



An Evaluation of Contingent Gum Chewing on Rumination Exhibited by an Adolescent with Autism Spectrum Disorder

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Accepted: 3 April 2023 / Published online: 8 May 2023
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Abstract

Rumination is defined as repeated regurgitation of food, not attributed to other medical conditions. Some individuals with autism or other developmental disabilities engage in rumination, and it can lead to multiple health issues. Previous research demonstrated that noncontingent presentation of chewing gum could be an effective treatment for reducing ruminations. The current study evaluated the effects of noncontingent chewing gum and contingent gum on rumination of an adolescent boy with autism and the results suggest that both treatments were effective, but contingent gum resulted in the lowest rate of rumination.

- Rumination can cause multiple health issues including malnutrition, weight loss, esophagitis, tooth decay, and abnormal gastrointestinal symptoms.
- Rumination in individuals with autism is often automatically maintained.
- Continuous noncontingent gum and contingent gum may be viable treatments for rumination.
- Contingent gum may be a more practical intervention for rumination relative to continuous noncontingent gum.

Keywords Rumination · Noncontingent gum · Contingent gum · Regurgitation · Developmental disabilities

Rumination is defined by repeated regurgitation of food, which may be rechewed, reswallowed, or spit out, and is not attributed to other medical conditions (American Psychiatric Association, 2013). Rumination can cause multiple health issues including malnutrition, weight loss, esophagitis, tooth decay, and abnormal gastrointestinal symptoms (American Psychiatric Association, 2013; Kliebert & Tiger, 2011).

Research on the treatment of rumination exhibited by individuals with developmental disabilities has focused on a

combination of antecedent- and consequence-based interventions. Many of the antecedent-based interventions include noncontingent (fixed-time) presentation of preferred food or stimuli (e.g., Kliebert & Tiger, 2011) or continuous access to alternative stimuli (Dudley et al., 2002). Some consequence-based strategies have focused on punishment using stimuli such as mouthwash, reprimands, or lemon juice (Foxy et al., 1979; Sajwaj et al., 1974).

Rhine and Tarbox (2009) evaluated the use of continuous access to chewing gum to reduce ruminations by comparing the effects of continuous noncontingent access to chewing gum to the absence of gum using a multi-element design. Results indicated consistently lower rates of rumination in the conditions in which gum was available.

Although these antecedent interventions have been successful in reducing ruminations, continuous presentation of food and alternative stimuli may be difficult to implement long-term (Luiselli, 2015). It is possible that presenting alternative stimuli contingent on rumination would reduce the duration of time the item is provided, thereby increasing the practicality of treatment implementation. Thus, the present study extends current research by evaluating the effects of a continuous noncontingent gum procedure and a contingent gum procedure on the rate of ruminations.

We thank Ryan Claypool for assistance with data collection.

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Method

Participant, Setting, and Materials

Keldon was a 12-year-old boy diagnosed with autism spectrum disorder (ASD) who attended in-clinic behavioral intervention services at an outpatient facility. Keldon was able to communicate his basic wants and needs using one- to two-word mands, follow two- and three-component instructions, and imitate fine and gross motor behaviors. Keldon's caregivers reported that he was a picky eater. Keldon's caregivers identified rumination as a significant problem behavior, which occurred across all settings, times of day, and activities. Prior to intervention, Keldon underwent medical evaluation from an outside provider and his parents shared the results. The evaluation showed inflammation of the esophagus and a diagnosis of mild chronic gastritis was provided. However, due to lack of improvement with several antacid medications, rumination and emesis were determined to be behavioral. In addition, his speech language pathologist determined that he did not have any issues with chewing or swallowing.

Therapists conducted all sessions in Keldon's regular therapy room at the clinic. All sessions were conducted between 3 PM and 5 PM after school. It is unknown what his feeding schedule was while he was at school. During his behavioral sessions, he sometimes earned a small chocolate ice cream at the end of the day. In addition, the senior researcher of the current study had extensive experience in treating severe problem behavior including rumination.

During treatment sessions, when gum was provided, we used Trident sugar-free gum. The participant was given a choice between Trident original flavor or Trident Spearmint at the start of each session.

Measurement and Data Collection

Frequency data were collected on rumination, which was defined as upward movement of the throat accompanied by a gag or burp noise, regurgitation of consumed edibles, or expulsion of consumed edibles or liquid. Frequency data were converted to responses per minute. Data were also collected on the duration of time the participant spent chewing gum. Gum chewing was defined as time that gum remained in the participant's mouth. Scoring began when gum entered the mouth by passing the participant's lips, and scoring ended when gum exited the mouth passing the participant's lips. Therapists collected data using a tablet with the data collection application Countee.

A second, independent observer collected data during 28% of treatment evaluation sessions. Interobserver agreement was calculated using the proportional agreement method. Sessions were divided into 10-s intervals, the lower number recorded was divided by the higher number recorded in each interval, all of the scores were then averaged across

each session, and then multiplied by 100. Arithmetic mean interobserver agreement was 99.8% (range: 99.6%–100%).

Procedures

Preintervention Data

Previous research has targeted specific times of day for intervention (e.g., after meals; Dudley et al., 2002). Prior to beginning the treatment evaluation, data were collected on the frequency of ruminations across 10-min intervals throughout 2-hr therapy sessions. There were no programmed socially mediated consequences for rumination. This was done to (1) screen for behavior maintained by automatic reinforcement (Querim et al., 2013); and (2) identify periods of time with elevated levels of rumination for which the intervention could be targeted. Data were collected across seven therapy sessions and graphed as average frequency per 10-min interval.

Gum Chewing Training

Keldon's parents reported that they had never exposed him to chewing gum. In addition, he did not demonstrate gum chewing skills during probe sessions. Therapists implemented a prompting procedure, which involved modeling and reinforcement of correct steps, to teach Keldon to independently chew gum. Therapists gave Keldon the instruction "chew your gum" and provided a model prompt of the current step (e.g., place gum in mouth, bite gum, chew gum twice). If Keldon completed the current step accurately, he received 1-min access to a highly preferred item identified via a preference assessment. Keldon advanced to the next step after one correct completion of the current step until he demonstrated gum chewing for 10 min consecutively. We would have terminated sessions if Keldon swallowed three pieces of gum, however, this criterion was never met.

Continuous Noncontingent Gum and No Gum Comparison

An alternating treatments design was used to compare the effects of continuous noncontingent access to chewing gum to no gum. Sessions occurred during Keldon's regularly scheduled out-patient therapy, which occurred in 2-hr blocks, twice a week. Sessions were 10 min in duration and the sequence of conditions was randomly selected at the beginning of each therapy session. At the beginning of each continuous noncontingent gum chewing session, therapists presented a piece of chewing gum to Keldon and gave the instruction, "It's time to chew gum." In addition, a green stimulus card with a picture of chewing gum was displayed for the duration of the session. If Keldon spit out the gum before the end of the session, a new piece of gum was presented. At the beginning of each no gum session, therapists presented a red stimulus card with a picture of gum and a

transparent overlay “no” symbol (i.e., a red circle with a backslash) covering the gum within the image. In addition, prior to a no gum session, Keldon was prompted to spit the gum out from the previous session, if applicable.

Contingent Gum Evaluation

A reversal design was used to assess the effectiveness of presenting the instruction to chew gum contingent on ruminations. Sessions continued to occur during the participant’s regularly scheduled therapy times and were 30 min in duration. During baseline, the participant engaged in regular therapy session activities and no consequences were presented for ruminations. During intervention, therapy sessions were conducted as usual. Contingent upon rumination, therapists presented the demand, “Chew your gum,” displayed a green stimulus card with a picture of gum, and set a timer for 5 min. If Keldon attempted to spit out the gum before 5 min elapsed, a new piece was presented. If Keldon refused to chew gum, an escape extinction procedure was used (i.e., therapists held the piece of gum within 2 in of Keldon’s mouth and presented the instructions “chew your gum” every 3 s until he complied). However, we never implemented the escape extinction procedure.

Maintenance Maintenance sessions were conducted every 2 weeks for 6 weeks following the intervention. In addition, the participant’s caregivers were trained to implement the contingent gum procedure using written instructions and modeling. Caregivers met fidelity with a confederate and then completed the last maintenance session with the participant.

Results

Figure 1 depicts the results of the preintervention data. The arithmetic mean rate of rumination per 10-min interval across seven preintervention sessions is displayed by the black bars. Rumination occurred in 100% of intervals and the mean number of responses across intervals was 0.81 responses per min and was variable across intervals (range: 0.02–1.60 responses per minute). Rumination occurred regardless of the time of session or activity as well as the absence of any socially mediated consequences, suggesting the behavior may be maintained by automatic reinforcement.

Figure 2 depicts the results of the continuous noncontingent gum and no-gum comparison. Keldon engaged in lower rates of rumination in the continuous noncontingent gum condition relative to the no gum condition. In particular, Keldon engaged in an arithmetic mean of 0.85 ruminations per min (range: 0–2.3 ruminations per minute) during continuous noncontingent gum condition and an arithmetic mean of 4.1 ruminations per minute (range: 2.3–7.3 ruminations per minute) during the no gum condition. At session 24 in a continuous noncontingent gum condition, Keldon’s ruminations increased relative to previous sessions. This occurred after he scooped a handful of soapy water into his mouth while washing dishes. Rates of ruminations decreased in the following session.

Figure 3 depicts the results of the contingent gum evaluation. During baseline, rumination generally occurred at high levels. Keldon engaged an arithmetic mean of 4.6

Fig. 1 Results of preintervention data collection

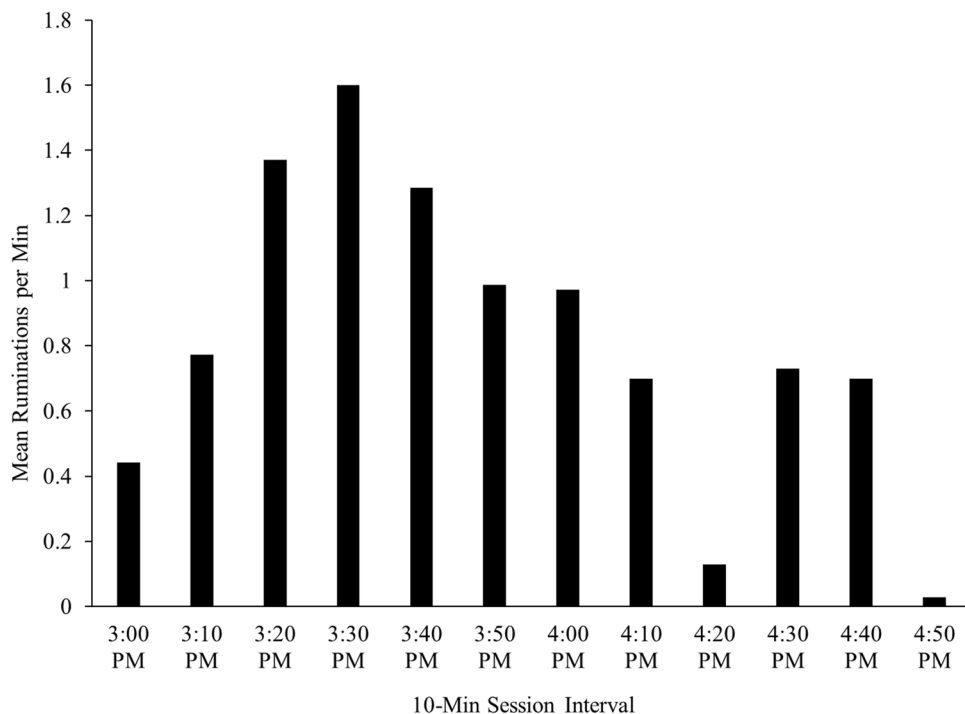
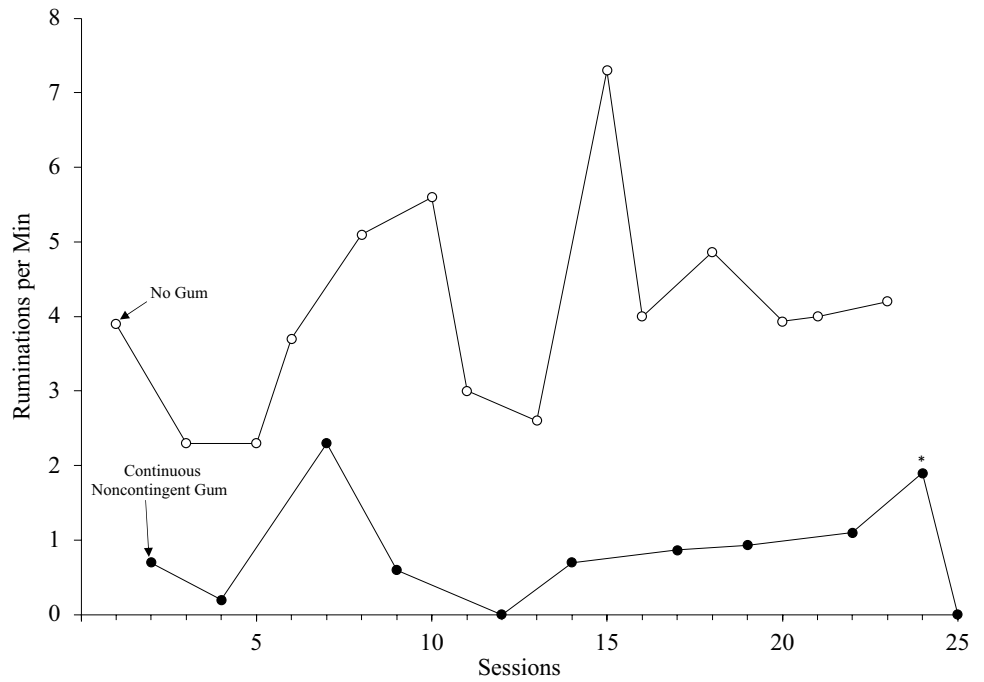


Fig. 2 Results of the continuous noncontingent gum and no-gum comparison

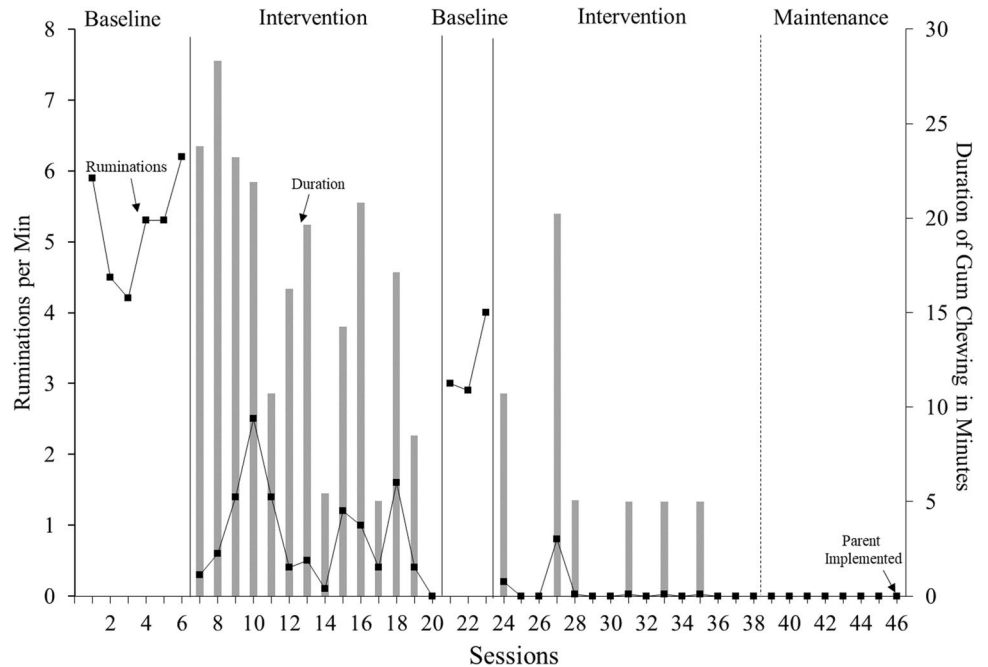


ruminations per minute (range: 2.9–6.2 ruminations per minute) during baseline. During the contingent gum condition, Keldon’s ruminations decreased to zero. Ruminations remained at zero during maintenance sessions conducted every 2 weeks, and during a generalization session implemented by Keldon’s parents in a separate therapy room at the clinic. Keldon’s emitted an arithmetic mean of 0.35 ruminations per minute (range: 0–2.5 ruminations per minute) across treatment sessions.

Discussion

The results of the current study replicate and extend those of Rhine and Tarbox (2009). First, continuous noncontingent access to chewing gum was effective in reducing the rate of rumination exhibited by Keldon. Second, contingent chewing gum was also effective in reducing rumination, the treatment effects maintained after 6 weeks, and the treatment extended to his parents.

Fig. 3 Results of the contingent gum evaluation



Previous research has shown that noncontingent chewing gum is an effective treatment for rumination. However, this treatment requires continuous access to gum and potentially access to a large amount of gum in general. In addition, continuous access to gum may interfere with vocal responding during instructional tasks. A good alternative could be to provide gum contingent on rumination as demonstrated by the current study.

There are several mechanisms that could be responsible for the reduction of rumination when gum was delivered contingently. First, contingent gum could have functioned as a positive punishment procedure. Given that rumination did not occur for the last 19 sessions of the intervention, it is possible that the presence of gum could have served as a discriminative stimulus for punishment reducing the likelihood of engaging in rumination. Second, it is possible that chewing gum competed with rumination, thereby, reducing the rate of rumination. Future researchers should attempt to isolate the mechanism responsible for the reduction in rumination.

Although the results of the current study are positive, it is important to note that the senior researcher of the current study had extensive experience in treating severe problem behavior including rumination. It is important that behavior analysts work within their scope of competence especially when treating problem behavior as severe as rumination.

There are several limitations of the current study. First, we only screened for an automatic reinforcement function. Therefore, we did not rule out a possible socially mediated function for rumination. However, previous research has shown that rumination is often automatically maintained (e.g., Wilder & Neve, 2018) and our treatment was developed with that assumption. Future researchers should conduct a functional analysis (Iwata et al., 1982/1994) prior to evaluating the current treatment to determine what functions the current treatment is effective in treating.

Second, the current study evaluated both continuous noncontingent access to chewing gum and contingent presentation of chewing gum as potential treatments. Although both procedures resulted in a reduction in ruminations for this participant, the current study did not directly compare the two procedures, thus the experimenters cannot draw direct conclusions about which procedure was more effective.

Finally, parents only implemented one of the treatment sessions and generalization across settings was not evaluated. In addition, during the parent-implemented session, the participant never engaged in rumination, so the parents did not get the opportunity to implement the treatment procedures. Future research should measure caregiver fidelity over time and assess for generalization by conducting sessions in more natural settings.

In summary, the present study extends the research on treatments for rumination. Both continuous noncontingent access to chewing gum and the contingent presentation of chewing gum were effective at reducing ruminations for this participant. Given the health issues related to rumination

(e.g., esophagitis, tooth decay), future researchers should continue to assess and treat this challenging behavior.

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author.

Declarations

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare that they have no conflict of interest.

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