THE RELATION OF FOOD QUANTITY TO RUMINATION BEHAVIOR

JIM RAST, JAMES M. JOHNSTON, CHERYL DRUM, AND
JAMES CONRIN

UNIVERSITY OF FLORIDA, SUNLAND CENTER, AND
W. A. HOUSE DEVELOPMENTAL CENTER

Preliminary work suggested that the quantity of food ingested by retarded individuals who usually ruminated following meals was related to the frequency and duration of ruminating responses. This possible relation was experimentally examined by systematically varying food quantity from regular portions to satiation levels for three retarded individuals who exhibited high levels of ruminating. A clear functional relation of food quantity to ruminating emerged, with satiation procedures producing rapid and large decreases in the relatively high frequencies and durations of ruminating characteristic of baseline food quantity conditions.

DESCRIPTORS: ruminating, food quantity, retardation, satiation, self-stimulation

Ruminating or the chronic regurgitation, chewing, and reswallowing of previously ingested food has long been recognized as a behavior problem with serious medical consequences. Ruminating occurs in many settings but is most often observed in institutions for the retarded. A survey of California hospitals for the mentally retarded (Nielson, Note 1) cited an incidence of vomiting not related to illness of 9.6%. A survey at Sunland Center—Gainesville (Rast, Drum, Conrin, & Johnston, Note 2) placed the incidence of clients who ruminate at over 8% for a population of more than 1,200 mentally retarded residents. Ruminating not only detracts from the physical appearance of the client, it also is a primary factor in malnutrition, de-

hydration, and decreased resistance to disease. These consequences are sometimes life threatening, and the mortality rate attributed to chronic rumination ranges from 12% to 20% (Gaddini & Gaddini, 1959; Kanner, 1957; Sajwaj, Libet, & Agras, 1974). In the past 3 yr, there have been three deaths at Sunland Center—Gainesville in which rumination was a primary contributing factor.

Treatment strategies for controlling this behavior have ranged from intensive one-on-one "mothering" to the administration of electric shock. Behavioral interventions for this problem can most easily be classified as either punishment, differential reinforcement of other behavior (DRO), or controlling antecedent stimulus conditions. Numerous studies have replicated the initial finding of White and Taylor (1967) that shock can effectively be used as a punishing stimulus to decrease the frequency of chronic regurgitation and vomiting (e.g., Lang & Melamed, 1969; Luckey, Watson, & Musick, 1968). However, this procedure is not generally the treatment of choice for a number of reasons. First, many administrative regulations and state laws severely restrict the use of shock as an aversive stimulus. Second,

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negative reaction to its use both by concerned advocate groups and training staff may also limit its utility (Sajwaj *et al.*, 1974). Third, a variety of personnel must be involved in treatment to ensure adequate stimulus control, which often requires unwilling and/or untrained persons to administer shock. Fourth, it may be difficult to fade the use of shock without an increase in the ruminating thus necessitating that shock must be used continually (Kohlenberg, 1970). Another punishing stimulus is the oral administration of lemon juice (Sajwaj *et al.*, 1974). The problems that exist with the use of shock, however, have all been observed locally with the use of lemon juice. A final concern must be expressed about punishment procedures in general in these cases. Clients who ruminate generally exhibit severe behavioral deficiencies. To reduce the occurrence of one response class in their repertoire may lead to lower rates in other response classes if the punishment procedure results in the creation of conditioned aversive stimuli in the form of trainer or training environment.

For these reasons, DRO procedures may be more appropriate as a treatment tactic. DRO procedures avoid the major problems of punishment procedures in this context and offer certain benefits. Other response classes are increased in frequency or added to the client's repertoire, and transfer of training may be less of a problem than with punishment procedures. However, DRO can only be used when resources are in adequate supply because these procedures require extensive training time. DRO also often produces slow deceleration of the target response class that may be difficult to maintain at low frequencies (Hartman, 1979).

To avoid some of these problems and to improve staff efficiency, other methods of controlling ruminating have been examined. Ball, Hendricksen, and Clayton (1974) increased the amount of stimulation during meals by moving the feeding utensils and spray of milk around the mouth. This seemed to result in decreased ruminating in two clients. Another way to vary

the amount of oral stimulation provided by the meal is to alter food quantity. Jackson, Johnson, Ackron, and Crowley (1975) used food satiation with two clients and reported excellent results with one of them. Some pilot work performed at Sunland Center—Gainesville (Rast *et al.*, Note 2) suggested that food quantity might have effects on ruminating. The present study was therefore designed to be a preliminary investigation of the relation between food quantity and rumination behavior.

EXPERIMENT 1

METHOD

Subjects and Setting

Robert was a 19-yr-old severely retarded male who had been institutionalized for 8 yr at the time of this study and weighed 131 pounds. His ideal weight range was projected by the senior dietician as 140-150 pounds. He had a history of ruminating for over 10 yr.

John was a 21-yr-old profoundly retarded male who had been institutionalized for 18 yr and weighed 96 pounds. John had had a serious underweight problem for over 12 yr for which he had repeatedly been hospitalized. His ideal weight range had been projected as 127-139 pounds. John had been ruminating for at least 6 yr at the time of the study. Both John and Robert were ambulatory, nonverbal, and fed themselves.

The study was conducted in a small cottage on the grounds of the Sunland Center in Gainesville, Florida. Three rooms and a bathroom were used for this purpose. There were no individuals present during the study other than these two clients, observation personnel, and occasional monitoring personnel. The three rooms included an eating room, a client sitting room, and an observation room.

The eating room of the experimental setting contained a table, two benches, and a refrigerator. A sitting room was used by the clients during the post-meal observation periods and contained two chairs. The observers sat in

an adjacent room divided by reinforced glass. Clients had access to a bathroom at all times.

Measurement

One staff member was assigned to monitor each client during each meal and for sixty minutes after that meal. During this post-meal observation period the two observers counted each ruminating response and recorded each duration. Durations were timed from the time food was regurgitated to the mouth to the time it was reswallowed.

During each of the six phases, multiple observer procedures were used at least once at each meal for each client. These interobserver agreement checks consisted of placing a third observer in the room with the clients. This individual sat in the corner away from the clients and out of sight of the two primary observers who were in the observation room. Multiple observer measurements were taken during a total of 31 sessions. The percentage agreement ranged from 92.4% to 100% for frequency measures and from 90% to 100% for duration measures.

Experimental Procedures

Experimental procedures were conducted only for breakfast and lunch meals because of personnel limitations. At the dinner meal the two clients received meals of the same quantity and food types as at lunch except during satiation, when the evening portion was double the standard meal. Dinner meals were measured and prepared by the dietary staff who prepared lunch. The clients ate the dinner meals with the other residents on their cottage and no observations were made. Pilot work had indicated that ruminating frequencies and durations were similar for lunch and supper for each of these clients.

At breakfast and lunch meals, John and Robert were seated at the same time at opposite ends of the table in the eating room. They were given the liquid portion of the meal in the specified amount before they were allowed to eat. Except under satiation conditions, both cli-

ents ate all of the food presented to them. When a client attempted to leave the table before completing his meal, he was returned to the table. Meal completion was signaled when the client ate all food on his tray or gave three consecutive "meal completion responses" without intervening eating behavior. These responses consisted of setting the spoon down, spitting out food, or getting up from the table. Beginning at this point (meal completion) and lasting for 60 min, the observers made dependent variable measurements and interacted with the client only to assist John with toileting and to control occasional aggressive outbursts by Robert. During this post-meal observation period, the clients were seated beside each other in the sitting room. Robert generally remained seated during the observation period, and John frequently paced the floor.

Baseline. During the baseline condition, each client received 6 oz. of orange-grapefruit juice for breakfast followed by 2.5 oz. (one egg) of scrambled egg, .75 oz. (one slice) of white bread, and 8.5 oz. of hot cereal. At lunch each client received 8 oz. of milk before the meal and 5 oz. of a diced meat, 5 oz. of a green vegetable, 5 oz. of starch, and 5 oz. of fruit. This was a special diet prepared without tomatoes and with minimal fat, because pilot work had suggested that these might affect the frequency of ruminating.

Large portions. During the second condition each client received 12 oz. of orange-grapefruit juice before breakfast followed by 5 oz. of egg, 1.5 oz. of white bread, and 17 oz. of hot cereal. Before lunch each received 16 oz. of milk followed by 7.5 oz. of chopped meat, 1.5 oz. of white bread, 7.5 oz. of a green vegetable, 7.5 oz. of a starch, and 7.5 oz. of fruit.

Satiation. During this phase, each client received the same amount of food as in the previous large portion phase. As this food was consumed, each client was given all the potatoes, unflavored instant grits, cream of wheat, and/or bread that he would freely consume. Because it was noted during the first 2 wk of this phase

that the frequency of eating responses decreased as the plate emptied, the tray was never allowed to be empty. The weight of these meals usually ranged from 5 to 8 times the baseline breakfast quantity and from 3 to 6 times the baseline lunch quantity.

Spaced baseline. During this condition, the time it took for each client to consume the baseline meal portions was extended to match the same meal durations under the preceding satiation phase. This was done to separate the effects of meal duration from meal quantity, and was implemented by placing only small quantities of the meal on the plate at one time.

Spaced baseline regular diet. During this phase, the diet was changed from the special diet to the regular institutional diet (i.e., tomatoes were not omitted and fat was not minimized). The quantities, food types, and spacing were the same as in the spaced baseline phase.

Satiation regular diet. The diet in this phase was again the regular institutional diet. The quantities and food types were the same as the original satiation phase.

RESULTS

Baseline

Both clients were observed during 31 sessions in this phase, which included 17 breakfasts and 14 lunches. The data for each client showed differences in responding for breakfast and lunch meals, and the data are therefore plotted separately by meals in Figure 1 on a semi-logarithmic chart. The charting conventions are generally those of the Standard Behavior Chart (Pennypacker, Koenig, & Lindsley, 1972), and it should be noted that durations increase as they near the bottom of the chart. Thus, a duration on the 1.0 line represents a duration of 1 min or less and a duration on the .10 line represents a 10-min duration.

Figure 1 shows that under this first set of conditions, Robert ruminated .6 to 1.5 times per min (between 42 and 104 times in 60 min) after breakfast and between .8 and 3.2 times

per min after lunch. The duration of his ruminating was between 7 and 15 min after breakfast and 7 and 24 min after lunch. John ruminated .5 to 1.2 times per min after breakfast and .75 to 1.2 times per min after lunch. Although his frequency of ruminating was lower than Robert's, the duration of ruminating was similar and more stable (8 to 15 min after breakfast and 12 to 19 min after lunch).

Large Portions

Robert's frequency of ruminating increased noticeably when the amount of food he was given at breakfast was doubled. Robert was now ruminating between 1.3 and 3.0 times per min for a total duration of 11 to 30 min out of each 60-min observation period. John also ruminated somewhat more frequently during this phase, and the duration of ruminating increased to a range of 12 to 24 min.

While breakfast food quantities were doubled, lunch quantities were increased by a factor of 1.5. Robert's frequency of ruminating increased slightly while John's frequency and duration of ruminating decreased slightly.

Satiation

Robert's frequency and duration of responding decreased dramatically in the first three meals of this phase. After these meals, Robert ruminated only once during the remaining 32 sessions of this condition. John ruminated during 10 of the 35 meals and during these sessions his frequencies and durations were decreased markedly from previous phases.

Spaced Baseline

At breakfast Robert returned to baseline levels of responding in one meal. At lunch meals the duration of ruminating responses increased to baseline levels in eight sessions; frequency also stabilized after eight sessions, but was slightly decreased from baseline levels. With John, the effect was reversed. He ruminated at baseline frequency and durations from the first

lunch meal, but it was then some days before his response frequencies at breakfast reached baseline levels and stabilized.

Spaced Baseline Regular Diet

Switching to the regular diet did not produce a noticeable effect with either client for either meal.

Satiation Regular Diet

The return to satiation conditions produced similar effects to the original satiation phase. Robert ruminated a total of only 19 times in the 162 sessions of this phase after the first

week. John continued to ruminate in about half the sessions, and the duration and frequency of ruminating in these sessions was lower than the baseline measures.

EXPERIMENT 2

METHOD

Subject and Setting

David was a 24-yr-old profoundly retarded male who had been institutionalized for 17 yr at the time of this study. David had a 10-yr history of ruminating and had been admitted to the hospital for chronic weight loss, dehydra-

Fig. 1. Frequency (circles) and duration (squares) of ruminating responses after breakfast and lunch meals for Robert and John.

tion, and aspiration pneumonia on numerous occasions. Due to David's physical condition, it was not possible to take him to the same research setting described in Experiment 1, so similar experimental procedures were conducted in his cottage in a room arranged for this purpose. The observer was in the same room with David and they were separated from other clients during sessions. After each meal a diaper was pinned around David's neck; it hung freely over his shirt so that he could easily place part of it in his mouth.

Measurement

Observational procedures were the same as in the previous study except that the observer also recorded the amount of time the towel was in David's mouth. Fifteen interobserver agreement checks were made during this study. At least one check was performed for a breakfast and a lunch meal in each phase and were conducted as described in Experiment 1, except that both observers were in the same room. Fourteen of the fifteen occasions showed perfect agreement on frequency measures of ruminating and 92.8% to 100% agreement on duration measures. Interobserver agreements for the du-

ration of towel chewing ranged from 91.7% to 100%.

Experimental Procedures

Experimental procedures were the same as described in Experiment 1 except for the sequence of independent variable conditions. The nonproductive variables in Experiment 1 (spaced eating and special diets) were omitted for design efficiency. An initial baseline condition was followed by a satiation condition, a reversal to baseline conditions, and a final return to satiation condition. Foods were prepared in the usual institutional manner, as in the regular diet phases of Experiment 1.

RESULTS

Baseline

Figure 2 shows that across the 4 wk of this phase there was a slight decrease in ruminating frequencies at both breakfasts and lunches. However, over the same period the aggregate durations were increasing slightly at breakfast (median of approximately 17 min) while remaining constant at lunches (median of approximately 20 min). Figure 2 also shows that the duration of David's towel chewing ranged from about

Fig. 2. Frequency (circles) and duration (squares) of ruminating responses (top panels) and duration of towel chewing responses (bottom panels) after breakfast and lunch meals for David.

1 to 27 min, with a median duration of approximately 17 min after breakfast and 13 min after lunch.

Satiation

Following the initiation of satiation procedures, there was an immediate decrease in duration and frequency measures for ruminating after the breakfast and lunch meals. Figure 2 shows that these measures were maintained for the first 2 wk of this condition, when both frequency and duration values began to increase. These changes during the later portion of this satiation phase are quite similar to the effects of aspiration pneumonia reported by Williams and Conrin (Note 3) and the phase was interrupted when David was admitted to the hospital with this diagnosis and later put on bed rest in the cottage. Following a return to satiation procedures, the frequency and duration of ruminating responses decreased dramatically. Figure 2 also shows that towel chewing decreased quickly for both meals and was not affected by the pneumonia and remained at near zero levels.

Baseline

When David again received baseline food quantities, the frequency and duration of ruminating responses increased in the first session and remained fairly stable for the remaining sessions of this condition. These values were less than during the original baseline phase, but this may have been the result of increased towel chewing. During this phase, David chewed on the towel much more than he had during both previous phases.

Satiation

During the final satiation phase the frequency and duration of both ruminating and towel chewing decreased to levels observed in the previous satiation phase.

DISCUSSION

The goal of these two experiments was to examine the nature of the relations between

quantity of food ingested and ruminating in institutionalized retarded residents. This was approached by using the parametric extremes available with the independent variable—standard portions and the largest quantity which the clients would consume (satiation). The data from all three clients are unambiguous in describing an apparent functional relation between food quantity (as defined by the described procedures) and ruminating (as measured in terms of frequency and duration). The data on ruminating responses emitted under the conditions of this study show that responding decreased in session frequency and duration when extremely large quantities of food were consumed and increased again when smaller "standard" portions were eaten. This general relation was manifest in all phases for all clients.

Within this general conclusion, there were differences in the extent to which the measures of ruminating decreased under the satiation conditions. At one extreme, Robert virtually ceased ruminating at both breakfast and lunch meals within a few days of the onset of satiation procedures. John, however, showed a slightly more gradual transition to a level of stable responding at which he ruminated in about half of the sessions, though at much lower levels than when under nonsatiation conditions. The change in David's responding fell between that described for Robert and John. It is interesting to note that when food quantities were increased 1.5 to 2 times baseline levels, frequencies and durations of responding were affected but in different directions.

Although the data collected under the various conditions after breakfast versus lunch meals show the same general changes, there are some differences that should be noted. For example, the data for Robert under both single portion special and regular diets (fourth and fifth phases) show noticeably higher frequencies and durations after the lunch meals compared to breakfasts. No such differences exist under satiation conditions. If an interaction exists between the quantity of food consumed at breakfast and

the following lunch and levels of ruminating at the two meals, it might be because a single portion breakfast followed by a single portion lunch maximizes the effect of minimum food quantity on post-lunch ruminating.

One of the effects of the satiation procedure is that it probably results in a weight gain by the resident that is faster and greater than that which would result from other methods of treating ruminating. Figure 3 shows data from weekly weighings of the clients. The weight gains associated with the satiation treatment conditions are both substantial and clinically significant. This benefit of the satiation procedure is especially valuable given the characteristic malnourished and under-weight condition of residents who exhibit this problem. The obvious question raised by this effect on weight concerns the necessary duration of the satiation procedure as a means of controlling ruminating. That is, an overweight condition would clearly develop if the satiation procedure were continued beyond a certain point. Can the procedure be modified or terminated at some point in such a way that

ruminating will not again become a problem? The present study does not answer that question, but a continuing investigation with these and other residents is examining this issue.

The duration measures of the towel chewing behavior for David show some relation to ruminating. Similar conditions produced similar changes across phases in both response classes. Within phases, however, the relation was reversed. These effects and relations suggest that these behaviors may be in a similar response class. These responses appear to follow the form of adjunctive behavior (Falk, 1971). These clients were food deprived as witnessed by the fact they ate five to ten times their normal portions when allowed to free feed and continued to do this for many meals. Responding began during the period immediately after the fixed time meal and decreased across the session. Whether or not rumination and towel chewing in this case are formally adjunctive in nature cannot be determined from these procedures and data; however, an earlier study by Villareal (Note 4) suggests this could be pos-

Fig. 3. Pounds of body weight throughout all conditions for Robert, John, and David.

sible. The present data should encourage the experimental investigation of the determinants of various pica response classes under different conditions. The effectiveness and efficiency of both treatment and prevention procedures may be augmented by the results of such a research effort.

The present study also calls attention to certain methodological practices. One has to do with what dimensions of the response class of interest are quantified through the measurement operations (see Johnston & Pennypacker, 1980). In this case, it seemed likely that variability in responding which would be of experimental interest might be detected in measures of both frequency and duration. Although frequency is a dimensional quantity only characteristic of a class of responses, duration is a dimensional quantity that can describe individual responses. However, even though the durations of each ruminating response were measured, the daily data are displayed as totals of the individual durations for each session. This decision followed examinations of the duration data in other forms. For example, to examine the effect on individual durations, average duration per response was plotted both by session and within session in 6-min bins. These measures confirmed that the duration of individual responses decreased within each session and across sessions when the total durations for these sessions decreased. Although the data in Figures 1 and 2 generally show a strong direct relation between these two dimensions, such a conclusion indicates a superficial examination of the data. A point-by-point analysis shows differing patterns of variability for the two dimensions. This is especially the case for John and David whose data are generally more variable than Robert's. The use of these two-dimensional quantities in this study simply present more information than would be the case with either alone and allows more reliable and general conclusions about the relation between ruminating and quantity of food ingested.

The apparent relation between quantity of

food ingested and ruminating exhibited by these data may be of considerable therapeutic importance, but it raises a number of questions both basic and practical which demand experimental attention. The present study only demonstrates a tentative relation, and the first and most important task is to examine empirically in greater detail the exact nature of the relation. Following an evaluation of the reliability of the effect, one group of questions concerns the qualities of the substances consumed. Does it make a difference what foods are consumed in a satiation procedure? In more basic terms, are there chemical or structural variables which are important to the effect? For example, does the fibrous quality of the diet, the particle size, the caloric density of the food, and/or the fat content of the diet affect ruminating?

Another group of questions is even more basic and address the actual explanation of the effect. If simply feeding a ruminating retardate unusually large quantities of food tends to reduce or even eliminate occurrences of ruminating, why? Exactly what are the most fundamental and necessary elements of the relation? Is the effect solely or in some combination chemical, mechanical, or behavioral (conditioning)? In the process of answering such questions in an interdisciplinary fashion, something may be learned about whether other natural processes are also involved. Investigation of this phenomenon is not completed until this group of questions has been thoroughly addressed. Answers here may have important implications for treatment procedures. The routine and nonexperimental use of satiation as a treatment in the absence of a complete explanation of the processes involved must be considered somewhat naive and not devoid of risk.

Finally, one class of questions must address treatment-oriented considerations that emerge from these research efforts. Exactly what procedures to control ruminating are dictated by research data? How should such procedures be introduced, managed, and terminated? What precautions must be attended to and in what

fashion? These kinds of questions are most profitably answered only after a thorough program of experimental investigation which fully describes and explains the basic phenomena.

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