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BEHAVIORAL TREATMENT OF RUMINATION: RESEARCH AND CLINICAL APPLICATIONS

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This brief review describes research on rumination treatment that emphasizes functional analysis, recent intervention methods (supplemental feeding, fixed-time stimulus presentation, continuous access to preferred stimulation), clinical implications, and procedural recommendations.

Key words: applied behavior analysis, behavioral intervention, functional analysis, rumination

Rumination is the repetitive regurgitation of undigested food that is rechewed and reswallowed; it is usually detected by rapid throat movements, puffing of the cheeks, and passing stomach contents past the lips. The physical ill effects from rumination include weight loss, malnutrition, esophagitis, electrolyte imbalance, and erosion of tooth enamel (American Psychiatric Association, 2013). In addition, a person with chronic rumination may be avoided and socially ostracized by others. Notably, the earliest behavioral interventions for rumination lacked a functional analysis, relied on punishment procedures such as contingent application of distasteful solutions (Sajwaj, Libet, & Agras, 1974) and overcorrection (Foxx, Snyder, & Schroeder, 1979), and interventions later incorporated satiation diets (Rast, Johnston, Drum, & Conrin, 1981). More recent approaches have focused on function-based intervention plans that emphasize supplemental feeding, noncontingent (fixed-time) delivery of preferred stimuli, and continuous access to alternative stimulation (Luiselli, in press; Tarbox, Kenzer, & Bishop, 2011). This brief review summarizes recent developments in the treatment of rumination among individuals with intellectual disabilities (ID; Rogers, Stratton, Victor, Kennedy, & Andres, 1992) and other neurodevelopmental disorders, with emphasis on research published in the *Journal of Applied Behavior Analysis* during the preceding 7 years.

Functional Analysis and Treatment Evaluation

One of the most noteworthy developments in recent years has been the functional analysis of rumination to inform treatment decisions. In four studies (Kliebert & Tiger, 2011; Lyons, Rue, Luiselli, & DiGennaro, 2007; Wilder, Register, Register, Bajagic, & Neidert, 2009; Woods, Luiselli, & Tomassone, 2013), researchers implemented traditional functional analysis methodology (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) with similar results. That is, the functional analyses confirmed that rumination was automatically reinforced by response-produced sensory stimulation rather than social positive (attention, tangible items) or social negative (escape) reinforcement. An automatic reinforcement function was hypothesized because rumination occurred at similar levels (rate, duration, percentage of intervals) during all functional analysis conditions. However, clear confirmatory evidence was not evident in every case. For example, Woods et al. (2013) acknowledged that rumination displayed by their participant was automatically reinforced even though responding was not higher in the ignore condition, occurred in a condition of relatively high stimulation (escape), and did not appear to be stable in some test conditions. Also, in a gum-chewing intervention study that did not include a functional analysis, Rhine and Tarbox (2009) posited that rumination was at least partially maintained by automatic

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reinforcement because the behavior did not decrease over many sessions in which there were no rumination-contingent social consequences. Given recent publication trends apparent in this review, it appears that conducting a functional analysis will and should be a prerequisite for dissemination-worthy treatment research.

In some studies, researchers modified functional analysis methodology to accommodate clinical exigencies. For example, Wilder et al. (2009) did not include an alone condition because the participant had to be continuously monitored; instead, a therapist was present with the participant but did not interact with him. For the same reason, Lyons et al. (2007) altered the alone condition by having a therapist in the room but sitting at a distance from the participant without engaging with him. In another variation, Kliebert and Tiger (2011) conducted a 20-session functional analysis but then implemented four additional sessions exclusively in the alone condition to verify that the participant's rumination was not maintained by social consequences. It is likely that researchers will need to individualize functional analyses to fit the unique characteristics of participants and settings (Hanley, 2012). For example, most individuals who require treatment for rumination are not left alone in the natural environment, making it unnecessary to test this condition formally.

In the following studies, researchers completed a functional analysis of rumination before they evaluated hypothesis-derived treatments. Lyons et al. (2007) compared noncontingent delivery of foods and liquids to treat automatically reinforced rumination in an 11-year-old boy with developmental disabilities. The foods were a Cheez-It cracker and a 10th of a Nutri-Grain bar; the liquids were 1 oz of fruit juice or water. A therapist presented these items on a fixed-time (FT) 30-s schedule during 15-min sessions following meals. Rumination was lowest when the boy consumed fruit juice ($M = 0.5\%$), followed by the Nutri-Grain bar ($M = 5.5\%$), Cheez-It cracker ($M = 25\%$), and water ($M = 92\%$).

A second participant in Lyons et al. (2007) was a 14-year-old boy with autism and ID. He participated in 20-min sessions following meals that compared FT 30-s delivery of a third of a pretzel and 1 oz of fruit punch. There was an additional condition in which he had continuous access to an infant teething ring. During an initial intervention phase, the boy did not ruminate when given food, liquid, and the teething ring. Rumination increased in a reversal-to-baseline phase ($M = 29\%$) and subsequently decreased when noncontingent food ($M = 0\%$) and liquid (one session = 5%) were reintroduced but not with the teething ring ($M = 27\%$).

Wilder et al. (2009) addressed automatically reinforced rumination displayed by a 37-year-old man with autism and ID through FT delivery of a flavor spray. After an initial baseline phase in which there were 2.8 ruminations per minute during 10-min post-meal sessions, the man received one squirt of the flavor spray on FT 20-s, FT 2-s, and FT 10-s schedules across separate phases. As evaluated in a reversal design, the largest reduction in rumination was recorded with the FT 2-s schedule (0.47 ruminations per minute). Lower-than-baseline levels of rumination (2.8 ruminations per minute) were maintained at 0.93 ruminations per minute when the man was taught to self-administer the flavor spray according to the FT 10-s schedule.

In the context of a multielement design, Rhine and Tarbox (2009) recorded rumination of a 6-year-old boy with autism during behavioral intervention sessions at home. In one condition, a therapist presented him with a quarter of a piece of chewing gum, instructed him to chew, and re-presented the gum if he spit it out or if it fell on the floor. This intervention was compared to in-home sessions without access to the gum. Chewing gum led to near-zero occurrences of rumination compared to a range of 0 to 56

ruminations per hour in the no-gum condition. The low rate of ruminating with gum chewing was maintained when in-home session duration gradually increased from 15 min to 120 min and for 1 to 3 months posttreatment.

Kliebert and Tiger (2011) examined the direct and distal effects of noncontingent apple juice on automatically reinforced rumination displayed by an 11-year-old boy with autism, ID, and sensory impairment. This study was conducted at the boy's school after his lunch meal. After a baseline phase, a therapist provided him with a small sip of apple juice every 15 s. Rumination data were recorded during 10-min intervention sessions and also during an additional 10 min that immediately followed termination of juice delivery. The average percentage of sessions with rumination decreased from 24% in baseline to an average of 0.3% during intervention. However, average rumination was 23% during the immediate postintervention sessions, indicating that treatment effects could not be sustained when consumption of apple juice stopped.

Finally, Woods et al. (2013) compared the effects of auditory, visual, and food stimuli on automatically reinforced rumination by a 19-year-old man with ID. The experimenters conducted an additional evaluation of different food textures and food-presentation formats. In Phase 1, continuous access to small pieces of a soft granola bar during 5-min sessions after lunch reduced rumination from an average of 53% of intervals in baseline to an average of 4% during intervention. These results were superior to continuous access to movies and television shows ($M = 25.5\%$) and music ($M = 40\%$). During Phase 2, the soft granola bar ($M = 6\%$) was also more effective than applesauce ($M = 10\%$), Goldfish crackers ($M = 14\%$), and graham crackers ($M = 20\%$). With regard to food-presentation format in Phase 3, continuous access to the soft granola bar both before sessions ($M = 2\%$) and during sessions ($M = 3\%$) was more effective than delivery on an FT 60-s schedule ($M = 23\%$).

Research Summary and Clinical Implications

All of the studies described in this review included continuous or FT access to sensory stimuli (in most cases, foods and liquids). For some individuals, certain foods and liquids are more effective than other items (Lyons et al., 2007; Woods et al., 2013), suggesting that the differential effectiveness of gustatory stimuli in treating rumination should be researched more extensively (Kliebert & Tiger, 2011). Indeed, there is evidence that rumination frequency can be influenced by the nutrient composition of some foods (Dudley, Johnson, & Barnes, 2002) and that increased liquid consumption may actually facilitate rather than inhibit rumination during and after meals (Heering, Wilder, & Ladd, 2003). Another key research finding is that the most positive effects of food and liquid on rumination may be dependent on delivering them rapidly (Woods et al., 2013) and for a prolonged period of time after meals (Kliebert & Tiger, 2011; Lyons et al., 2007). Also, with few exceptions (e.g., Rhine & Tarbox, 2009), the long-term outcome from rumination treatment is unknown. Accordingly, future research might profitably compare and contrast the immediate and long-lasting results of various reinforcement and FT schedules.

Interventions that rely on foods and liquids demand pretreatment stimulus preference assessments. Some studies relied on observation of participants or care-provider reports to determine preferences (Lyons et al., 2007), but ideally, selection of potentially effective stimuli should be guided by more formal choice assessments (Kliebert & Tiger, 2011; Wilder et al., 2009; Woods et al., 2013). These assessments could identify both appealing foods and liquids and possibly texture, composition, and taste elements that compete most successfully with rumination. Another recommendation for rumination treatment is conducting repeated stimulus preference assessments to detect preference variations that should be anticipated when individuals have

frequent exposure to the same foods and liquids for many weeks and months.

Notwithstanding the beneficial effects of FT and continuous access to foods and liquids on rumination, the behavioral processes responsible for operant control are not definitive. For example, foods and liquids may operate by changing the taste of regurgitated contents (providing stimulation that competes with the sensory consequences of rumination), physically preventing rumination, inducing satiation, or possibly a combination of these factors (Wilder et al., 2009). The only study that has compared the effects of nongustatory stimuli on rumination (Woods et al., 2013) suggests that foods and liquids are effective because they match the oral-esophageal topography and pleasurable sensory consequences of rumination. These influences are not operative when nonmatched stimuli (e.g., auditory, visual, tactile) are programmed. The relative paucity of research comparing similar and dissimilar competing stimulation warrants future studies that can expand treatment options for reducing and eliminating rumination.

Lastly, due to possible satiation, "continuous provision of food and liquid may not be feasible or effective for longer periods" (Kliebert & Tiger, 2011, p. 958). Similarly, dense FT schedules are difficult to sustain, may be impractical in most settings, and have associated nutritional concerns due to increased caloric intake. Therefore, studies must continue to explore strategies for reducing implementation barriers and constraints to research-supported methods of rumination treatment. These alternatives include gradually reducing the amount of food and liquid quantities while simultaneously extending the duration of treatment sessions (Lyons et al., 2007), using a relatively low-effort procedure such as chewing gum (Rhine & Tarbox, 2009), and teaching individuals to self-administer the intervention (Wilder et al., 2009).

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