive treatment plan which includes multiple elements of behavioral procedures (i.e., antecedent modification, reinforcement, consequence) may optimize treatment outcomes.

Antecedent modification interventions for the treatment of pica include NCR, environmental enrichment, discrimination training, and response effort procedures. NCR and environmental enrichment interventions appear to be the most

effective in reducing pica maintained by automatic reinforcement or social attention because they provide alternative sources of reinforcement. In order for NCR and environmental enrichment to be effective, clinicians need to identify preferable items (e.g., toys, food, activities) that provide the same or similar type of reinforcement. In addition, opportunities for reinforcement should be maximized. As such, antecedent modification interventions may be time and staff intensive. Discrimination training and response effort procedures should not be used as the sole intervention for treating pica. Rather, they should be applied as a component of treatment in an intervention package, in conjunction with a reinforcement system such as DR.

Within the category of response-contingent interventions, DR, response blocking, and visual screening procedures have been found to reduce pica. Response-contingent interventions provide individuals with a clear consequence of behavior, and inappropriate behaviors are reduced. Response-contingent interventions are successful in reducing pica only if the strict schedule of reinforcement is implemented (i.e., during DRA) or each pica attempt is consistently interrupted (i.e., during response blocking). As a result, response-contingent procedures are time and staff intensive and are rarely used as the sole intervention.

Punishment-based interventions include overcorrection, aversive stimuli, physical and mechanical restraint, and time-out procedures. Punishment procedures are among the oldest methods of treatment and have been found to reduce or eliminate pica. However, punishment-based interventions do not teach appropriate, alternative behaviors and thus should be implemented in conjunction with antecedent modification interventions. Following the development of more socially acceptable interventions, punishment-based interventions are less frequently evaluated in research studies. While punishment-based interventions have a long history of use, these methods should be carefully considered before implementing and only be used once other non-aversive methods have been shown as ineffective. However, these extreme procedures may be warranted given the life-threatening nature of pica.

Overall, behavioral interventions have resulted in a 70–90% reduction in pica. In an analysis of the treatment of pica in an intensive day-treatment clinical setting, Call and colleagues (2015) found that only 25% of participants had a 100% reduction of pica. Given that just one instance of pica can lead to a serious health complications, the ultimate goal of treatment interventions should be to completely eliminate pica, not just to reduce it. A number of study limitations may affect the variation in pica reduction levels across studies.

A general limitation to behavioral intervention research was pointed out by McAdam and colleagues (2004), who noted that only 11 of the 26 studies evaluated generalization of behavior. Of the 11 studies, 10 studies reported successful generalization across behaviors ($n = 2$), behavior-change agents ($n = 4$), settings ($n = 2$), and behavior-change agents and settings ($n = 1$). Despite reports of generalization, none of the studies included measures of long-term maintenance or generalization that are required to meet the criteria for most evidence-based practice standards. This is not surprising given that most of the study settings were limited to institutional settings or clinical settings (e.g., inpatient clinic at a medical school; McAdam et al., 2004). Thus, it is unclear if individuals living in the community would demonstrate treatment outcomes as study participants in the existing research. Only 3 of the 26 studies were conducted in a community setting (e.g., classroom). Institutional and hospital settings typically have constant, individualized staff supervision and are not representative of the environments of many individuals with pica. Thus, study settings should be expanded to community-based and/or home settings in order to increase generalization of learned behavior.

Overall, behavioral treatments are effective at significantly reducing pica. Given this, it is essential to routinely screen for pica in order to assess and treat pica as soon as it detected. Using reliable methods to detect pica and implementing

effective function-based treatments, the serious medical consequences of this challenging behavior should be reduced.

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