EFFECTS OF PRIOR TASTE EXPERIENCE ON PALATABILITY AS MEASURED BY SALIVARY RESPONSE

by

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(ABSTRACT)

The taste of a preferred food, pizza, was adulterated with quinine sulfate and the effects of taste experience on subsequent measures of palatability were measured. The measures of palatability were salivary responses to the thought and presentation of pizza. Additional measures were latency to start eating, amount eaten, meal duration, rate of eating and preference ratings of the pizza's taste, aroma and appearance.

Thirty-six subjects received access to regular and/or adulterated pizza over two experimental sessions. The resulting groups of nine subjects each received either adulterated and adulterated, adulterated and regular, regular and regular, or regular and adulterated pizza over the two sessions. In a third session all subjects received regular pizza.

In session two, groups which had received regular pizza in session one showed a reliably greater salivary response on the presentation trial than on the thought trial.

Groups which had received adulterated pizza showed minimal differences in salivation between these trials. In session three, groups which had received regular pizza in session one yielded reliably greater salivation on the presentation trial than did groups which had received adulterated pizza in session one. Furthermore, nonshift groups, which had received the same pizza condition over sessions one and two, showed a greater difference between thought and presentation trial responses than did shift groups, which had received different pizza conditions over sessions one and two. An approach-avoidance conflict model of behavior was applied to the salivation data.

Preference ratings of the pizza's taste, the amount eaten and the rate of eating data yielded reliably greater responses for groups which received regular pizza than for groups which received adulterated pizza in sessions one and two. Positive and negative contrast effects were also evidenced by these data. The meal duration and latency to start eating data yielded highly similar responses among groups over days.

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Identification of the factors which influence food acceptance and rejection is critical to our understanding of eating behaviors and disorders (Pelchat & Rozin, 1982). Whereas social convention dictates much of our eating behavior, the physiological needs of the individuals within a society dictate convention, such as number of meals and types of food consumed. Within a society, sensory, cognitive, gastrointestinal and metabolic stimuli become associated with the physiological needs and eating behavior of individuals (Le Magnen, 1978; Booth, 1978).

Palatability is sometimes referred to as "a food's ability to stimulate an eating response" (Le Magnen, 1978). Booth (1978; 1981) argues that palatability is a much broader and more dynamic concept than that based merely on the sensory characteristics of a food's taste, texture, temperature, aroma and appearance. He maintains that a food's potential for evoking an eating response depends on the momentary acceptability of the food. Momentary acceptability (acceptance or rejection of a food for consumption at a given time) is based not only on the sensory characteristics of the food, but on the social and physical context in which the food is situated, the physiological, gastrointestinal, metabolic and cognitive state of the individual, and the expectations of physical, gastrointestinal and social consequences from eating the

food. These expectations are based on the individual's prior experiences with the food. Berridge and Grill (1984) similarly maintain that palatability is an assessment of a food based on sensory information, internal state and prior learning.

Changes in Palatability

The idea that a food's potential to elicit an eating response changes with time or experience is not a totally new one. The following studies illustrate how this potential changes as a function of food deprivation, during the course of a meal, and with learning.

Food Deprivation: Wooley and Wooley (1973) reported that salivary responses to palatable food were greatest after deprivation, less at mealtime, and lesser still after eating.

During a Meal: Rolls, Van Duijvenvoorde and Rolls (1984) demonstrated that a variety of less-preferred foods could evoke more eating behavior than could a single highly-preferred food. Furthermore, during meals which offered a variety of foods, a food which had already been tasted declined in its elicitation of eating as measured by rated preference for eating that food. Conversely, foods which were not yet tasted continued to elicit high preference ratings. Blundell and Freeman (1982) suggest that this decrease in preference may not be food specific,

but may generalize across similar types of foods. They demonstrated that following ingestion of a solution of 50 grams of glucose, salivary response to honey, but not to lemon juice or beef bouillon, was less than that of controls which had ingested an equal amount of a solution containing two grams of glucose.

Learning: Food aversion studies offer classic examples of how previous experience with food influences eating behavior. Research by Garcia and Koelling (1966), and Domjan (1980) shows that animals will subsequently avoid novel stimuli which had previously been paired with toxicosis-inducing procedures. Logue, Ophir and Strauss (1981), and Cannon and Baker (1981) showed that most foods which were disliked or avoided by humans were associated with gastrointestinal distress.

Assessing Palatability

One method of assessing the palatability of a food stimulus is the measure of salivary response at food presentation. Bolles (1980), Blundell and Freeman (1981), Booth and Fuller (1981), Wooley and Wooley (1973), Wooley, Wooley and Williams (1976), Wooley, Wooley and Dunham (1976), Klajner, Herman, Polivy and Chhabra (1981), Guy-Grand and Goga (1981), Nirenberg and Miller (1982) and Christensen and Navazesh (1984) report that the presentation of food yields an increase in salivation

above that of baseline levels. This increase is influenced by (1) individual preferences for eating the food item, (2) the physical appearance of the food, and (3) the expectancy to eat the food based on the context in which the food is presented.

Preference: Wooley and Wooley (1973) and Klajner, et al. (1981), reported that salivary response to food was positively correlated with food preferences. Nirenberg and Miller (1982) demonstrated that salivation increased above baseline to the presentation of food only when the food was preferred.

Physical Appearance: Apparently, a food's appearance must meet some physical standard to be associated with eating behavior. Klajner, et al. (1981) reported that the presentation of chocolate chip cookies, made green by the addition of food coloring, yielded virtually no increase in salivation above baseline. Presentation of pizza which was "unappealing despite gross resemblance to [normal pizza]" failed to elicit any change in salivary behavior (Wooley & Wooley, 1973).

Expectancy to Eat: The availability of a food item for consumption has been found to affect salivary responding. Wooley and Wooley (1973), Wooley and Dunham (1976), Rosen (1981), Durrant (1981), and Klajner, et al. (1981), reported that salivation to the presentation of a

food was reliably greater than baseline levels only if the individual expected to eat the food.

Another method of assessing a food's palatability is to measure the salivary response to the thought of that food. Wooley and Wooley (1973) and White (1978) reported that when subjects were instructed to think about eating they increased salivation above baseline levels. White also reported that salivation to the thought of an individually preferred food was greater than that to a neutral or non-preferred food. Furthermore, subjects who were vivid imaginers increased salivation to the thought of food more than did subjects who were not vivid imaginers. White concluded that "images are simply conditioned stimuli of the second signalling system (Skinner, 1972) affecting autonomic [salivary] responses in direct proportion to their ideational vividness". Wooley and Wooley reported that at mealtime, or when subjects were food deprived, salivation to the thought of food was less than that to the sight of food. However, following a meal, salivation to the thought of food was not reliably different from salivation to the sight of food.

Spitzer and Rodin (1981) have suggested that the validity of salivary responding as a measure of palatability may be assessed by studying salivation's

relation to a measure of oral acceptance such as latency to start eating, or to a measure of ingestion such as amount eaten. Currently, there seems to be no reported study on the relation between salivary responding and latency to start eating. Furthermore, only one study examined the relation between salivary responding and amount eaten (Klajner, et al., 1981). This study reported that these two measures were not correlated.

There is evidence, however, that amount eaten is positively correlated with preference ratings (Grinker, 1975); Hill, 1974; Hill & McCutcheon, 1975; Hill, Magson & Blundell, 1984; Hill & McCutcheon, 1984; McKenna, 1972; Nisbett, 1968; Price & Grinker, 1973; Rodin, 1975; Rodin, Slochower & Fleming, 1977; Woody, Costanzo, Liefer & Conger, 1981) and preference ratings, in turn, are positively correlated with salivary responding (Wooley & Wooley, 1973; Nirenberg & Miller, 1982; White, 1978; Klajner, et al., 1981). Furthermore, Wooley and Wooley (1973), and Klajner, et al. (1981), have reported that when unappealing food was presented, not only were salivary responses nonexistent, but no food was ingested.

Salivary responding is the initial alimentary response to a food stimulus. Salivation prepares the mouth for oral acceptance of the food and initiates enzymatic digestion (Christensen & Navazesh, 1984).

Saliva contains an enzyme called amylase which initiates the breakdown of starch (Keeton, 1973). If a food item does not represent an edible stimulus (e.g. green chocolate chip cookies), or if food consumption is restricted, no salivary response is made. This anticipatory character of salivary responding is evidenced by the results of the Wooley and Wooley (1973) and Klajner, et al. (1981) studies, wherein salivary responding was negligible when foods did not meet expectations of physical quality or were not available for consumption. If salivary response to a food item is a measure of palatability, and palatability depends, in part, on the organism's prior experience with a food, then a manipulation of experience with a food should influence subsequent salivary responding. Previous research has examined salivary responding to the thought or presentation of a preferred or non-preferred food which was either available or not available for consumption. Preferences are presumably based on the subject's past experiences with the foods, but, in those studies the subject's past experiences were not manipulated. To assess salivary responding as a measure of palatability, the effect of previous experience on subsequent salivary responses should be investigated.

One possible method of examining the effects of previous experience on palatability, as measured by

salivary responding, would be to manipulate the taste of a preferred food and measure salivary responding at subsequent thought and presentation of that food. In an unfamiliar setting, thought and presentation of a highly preferred food should elicit salivary responses which reflect expectations of taste based on myriad past experiences with the food. Subsequent thought and presentation of the food, in the same setting, should yield salivary responses which may reflect expectations of taste based on the previous experience with the food in that setting. The taste of a food could be manipulated by the addition of quinine sulfate. Nisbett (1968) and Woody, et al. (1981), added bitter-tasting quinine sulfate to ice cream, a highly preferred food, without, apparently, altering its visual or olfactory qualities. These researchers reported that the adulteration with quinine reliably reduced preference ratings and amounts of ice cream eaten.

The purpose of the present study was to examine the effects of prior taste experience on food palatability as measured by subsequent salivary responses to the thought and presentation of the food.

Regular and adulterated pizza conditions were combined in an orthogonal (2 x 2) research design; and slices of pizza were presented to 36 subjects over two mealtime

sessions. This design resulted in four groups of nine subjects, which received either adulterated and adulterated, adulterated and regular, regular and regular, or regular and adulterated pizza over the two mealtime sessions. During a third session, each subject received regular pizza. Measures of salivary responses to the thought and presentation of pizza, latency to start eating, amount eaten, meal duration and rate of eating were obtained in each session. After session three, preference ratings of the pizza's taste, appearance and aroma were obtained from the subjects as checks on the adulteration manipulation.

Hypotheses

If prior experience with a food influences the food's palatability, as Booth suggests, then consumption of adulterated and regular pizza in the first experimental session should differentiate the groups on salivary responses to the thought and presentation of pizza in the second session.

Hypothesis 1: In session two, groups which received regular pizza in session one should show greater salivary responses to the thought and presentation of pizza than should groups which received adulterated pizza in session one.

If expectancies of the taste of pizza in the

experimental situation are based on the pizza condition received in session one, then confirmation or disconfirmation of these expectancies in session two should differentiate groups on salivation in session three. That is, groups which had received either regular pizza in sessions one and two, or adulterated pizza in sessions one and two may have had their expectancies of taste, based on the pizza condition received in session one, confirmed by the pizza condition received in session two. Groups which had received either regular or adulterated pizza in session one, and the alternative pizza condition in session two, may have had expectancies of taste disconfirmed by the pizza condition received in session two. In session three, therefore, the group which received regular pizza in both sessions may show greater salivary responding than did the group which received adulterated pizza in both sessions. Beyond that, the relative magnitudes of salivary responding among the groups are difficult to predict. The groups which received adulterated and regular or regular and adulterated pizza in sessions one and two may show any of three relative effects for salivary responding (Flaherty, 1982): (1) Disconfirmation of expectancies could decrease salivary responding to levels equal to or lower than those of the group which received adulterated pizza in both sessions by evoking

conflict between approach and avoidance tendencies. This effect is analogous to approach-avoidance conflict in the animal literature (Miller, 1959). (2) Disconfirmation of expectancies could result in responses intermediate to those of the group which received regular pizza in both sessions and the group which received adulterated pizza in both sessions. This effect is analogous to averaged responses based on animal models of reward magnitude shift effects (Black, 1968). (3) Disconfirmation of expectancies could lead to levels of salivary responding greater than those of the group which received regular pizza in both sessions for the group which received adulterated pizza in session one and regular pizza in session two; and less than those of the group which received adulterated pizza in both sessions for the group which received regular pizza in session one and adulterated pizza in session two. These effects are analogous to positive and negative contrast effects evidenced by animal models of reward magnitude shift effects (Crespi, 1942).

Hypothesis 2: In session three, the group which received regular pizza in both previous sessions should show greater salivary responses to the thought and presentation of pizza than groups which received adulterated pizza in both previous sessions. Groups which

received either regular and adulterated or adulterated and regular pizza in sessions one and two could show one of the following relative magnitudes of salivary responding: (1) Both groups could show levels of responding less than those of the group which received adulterated pizza in both sessions. (2) Both groups could show levels of responding intermediate to the group which received regular pizza in both previous sessions and the group which received adulterated pizza in both previous sessions. (3) The group which received adulterated pizza in session one and regular pizza in session two could show a level of responding greater than that of the group which received regular pizza in both sessions; and the group which received regular pizza in session one and adulterated pizza in session two could show a level of responding less than that of the group which received adulterated pizza in both previous sessions.

If latency to start eating, as suggested by Spitzer and Rodin (1981), is a valid measure of a food's oral acceptability, then the different taste experiences of session one should subsequently differentiate groups on measures of latency to start eating in session two.

Hypothesis 3: In session two, groups which received regular pizza in session one should show shorter latencies

to initiate eating than groups which received adulterated pizza in session one.

Since latency to start eating and salivary responding are both anticipatory responses to a currently available food stimulus, based on previous experience with the food, latencies to start eating in session three should also reflect the confirmation or disconfirmation of expectancies in session two. The predicted measures of latency were based on the same logic from animal models of behavior as those which were used to predict salivary responding.

Hypothesis 4: In session three, the group which received only regular pizza in the previous sessions should show a shorter latency to start eating than the group which received only adulterated pizza in previous sessions. Groups which received either adulterated and regular or regular and adulterated pizza over sessions one and two could show one of the following latencies: (1) Both groups could show latencies greater (slower responding) than that for the group which had received only adulterated pizza in previous sessions. (2) Both groups could show latencies intermediate to those of the groups which received only regular pizza in the previous sessions and the group which received only adulterated pizza in the previous sessions. (3) The group which received

adulterated and regular pizza in sessions one and two, respectively, could show a latency shorter than that of the group which received only regular pizza in the previous sessions; and the group which received regular and adulterated pizza in sessions one and two, respectively, could show a latency greater than that of the group which received only adulterated pizza in previous sessions.

If latency to start eating and salivary response to the presentation of food are both anticipatory responses which reflect the acceptability of the currently available food and these responses are opposite in direction, then measures of these responses should be negatively correlated. That is, the greater the salivary response to the presentation of food, the shorter the latency to start eating.

Hypothesis 5: In each session, latency to start eating should be negatively correlated with salivary response to the presentation of pizza.

If the taste manipulations influence preferences for the taste of the pizza, then measures of amount eaten should be greater for groups which receive regular pizza in sessions one and two, than for groups which receive adulterated pizza. Furthermore, in sessions two and three,

there should be negative and positive contrast effects on amount eaten for groups which receive pizza conditions different from those received in the preceding session. Consequently, a shift from regular to adulterated pizza may make the adulterated pizza seem less edible than it seems to the group which had previously received adulterated pizza. Conversely, a shift from adulterated to regular pizza may make the regular pizza seem more edible than it seems to the group which had previously received regular pizza. Amount eaten could, therefore, be greater for groups shifting from adulterated to regular pizza than for those groups which receive regular pizza in both the preceding and current sessions. Conversely, amount eaten could be less for those groups shifting from regular to adulterated pizza, than for those groups which receive adulterated pizza in both the preceding and current sessions.

Hypothesis 6: In sessions one and two, amount eaten should be greater for groups which receive regular pizza than for groups which receive adulterated pizza.

Hypothesis 7: In sessions two and three, amount eaten should be greater for groups which have shifted from adulterated pizza in the previous session, to regular pizza in the current session, than for groups which have received regular pizza in both sessions. Conversely,

amount eaten should be less for groups which have shifted from regular pizza in the previous session to adulterated pizza in the current session, than for groups which have received adulterated pizza in both sessions.

Spitzer and Rodin (1981) have suggested that a measure of ingestion such as amount eaten, and a measure of palatability such as salivary responding, should be positively correlated, although Klajner, et al. (1981), reported that these measures were not correlated. If expectancies of taste are based on prior experience with pizza in session one, and confirmed by the pizza condition in session two, then amount eaten and salivary responses to the presentation of pizza in session two, for groups which received regular pizza or adulterated pizza in both sessions may be positively correlated.

Hypothesis 8: In session two, amount eaten should be positively correlated with salivary responses to the presentation of pizza for groups which received either regular or adulterated pizza in both sessions one and two.

Method

Subjects

Subjects were 36 male students at Virginia Polytechnic Institute and State University. They were recruited from among volunteers who completed a prescreening questionnaire (Form 1A, Appendix A). Subject selection was based on the following criteria: (a) a high preference for eating cheese pizza; (b) a frequency of eating cheese pizza which did not exceed three times per week; and (c) no food allergies. Table 1A lists group information obtained from criterion questions on the prescreening questionnaire.

The experimenter recruited subjects in person at the time of the prescreening procedure or by telephone. Prospective subjects were told that (a) the purpose of the study was to investigate the effects of appetite on salivation at mealtime; (b) they would receive something to eat during each of the three required mealtime sessions; and (c) all three sessions had to be attended before the three extra credit points would be awarded toward their final grade in their current psychology class.

Volunteers signed-up for the half-hour time slots on Monday, Wednesday and Friday, which coincided with their regular lunch or dinner time. For each subject, sessions were held at the same time on each of the three days. Lunch sessions were held every half hour between 11:00 A.M.

and 2:00 P.M. Dinner sessions were held every half hour between 4:00 and 7:00 P.M.

Design

Subjects were randomly assigned to a 2 x 2 x 3 factorial design: 2 Phase 1 pizza conditions (Ph1) x 2 Phase 2 pizza conditions (Ph2) x 3 days of measurement. In each phase the pizza conditions were either adulterated (A) or regular (R). The adulterated pizzas were made bitter by the addition of quinine sulfate to the pizza sauce. Thus, an orthogonal combination of pizza conditions over Phases 1 and 2 yielded four independent groups of nine subjects each. One group received adulterated-adulterated pizza conditions (AA), one received adulterated-regular (AR), one received regular-regular (RR), and one received regular-adulterated (RA). On day 3, all subjects received regular pizza.

Apparatus

The study was conducted in a small room with a one-way mirror in one wall. The room contained one small wooden table, two straight-backed wooden chairs and several school desks. The table, with straight-backed chairs arranged on opposite sides, was positioned in front of the one-way mirror. The experimenter always occupied the chair facing the mirror. The subject occupied the opposite chair. On the table were a stack of paper napkins, a stack of paper

cups, a pitcher of water, a stopwatch and a large plastic baggie which contained five smaller baggies. Each small baggie contained a pair of preweighed dental rolls. The stopwatch was used to time salivation trials, intertrial intervals, latency to start eating and meal duration. Additional experimental materials included a placemat, a sanitizing spray cleaner and extra cups and napkins which were stored on a school desk beside the experimenter's chair.

Pizza slices were individually heated in a toaster oven in a room on the opposite side of the building. Slices were carried to the experimental room on a covered tray. Each pizza slice was approximately one-eighth of a 17-inch cheese pizza. Pizzas were prepared by Casa di Pizza of Bluefield, West Virginia. The sauce of the pizza was the regular sauce used in the restaurant or that sauce adulterated with .033 grams of quinine sulfate per ounce (Nisbett, 1968; Woody, et al., 1981). The regular sauce consisted of a concentrate diluted with water. The adulterated sauce was identical to the regular sauce except that a premeasured amount of quinine sulfate was dissolved in the water before it was added to the concentrate. All pizzas were prepared by the cooks in the restaurant. Pizza slices were individually wrapped in celephane and refrigerated until they were warmed prior to

being served.

The following steps were taken to ensure that the experimenter was blind to the Phase 1 and Phase 2 pizza conditions: (1) adulterated and regular types of pizza were both served on days 1 and 2; (2) subjects were scheduled by identification number only; and (3) pizza slices were individually labeled with identification numbers one day prior to presentation.

Procedure

On day 1, the experimenter welcomed the subject at the experimental room, explained the purpose of the study, and gave the subject instructions on the use of the dental rolls (Form 2A). The subject then read and signed the Informed Consent Form (Form 3A). On each day of the experiment, the sequence of events were: four salivation trials (practice, baseline, thought, presentation), pizza access, a fifth salivation trial (post-ingestion), and completion of the Eating Habits Questionnaire (Form 4A).

On each day, while the subject drank a cup of water to hydrate and clean his mouth, the experimenter went to place the appropriately labeled pizza slice into the toaster oven. After the experimenter returned to the experimental room, the subject was asked to provide measures of salivation on the practice and baseline trials. Prior to the thought trial, the experimenter placed the

placemat, with a folded napkin on it, in front of the subject. The subject was told that a slice of cheese pizza from a local restaurant had been placed in an oven to warm, and would be ready to eat as soon as he provided the next measure of salivation. The experimenter then asked the subject to think about eating that slice of pizza. Once the dental rolls were in place for the measure of salivation on the thought trial, the experimenter reminded the subject to think about eating the pizza. After the subject had removed the dental rolls from his mouth, the experimenter went to get the pizza slice.

The pizza slice, on a paper plate, was placed in front of the subject. The subject then provided a measure of salivation on the presentation trial. While the subject removed the dental rolls from his mouth, the experimenter poured a cup of water and informed the subject that he could eat as much pizza as he wanted, that the experimenter would be outside in the hallway, and that the subject should open the door of the room to signal that he had finished eating. The experimenter then surreptitiously started the stopwatch, left the room and closed the door, stepped into the adjacent room and observed the subject through the one-way mirror. When the subject took the first bite of pizza, the experimenter stopped the stopwatch and recorded the measure of latency to start eating. The

experimenter immediately restarted the stopwatch and continued to observe the subject. When the subject opened the door to the experimental room, the experimenter stopped the stopwatch and recorded the measure of meal duration.

Upon re-entering the experimental room, the experimenter removed the remaining pizza, paper plate and placemat from the table. The subject then provided the measure of salivation on the post-ingestion trial. After the dental rolls had been removed from the subject's mouth the experimenter asked the subject about his eating behavior prior to attending the session, and recorded his responses.

Prior to leaving the experimental room, on days 1 and 2, the subject was told that cheese pizza would be served in the following session. The subject was asked to refrain from eating pizza between sessions.

After completion of the session on day 3, the subject was asked to rate his preference for the taste, appearance and aroma of each of the pizza slices which he had received (Form 5A). The subject then provided an address so that a letter of full disclosure could be mailed after all subjects had completed the experiment (Form 6A). The experimenter thanked the subject and gave him the extra credit slip to give to his psychology class instructor.

Measures

Salivation was measured using a modified Strong-Hensie-Peck technique (Peck, 1959). The subject was asked to drink a cup (approximately 5 ounces) of water to hydrate and clean his mouth. The subject removed a pair of 1.5 inch preweighed dental rolls from a baggie labeled to indicate the order and purpose of use ("P" for practice, "B" for baseline, "T" for thought, "Pres" for presentation and "PI" for post-ingestion). He placed one dental roll bilaterally between the cheek and gum on either side of the mouth. The experimenter instructed the subject to tilt his head forward and to refrain from moving his mouth or swallowing. The experimenter then timed 1.5 minutes, and instructed the subject to remove the dental rolls and reseal them in the baggie. Following removal of the second dental roll, the experimenter timed a 1.5 minute intertrial interval. During that time, the experimenter engaged the subject in light conversation. Prior to each subsequent trial the subject drank a small amount of water. All baggies of dental rolls were weighed to the nearest .0001 gram within one hour before and after each mealtime block of sessions on each day. To minimize the influence of individual differences in salivation responding, baseline salivation measures were subtracted from the measures on the thought, presentation and post-ingestion trials.

In each session, additional measures were latency to start eating (seconds), meal duration (seconds), and amount eaten (grams). Amount eaten was calculated by subtracting the weight of the uneaten pizza from the preweight.

On each day, a rate of eating (grams/second) index was calculated by dividing amount eaten by meal duration (Hill & McCutcheon, 1984).

On day 3, preference ratings of the taste, aroma and appearance of the pizza slices were each made on a Likert-type, 7-point scale.

Data Analyses

The salivation data were analysed with 2 (Phase 1 pizza conditions) x 2 (Phase 2 pizza conditions) x 3 (Days) Analysis of Variance (ANOVA) procedures. Latency to start eating, meal duration and rate of eating measures over days 1 and 2 were analysed by 2 (Phase 1 pizza conditions) x 2 (Phase 2 pizza conditions) x 2 (Days) ANOVA. The day 3 data, and the preference ratings data were analysed by 2 (Phase 1 pizza conditions) by 2 (Phase 2 pizza conditions) ANOVA. Tukey's Studentized Range Tests were used to make all pairwise comparisons. Pearson Correlation Coefficients were calculated between measures of salivary response on the presentation trial and latency to start eating. Pearson Correlation Coefficients were also calculated between measures of salivary response on the presentation

trial and amount eaten on day 2 for the group which received regular pizza conditions in Phases 1 and 2, and for the group which received adulterated pizza conditions in Phases 1 and 2. The alpha level for all analyses was .05.

Results

Salivation

Baseline Trial: Figure 1B (Appendix B) shows mean salivation and Table 1B lists the standard deviations of the means on the baseline trial on days 1, 2 and 3 for groups AA, AR, RR and RA which received adulterated (A) and regular (R) pizza over Phases 1 and 2. Measures were highly similar over days. Analysis of Variance (ANOVA) of the baseline trial over days 1, 2 and 3 yielded no reliable effects of Phase 1 (Ph1) or Phase 2 (Ph2) pizza conditions, or Day (Table 1C, Appendix C).

Thought and Presentation Trials: To minimize the influence of individual differences in salivation responding, the measures of salivation on the thought and presentation trials were transformed to difference scores by subtracting each of them by baseline salivation. These difference scores represent salivary responses relative to baseline. Table 2B lists the mean (M) and standard deviation (SD) of salivary responses on the thought (T) and presentation (P) trials of each day for groups AA, AR, RR and RA which received adulterated (A) and regular (R) pizza over Phases 1 and 2. Grand means for each trial on each day are presented at the bottom of the table. Grand means show that on each day, salivary responses were greater on presentation trials than on thought trials.

However, closer inspection of the group means on days 2 and 3 suggests that differences between thought and presentation responses depended on the pizza condition of the preceding phase. For example, on day 2 the difference in salivary responding between thought and presentation trials was greater for groups which had received regular pizza in Phase 1, than for those which had received adulterated pizza in Phase 1.

Figure 2B shows mean salivary responses on day 2 for thought and presentation trials for groups which received adulterated (A) and regular (R) pizza conditions across Phases 1 and 2. Groups which had received regular pizza in Phase 1 showed greater salivary responding on presentation trials than on thought trials. Groups which had received adulterated pizza in Phase 1 showed minimal differences in salivation between these trials. ANOVA of these data yielded reliable effects for Trial and Ph1 x Trial (Table 2C). Simple effects ANOVAs for each Ph1 pizza condition showed that groups which had received regular pizza in Ph1 yielded reliable effects for Trial (Table 3C). (This ANOVA also yielded spurious effects for Ph2). Groups which had received adulterated pizza in Ph1 yielded no reliable effects for trial (Table 4C).

Figure 3B shows mean amount salivated and Table 3B lists the standard deviations of the means on day 2 for

thought and presentation trials for groups which received adulterated (A) and regular (R) pizza conditions across Phases 1 and 2. The figure reveals results very similar to those provided by figure 2B. ANOVA of these data yielded the same conclusions as that of the salivary response data (Table 5C).

Figure 4B shows mean salivary responses on day 3 for thought and presentation trials for groups which received adulterated (A) and regular (R) pizza conditions across Phases 1 and 2. Responses on presentation trials were generally greater than those on thought trials. Groups which had received regular pizza in Phase 1 showed greater salivary responses on both trials than did groups which had received adulterated pizza in Phase 1. On presentation trials, salivation was also influenced by the Phase 2 pizza condition. The group which had received regular pizza in Phases 1 and 2 showed a greater salivary response than did the group which had received regular pizza in Phase 1 and adulterated pizza in Phase 2. Similarly, the group which had received adulterated pizza in Phases 1 and 2 showed a greater salivary response than did the group which had received adulterated pizza in Phase 1 and regular pizza in Phase 2. These data suggest that a shift in pizza conditions over Phases 1 and 2 (RA and AR groups) decreased salivary responding relative to that for nonshift

conditions (RR and AA groups). Conversely, on thought trials, salivary responding was greater for shift groups than for nonshift groups. These differences were smaller than those on presentation trials, however.

ANOVA of the Figure 4B data yielded reliable effects for Trial and Ph1 x Ph2 x Trial (Table 6C). Simple effects ANOVAs for each Ph1 pizza condition (Tables 7C & 8C) and each Ph2 pizza condition (Tables 9C & 10C) yielded reliable effects for thought verses presentation trial. However, ANOVAs for thought or for presentation trial alone failed to yield any reliable effects (Tables 11C & 12C). These findings were suspicious considering Figure 4B results. They may have resulted because the ANOVAs for each trial employed the error term generated by the data of the trial, and these error terms differed reliably ($p < .05$). Thus, a subsequent ANOVA for each trial employed an error term based on that of the overall ANOVA (Winer, 1962). ANOVA of the data on the presentation trial yielded a reliable effect for Ph1, although no reliable Ph1 x Ph2 interaction was found (Table 13C). The thought trial data yielded no reliable effects (Table 14C).

Figure 5B shows mean amount salivated and Table 4B lists the standard deviations of the means on day 3 for thought and presentation trials for groups which received adulterated (A) and regular (R) pizza conditions across

Phases 1 and 2. The figure reveals results similar to those in Figure 4B. ANOVA of these data yielded the same conclusions as that of the salivary response data (Table 15C).

Analysis of the salivation data by day were justified by the results of the ANOVA over the data of all days. ANOVA of the salivary response data over days 1, 2 and 3 yielded reliable effects for Trial, Ph1 x Ph2 x Trial and Ph2 x Day (Table 16C). ANOVA of the amount salivated data over days 1, 2 and 3 yielded reliable effects for Trial and Ph1 x Ph2 x Trial (Table 17C).

Post-Ingestion Trial: Mean salivary response on the post-ingestion trial was relatively uniform over days 1, 2 and 3. ANOVA of these data yielded no reliable effects for Ph1, Ph2 or Day (Table 18C).

Latency to Start Eating

Figure 6B shows mean latency to start eating and Table 5B lists the standard deviations of the means on days 1, 2 and 3 for groups AA, AR, RR and RA which received adulterated (A) and regular (R) pizza over Phases 1 and 2. Latencies were highly similar across groups over days. ANOVA over days 1, 2 and 3 yielded no reliable effects for Ph1, Ph2 or Day (Table 19C).

To examine the relation between latency to start eating and salivary response on the presentation trial,

Pearson Correlation Coefficients were calculated between these measures. Reliable correlations between a measure of oral acceptance (latency to start eating) and salivary response would lend additional support to the idea that the salivary response relates to ingestive behavior. Table 20C lists the correlations obtained for each day. No reliable correlations were found.

Amount Eaten

Figure 7B shows mean amount eaten and Table 6B lists the standard deviations of the means on days 1, 2 and 3 for groups AA, AR, RR and RA which received adulterated (A) and regular (R) pizza over Phases 1 and 2. On day 1, amount eaten was greater for groups which received regular pizza than for groups which received adulterated pizza (Table 21C). On day 2, amount eaten was again greater for groups which received regular pizza than for groups which received adulterated pizza. However, for Group AR the shift from adulterated pizza in Phase 1 to regular pizza in Phase 2 yielded greater intake than that for Group RR. Conversely, for Group RA the shift from regular pizza in Phase 1 to adulterated pizza in Phase 2 yielded less intake than that for Group AA. These data appear to show evidence for positive and negative contrast effects (Flaherty, 1982). ANOVA of the day 2 data revealed a reliable effect for Ph2 pizza condition, but, no reliable

effects for Ph1 or Ph1 x Ph2 (Table 22C). The latter would have been evidence for contrast effects. Failure of this analysis to reveal reliable effects for Ph1 or Ph1 x Ph2 (See Figure 7B) may have been due to a high degree of variability in the data. To minimize this possibility, the amount eaten data were transformed to logarithms (base 10). ANOVA of these data also failed to yield reliable effects of Ph1 or Ph1 x Ph2 (Table 23C).

Analyses of the amount eaten data by day were justified by the results of the ANOVA over days 1 and 2. This ANOVA yielded reliable effects for Ph2, Ph1 x Day and Ph2 x Day (Table 24C).

On day 3, intake was very similar across groups. ANOVA of the amount eaten data on day 3 yielded no reliable effects for Ph1 or Ph2 (Table 25C).

Pearson Correlation Coefficients were calculated between measures of amount eaten and salivary responses on the presentation trial for groups RR and AA on day 2. Reliable correlations between a measure of ingestion (amount eaten) and salivary response would lend support to the idea that salivary responding relates to ingestive behavior. Neither the correlation for Group AA ($r = 0.57$) or for Group RR ($r = 0.38$) were reliable.

Meal Duration

Figure 8B shows mean meal duration and Table 7B lists

the standard deviations for the means on days 1, 2 and 3 for groups AA, AR, RR and RA. On days 1 and 2 meal duration was greater for groups which received regular pizza than for groups which received adulterated pizza. ANOVA over days 1 and 2 yielded reliable effects for Ph2 x Day (Table 26C). ANOVAs of the data for each day yielded a significant effect for Ph2 on day 2 (Table 27C), but no reliable effect for Ph1 pizza condition on day 1 (Table 28C).

On day 3, meal duration was similar across groups. ANOVA yielded no reliable effects for Ph1 or Ph2 (Table 29C).

Rate of Eating

Figure 9B shows the mean rate of eating (grams/second) and Table 8B lists the standard deviations of the means for groups AA, AR, RR and RA. On days 1 and 2 groups which received regular pizza showed a higher rate of eating than did groups which received adulterated pizza. On day 2, for groups RA and AR, rate of eating was influenced by the pizza condition of the previous phase. For Group AR, rate of eating regular pizza increased over that for Group RR which had received regular pizza in both phases. For Group RA, rate of eating adulterated pizza decreased below that for Group AA which had received adulterated pizza in both phases. ANOVA over days 1 and 2 yielded reliable

effects of Ph1 x Day and Ph2 x Day (Table 30C). ANOVA for each day yielded reliable effects for Ph1 pizza condition on day 1 (Table 31C), and for Ph2 pizza condition on day 2 (Table 32C). However, reliable interactions, which would indicate that prior pizza conditions influenced current ingestion, were not found.

On day 3 rate of eating was highly similar across groups. ANOVA of these data yielded no reliable effects for Ph1 or Ph2 (Table 33C).

Preference Ratings

To verify that adulteration techniques altered the taste, but not the appearance or aroma of the pizza slices, subjects, on day 3, rated their preferences for the taste, appearance and aroma of the pizza slices received over days 1, 2 and 3.

Taste: Figure 10B shows the mean preference and Table 9B lists the standard deviations of the means on days 1, 2 and 3 for groups AA, AR, RR and RA. On day 1 preferences were greater for groups which received regular pizza than for those which received adulterated pizza. ANOVA yielded reliable effects for Ph1 pizza condition (Table 34C). On day 2, preferences were again greater for groups which received regular pizza. However, Group AR which had received adulterated pizza in Phase 1 yielded a greater preference rating for regular pizza than

did Group RR. Conversely, Group RA, which received regular pizza in Phase 1, showed a lower preference for adulterated pizza than did Group AA. ANOVA of these data yielded reliable effects for Ph1 and Ph2, but no Ph1 x Ph2 interaction (Table 35C). ANOVA of the data over days 1 and 2 yielded reliable effects of Ph1, Ph2, Ph1 x Day and Ph2 x Day, but again no Ph1 x Ph2 interaction (Table 36C).

On day 3, preferences for taste of regular pizza were greater for groups which had received adulterated pizza in Phase 2 than for groups which had received regular pizza in Phase 2. ANOVA of these data yielded a reliable effect for Ph2 (Table 37C).

Aroma: Ratings of preference were highly similar across groups on each day. ANOVAs of these data by day yielded no reliable effects for Ph1 or Ph2 pizza condition (Tables 38C, 39C & 40C).

Appearance: Ratings of preference were highly similar across groups on each day. ANOVAs of these data by day yielded no reliable effects for Ph1 or Ph2 pizza conditions (Tables 41C, 42C & 43C).

Taken together, the ratings data reveal that the adulteration manipulation reliably altered the taste of the pizza, and did not reliably alter the appearance or aroma of the pizza slices.

Discussion

Results showed that the thought of pizza elicited salivary responses greater than baseline. Furthermore, the presentation of pizza elicited salivary responses greater than those to the thought of pizza. These findings confirmed those of Wooley and Wooley (1973) and White (1978). To be consistent with Wooley and Wooley (1973), the current study employed measures of salivary response to both the thought and presentation of pizza. Employment of both measures allowed for the examination of not only differences between the elicitory effects of a present verses non-present stimulus, but also examination of possible differential effects of the adulteration manipulation on the subtle salivary response to the thought of pizza and the more robust salivary response to the presentation.

The degree to which salivary responses on the presentation trial exceeded those on the thought trial depended on the pizza condition received in the previous session. In session two, groups which had received regular pizza in session one showed reliably greater salivary response on the presentation trial than on the thought trial. Groups which had received adulterated pizza in the previous session showed no reliable differences in salivary responding between trials. In session three,

nonshift groups, which had received the same pizza condition over the two previous sessions, showed a reliably greater difference in salivary responding between thought and presentation trials, than did shift groups, which had received two different pizza conditions over the two previous sessions. These data seem consistent with an approach-avoidance conflict model of behavior (Miller, 1959).

The approach-avoidance model was used to formulate Hypothesis 2. The original interpretation of this model was that the adulterated pizza condition would be aversive and the regular pizza condition would be appetitive. Thus, if the consummatory behavior elicited by the pizza condition in session one became established to the experimental setting, then subsequent presentation of pizza, within the experimental setting, would elicit avoidance and approach tendencies, respectively. The strength of the tendencies would be evidenced by the strength of the salivary response. Furthermore, a shift in pizza conditions from regular or adulterated in session one to the alternative in session two would produce a conflict between approach and avoidance tendencies and impair salivary responding in session three. Therefore, the level of salivary responses for the shift groups would be similar to or below those for the group which had

received adulterated pizza in sessions one and two.

However, this interpretation of the approach-avoidance model had not considered the complexity of the pizza stimulus. As a stimulus, pizza has not only taste characteristics, but appearance and aroma characteristics as well. Perhaps, for the adulterated pizza, the appearance and aroma characteristics would evoke approach tendencies based on past experience; and the adulterated taste would evoke avoidance tendencies, based on the experimental situation. Thus, the adulterated pizza condition, per se, may occasion an approach-avoidance conflict, rather than simply elicitate avoidance as originally assumed. Consequently, two sources of conflict may be operative in this study. One source may be provided by the adulterated pizza condition, and another source provided by a shift in pizza conditions between adulterated and regular pizza over sessions one and two.

The salivary response data seemed consistent with the idea of two sources of conflict. In session two, the groups which had received regular pizza in session one showed approach tendencies as evidenced by increases in salivary responses relative to those for the groups which had received adulterated pizza in session one. The smaller salivary responses for the latter groups suggested the occurrence of avoidance tendencies or

approach-avoidance conflict. However, the session three data revealed that the group which had received adulterated pizza in sessions one and two increased salivary responding to the level of the group which had received only regular pizza in the previous sessions. These data suggested that repeated presentation of the adulterated pizza may have reduced conflict and increased approach tendencies (salivation) in session three for the AA group. Kaufman and Miller (1949) reported that in approach-avoidance situations, repeated presentation of the conflict situation reduced conflict behavior and increased approach tendencies.

The shift groups showed minimal differences between the thought and presentation trial responses in session three. These depressed salivary responses suggest that the shift may have provided a source of conflict which impaired responding. That is, for groups AR and RA, the thought and presentation of pizza on day 3 may have evoked conflict which was based not only on approach tendencies toward the appearance and aroma of the pizza and avoidance tendencies toward the adulterated taste, but conflict based on approach tendencies toward the regular pizza condition and avoidance tendencies toward the adulterated pizza condition as well.

For the amount eaten data, results showed that in

sessions one and two, amount eaten was reliably greater for groups which received regular pizza than for groups which received adulterated pizza. A shift from regular to adulterated pizza conditions from session one to two yielded less intake of adulterated pizza in session two, than that for the group which had received adulterated pizza in session one. A shift from adulterated to regular pizza conditions over sessions one and two yielded greater intake of regular pizza in session two, than that for the group which had received regular pizza in session one. A shift from adulterated to regular pizza over sessions two and three also yielded greater intake of regular pizza in session three than that for groups which had received regular pizza in session two. Unfortunately, none of these shift effects were reliable. They do, however, provide evidence of contrast effects and are consistent with an expectancy interpretation (Crespi, 1942).

The expectancy theory suggests that if the consummatory behavior elicited by the pizza condition in session one became established to the experimental situation, then subsequent thought and presentation of pizza within the experimental situation may evoke an expectancy about the pizza's taste. A shift in pizza conditions over sessions may disconfirm these expectancies and, consequently, affect amount eaten. That is, a shift

from regular to adulterated pizza over sessions one and two may have augmented the aversive character of the adulterated pizza. Consequently, the amount consumed was less than that for the group which had received adulterated pizza in session one. This decrement in responding for the RA group below that of the nonshift AA group represents a negative contrast effect. A shift from adulterated pizza to regular pizza over sessions one and two may have enhanced the character of the regular pizza. Consequently, the amount consumed was greater than that for the group which had received regular pizza in session one. This increment in responding for the shift group above that of the nonshift RR group represents a positive contrast effect. Although the effects were not reliable, they were consistent with an expectancy analysis. Similarly, the meal duration, rate of eating and preference rating data also yielded suggestive evidence of contrast effects and provide further support for the preceding interpretation.

The effect of a shift in pizza conditions on amount eaten, meal duration and rate of eating was dependent on the order of the shift. A shift from adulterated to regular pizza increased responding, whereas a shift from regular to adulterated pizza decreased responding. Conversely, a shift in pizza conditions impaired salivary

responding to the thought and presentation of pizza regardless of the order of the shift. These differential effects of the order of experimental manipulations may reflect differences in the characteristics of these responses.

The salivary response is an anticipatory response to food which prepares the mouth for oral acceptance. This response is based largely on expectations of taste based on prior experiences with the food. The response occurs before the currently available food is tasted. Conversely, consummatory responses such as amount eaten, meal duration and rate of eating, are affected not only by previous experience with food, but once the food is tasted, are dependent on the taste of the immediately available food. The differential roles of experience (previous vs. current) on anticipatory and consummatory responses suggest that although these responses participate within a single behavioral category, eating behaviors, they may not necessarily be as closely related as one might expect.

Failure to find reliable positive correlations between measures of salivary responding and amount eaten, in this study, and by Klajner, et al. (1981), may reflect inherent differences in the responses. That is, the salivary response is anticipatory and dependent on

previous experience with the food. Amount eaten is a consummatory response and dependent upon the taste of the immediately available food. Although prior experience with a food may influence whether or not a food is tasted, and thus, be related to the anticipatory response of salivation, once the food is tasted, subsequent consummatory responding is dependent on the currently available food's taste.

Unfortunately, this logic was not supported by the correlational data between the measures of salivary responding and latency to start eating. Although salivary responding and latency to start eating both appear to be anticipatory responses to the sight of food, no reliable correlations between these responses were found. This lack of reliable correlation may not necessarily indicate differences in the response indices, but may reflect problems in measurement.

Measurement of salivary responses on the presentation trial may have been underestimated. In the current study, subjects were told at the time they signed up for participation in the study that they would receive something to eat during each 30 minute mealtime session. This information may have predisposed salivary responding in the experimental session per se, and affected the baseline performance. In the experimental situation the instruction to think about eating pizza may not have

augumented salivation above baseline levels because these instructions may have been redundant to those given the subject during recruitment. Thus, the baseline levels obtained may have been inflated and, therefore, not reliably different from those obtained on the thought trial. As a consequence of the inflated baseline, actual increases in salivation to the presentation of pizza may have been disguised, and correlations between measures of salivary responding and latency to start eating diluted.

On the other hand, the definition of latency to start eating may have been too broad. Latency was defined as the time interval between the experimenter's instructions to the subject and the subject taking the first bite of pizza. Although all groups initiated eating within 20 seconds, some subjects drank water, coughed, blew their noses, placed napkins on their laps or prayed prior to picking up the pizza slice. A narrower measure of latency to start eating seems necessary to eliminate the opportunity for extraneous responses. A better definition of latency might be from the time the subject physically contacts the pizza until the subject takes the first bite. Refinement of the definition may yield group differences and enhance correlations between the measures of latency to start eating and salivary responding.

Future Research

Future research should examine the establishment of an avoidance response to a food. The levels of quinine sulfate used in the present study were the same as those used by Nisbett (1968). Nisbett reported that amount eaten was reduced, but eating behavior occurred. The present study revealed that approach responses toward adulterated pizza were weaker than those toward regular pizza, but anticipatory salivary responses and eating behavior occurred. Wooley and Wooley (1973), and Klajner, et al. (1981) demonstrated that no salivary or eating responses occurred to food which had been visually adulterated but which still maintained a strong resemblance to normal. Based on these few studies, the appearance of a food appears to be a stronger elicitor of avoidance behavior than expectations of taste. However, examination of the extent to which a preferred food's taste has to be adulterated to become aversive may yield insight into what aspects of food in naturally occurring situations might lead to avoidance behavior.

In the present study, the highly preferred food, pizza, was adulterated. The persistent approach behavior may have resulted from the vast prior history the subject had with pizza. If the subject's entire history with a food could be examined, then the development of approach and avoidance

responses could be extensively studied. Novel foods could be employed to establish preferences. Once preferences became established, the novel food could be adulterated with quinine sulfate. The number of presentations of the novel food prior to adulteration could be varied to determine the effects on the strength of the expectancy of taste as measured by salivary responses to the presentation of the food. The adulterated food could also be repeatedly presented to determine the number of trials required to decrease avoidance tendencies and establish a preference for the adulterated taste. The amount of quinine sulfate used to manipulate the taste of the food could be varied so that the extent to which a preferred food's taste has to be adulterated to become aversive could be examined.

References

Baker, J. B. E. (1960). The effects of drugs on the foetus. Pharmacological Review, 12, 37-90.

Berridge, K. C. & Grill, H. J. (1984). Isohedonic tastes support a two-dimensional hypothesis of palatability. Appetite, 5, 221-231.

Black, R. W. (1968). Shifts in magnitude of reward and contrast effects in instrumental and selective learing: A reinterpretation. Psychological Review, 75, 114-126.

Blundell, J. E. & Freeman, D. G. (1981). Sensitivity of Stimulus-Induced-Salivation (SIS), hunger ratings and alliesthesia to a glucose load: SIS as a measure of specific satiation. Appetite, 2, 373-375.

Bolles, R. C. (1980). Historical Note on the Term "Appetite". Appetite, 1, 3-6.

Booth, D. A. (1978). First steps toward an integrated quantitative approach to human feeding and obesity, with some implications for research into treatment. In G. A. Bray (ED.), Recent Advances in Obesity Research II (pp. 54-65). London: Newman.

Booth, D. A. & Fuller, J. (1981). Salivation as a measure of appetite: a sensitivity issue. Appetite, 2, 370-372.

Cannon, D. S. & Baker, T. B. (1981). Emetic and electric shock alcohol aversion therapy: assessment of

conditioning. J. consult. clin. Psychol., 49, 20-23.

Christensen, C. M. & Navazesh, M. (1984). Anticipatory salivary flow to the sight of different foods. Appetite, 5, 307-315.

Crespi, L. P. (1942). Quantitative variation in incentive and performance in the white rat. American Journal of Psychology, 55, 467-517.

Domjan, M. (1980). Ingestional aversion learning: unique and general processes. In Rosenblatt, et al. (Eds.), Advances in the study of behavior. New York: Academic Press.

Durrant, M. (1981). Salivation: a useful research tool? Appetite, 2, 362-365.

Flaherty, C. F. (1982). Incentive contrast: A review of behavioral changes following shifts in reward. Animal Learning & Behavior, 10 (4), 409-440.

Garcia, J. & Koelling, R. A. (1966). Relation of cue to consequence in avoidance learning. Psychonom. Sci., 4, 123-124.

Grinker, J. A. (1975). Obesity and taste: sensory and cognitive factors in food intake. In Bray, et al. (Eds.), Obesity in perspective (Vol. 2, pp. 73-80). Washington, D. C.: DHEW.

Guy-Grand, B. & Goga, H. (1981). Conditioned salivation in obese subjects with different weight kinetics.

Appetite, 2, 351-355.

Hill, S. W. (1974). Eating responses of humans during dinner meals. Journal of Comparative and Physiological Psychology, 80, No. 1, 652-657.

Hill, A. J., Magson, L. D. & Blundell, J. E. (1984). Hunger and palatability: Tracking ratings of subjective experience before, during and after the consumption of preferred and less preferred food. Appetite, 5, 361-371.

Hill, S. W. & McCutcheon, B. (1975). Eating Responses of obese and nonobese humans during dinner meals. Psychosomatic Medicine, 37, No. 5, 395-401.

Hill, S. W. & McCutcheon, N. B. (1984). Contributions of obesity, gender, hunger, food preference, and body size to bite size, bite speed, and rate of eating. Appetite, 5, 73-83.

Kaufman, E. L. & Miller, N. E. (1949). Effect of number of reinforcements on strength of approach in an approach-avoidance conflict. Journal of Comparative and Physiological Psychology, 42, 65-74.

Keeton, W. T. (1973). Elements of Biological Science, p. 113. New York: Norton.

Klajner, F., Herman, C. P., Polivy, J. & Chhabra, R. (1981). Human obesity, dieting and anticipatory salivation to food. Physiology and Behavior, 27,

195-198.

Le Magnen, J. (1978). Metabolically driven and learned feeding responses in man. In G. A. Bray (Ed.), Recent Advances in Obesity Research II (pp. 45-53). London: Newman.

Logue, A. W., Ophir, I. & Straus, K. E. (1981). The acquisition of taste aversions in humans. Behavioral Response Therapy, 19, 319-333.

McKenna, R. J. (1972). Some effects of anxiety level and food cues on the eating behavior of obese and normal subjects: a comparison of the Schacterian and psychosomatic conceptions. Journal of Personality and Social Psychology, 22, 311-319.

Miller, N. E. (1959). Liberalization of basic S-R concepts: Extensions to conflict behavior, motivation, and social learning. In S. Koch (Ed.), Psychology: A study of a science. Vol. 2, pp. 196-293. New York: McGraw-Hill.

Nirenberg, T. D. & Miller, P. M. (1982). Salivation: an assessment of food craving? Behavioral Response Therapy, 20, 405-407.

Nisbett, R. E. (1968). Taste, deprivation, and weight determinants of eating behavior. Journal of Personality and Social Psychology, 10, No. 2, 107-116.

Peck, R. E. (1959). The S. H. P. Test: An aid in the

detection and measurement of depression. Archives of General Psychiatry, 1, 25-40.

Pelchat, M. L. & Rozin, P. (1982). The special role of nausea in the acquisition of food dislikes by humans. Appetite, 3, 341-351.

Price, J. M. & Grinker, J. (1973). Effects of degree of obesity, food deprivation and palatability on eating behavior of humans. Journal of Comparative and Physiological Psychology, 85, 265-271.

Rodin, J. (1975). Effects of obesity and set point on taste responsiveness and ingestion in humans. Journal of Comparative and Physiological Psychology, 89, 1002-1009.

Rodin, J., Slochower, J. & Fleming, B. (1977). Effects of degree of obesity, age of onset, and weight loss on responsiveness to sensory and external stimuli. Journal of Comparative and Physiological Psychology, 91, 586-597.

Rolls, B. J., Van Duijvenvoorde, P. M. & Rolls, E. T. (1984). Pleasantness changes and food intake in a varied four-course meal. Appetite, 5, 337-348.

Rosen, J. C. (1981). Effects of low-calorie dieting and exposure to diet-prohibited food on appetite and anxiety. Appetite, 2, 366-369.

Skinner, B. F. (1972). Cumulative Record. 3rd Ed. New

York: Appleton.

Spitzer, L. & Rodin, J. (1981). Human eating behavior: a critical review of studies in normal weight and overweight individuals. Appetite, 2, 293-329.

White, K. D. (1978). Salivation: The significance of imagery in its voluntary control. Psychophysiology, 15, No. 3, 196-203.

Woody, E. Z., Costanzo, P. R., Liefer, H. & Conger, J. (1981). The effects of taste and caloric perceptions on the eating behavior of restrained and unrestrained subjects. Cognitive Therapy and Research, 5, No. 4, 381-390.

Wooley, S. C. & Wooley, O. W. (1973). Salivation to the sight and thought of food: A new measure of appetite. Psychosomatic Medicine, 35, No. 2, 136-142.

Wooley, O. W. & Wooley, S. C. (1981). Relationship of salivation in humans to deprivation, inhibition and the encephalization of hunger. Appetite, 2, 331-350.

Wooley, O. W., Wooley, S. C. & Dunham, R. B. (1976). Deprivation, expectation and threat: Effects on salivation in the obese and nonobese. Physiology and Behavior, 17, 187-193.

Wooley, O. W., Wooley, S. C. & Williams, B. S. (1976). In D. Novin, W. Wyrwicka & G. Bray (Eds.), Hunger: Basic mechanisms and clinical implications. New York:

Raven Press.

Appendix A

Form 1A.

LIFESTYLE QUESTIONNAIRE

Please indicate your answer to each of the following questions by filling in the appropriate circle on the opscan. Your thoughtful consideration of the questions and your cooperation are greatly appreciated.

1. Do you normally eat breakfast?
   1) YES 2) NO

2. If yes, at about what time do you usually eat?
   1) 5:00 - 6:00 a. m.
   2) 6:00 - 7:00 a. m.
   3) 7:00 - 8:00 a. m.
   4) 8:00 - 9:00 a. m.
   5) 9:00 - 10:00 a. m.
   6) 10:00 - 11:00 a. m.
   7) No set time

3. Do you normally eat lunch?
   1) YES 2) NO

4. If yes, at about what time do you usually eat?
   1) 11:00 a. m. - 12:00 noon
   2) 12:00 p. m. - 1:00 p. m.
   3) 1:00 p. m. - 2:00 p. m.
   4) 2:00 p. m. - 3:00 p. m.
   5) No set time

5. Do you normally eat dinner?
   1) YES 2) NO

6. If yes, at about what time do you usually eat?
   1) 3:00 - 4:00 p. m.
   2) 4:00 - 5:00 p. m.
   3) 5:00 - 6:00 p. m.
   4) 6:00 - 7:00 p. m.
   5) 7:00 - 8:00 p. m.
   6) 8:00 - 9:00 p. m.
   7) No set time

7. Do you normally eat a snack between breakfast and lunch?
   1) YES 2) NO

8. Do you normally eat a snack between lunch and dinner?
   1) YES 2) NO

9. Do you ever try foods that are unfamiliar to you?

   1) NEVER 2) RARELY 3) SOMETIMES 4) ALWAYS

10. Are you allergic to any foods?
    1) YES 2) NO

Form continues

Form 1A continued.

11. How conscious are you of what you are eating?

    1) NOT AT ALL 2) SLIGHTLY 3) MODERATELY 4) EXTREMELY

12. Are there any foods which you will not eat?
    1) YES 2) NO

13. Do you give too much time and thought to food?

    1) NEVER 2) RARELY 3) OFTEN 4) ALWAYS

On the scale below, please indicate your preference for each of the following food items.

DISLIKE EXTREMELY (1)	DISLIKE VERY MUCH (2)	DISLIKE SLIGHTLY (3)	INDIFFERENT (4)	LIKE SLIGHTLY (5)	LIKE VERY MUCH (6)	LIKE EXTREMELY (7)

14. Apples
15. Bread Sticks
16. Popcorn (without salt or butter)
17. Peanuts (unsalted)
18. Oreo Cookies
19. Cheese Doodles
20. Carrot Sticks
21. Grapes
22. Cheese Pizza
23. Peanut Butter on Bread or Crackers
24. Chocolate Chip Cookies
25. Potato Chips
26. Vanilla Wafers
27. Animal Crackers
28. Saltine Crackers (unsalted)
29. Saltine Crackers (salted)
30. Ritz Crackers
31. Doritos
32. Graham Crackers
33. Cheezits
34. Plain Doughnuts
35. Pretzels (unsalted)
36. Triscuits

Form continues

Form 1A continued.

On the scale below, please indicate how often you eat the following food items.

	DAILY (1)	2 or 3 TIMES A WEEK (2)	ONCE A WEEK (3)	TWICE A MONTH (4)	ONCE A MONTH (5)	ONCE EVERY TWO MONTHS (6)	TWICE A YEAR (7)	ONCE A YEAR (8)	NEVER (9)
37. Apples									
38. Bread Sticks									
39. Popcorn (without salt or butter)									
40. Peanuts (unsalted)									
41. Oreo Cookies									
42. Cheese Doodles									
43. Carrot Sticks									
44. Grapes									
45. Cheese Pizza									
46. Peanut Butter on Bread or Crackers									
47. Chocolate Chip Cookies									
48. Potato Chips									
49. Vanilla Wafers									
50. Animal Crackers									
51. Saltine Crackers (unsalted)									
52. Saltine Crackers (salted)									
53. Ritz Crackers									
54. Doritos									
55. Graham Crackers									
56. Cheezits									
57. Plain Doughnuts									
58. Pretzels (unsalted)									
59. Triscuits									

60. Are you currently taking any prescribed medication?
    1) YES 2) NO

61. Are you allergic to any medications?
    1) YES 2) NO

62. Do you smoke cigarettes?
    1) NOT AT ALL
    2) LESS THAN 5 CIGARETTES PER DAY
    3) 5 TO 10 CIGARETTES PER DAY (1/4 to 1/2 a pack)
    4) 11 TO 15 CIGARETTES PER DAY (1/2 to 3/4 a pack)
    5) 16 TO 20 CIGARETTES PER DAY (3/4 to 1 pack)
    6) MORE THAN 20 CIGARETTES PER DAY (more than 1 pack)

63. Do you have feelings of guilt after overeating?

    1) NEVER 2) RARELY 3) OFTEN 4) ALWAYS

Form continues

Form 1A continued.

64. What is the maximum amount of weight (lbs.) that you have ever lost within one month?
1) 0 - 4
2) 5 - 9
3) 10 - 14
4) 15 - 19
5) 20 +

65. What is your maximum weight gain (lbs.) within a week?
1) 0 - 1
2) 1.1 - 2
3) 2.1 - 3
4) 3.1 - 5
5) 5.1 +

66. In a typical week, how much does your weight (lbs.) fluctuate?
1) 0 - 1
2) 1.1 - 2
3) 2.1 - 3
4) 3.1 - 5
5) 5.1 +

67. In a typical month, how much does you weight (lbs.) fluctuate?
1) 0 - 1
2) 1.1 - 2
3) 2.1 - 3
4) 3.1 - 5
5) 5.1 +

68. In a typical 6 month period, how much does your weight (lbs.) fluctuate?
1) 0 - 1
2) 1.1 - 2
3) 2.1 - 3
4) 3.1 - 5
5) 5.1 +

69. Over the past 6 months, would you say you have

1) lost weight 2) maintained your weight 3) gained weight

70. How many pounds (lbs.) over your desired weight were you at your maximum weight?
1) 0 - 1
2) 1 - 5
3) 6 - 10
4) 11 - 20
5) 21 +

71. How often are you dieting?

1) NEVER 2) RARELY 3) SOMETIMES 4) OFTEN 5) ALWAYS

72. Are you currently dieting?
1) YES 2) NO

73. Were you on a diet in the past year?
1) YES 2) NO

Form continues

Form 1A continued.

74. If yes, during the past year, what's the most weight (lbs.) you lost by dieting?

1) 0 - 4
2) 5 - 9
3) 10 - 14
4) 15 - 19
5) 20 - 24
6) 25 - 29
7) 30 - 34
8) 35 - 39
9) 40 - 44

75. When you finished dieting, how much weight (lbs.) did you regain?

1) 0 - 5
2) 5.1 - 10
3) 10.1 - 15
4) 15.1 - 20
5) 20.1 - 25
6) 25.1 - 30
7) 30.1 - 35
8) 35.1 - 40
9) 40.1 - 45
10) 45.1 +

76. Do you eat sensibly in front of others and splurge when you're alone?

1) NEVER 2) RARELY 3) OFTEN 4) ALWAYS

77. Would a weight fluctuation of 5 lbs. affect the way you live your life?

1) NOT AT ALL 2) SLIGHTLY 3) MODERATELY 4) VERY MUCH

78. Would you like to be contacted so that you may earn additional Psychology 2000 extra credit points through participation in our other ongoing research?

1) YES 2) NO

79. Weight _____lbs. (As measured by experimenter at time questionnaire completed)

80. Height _____ft. _____in. (As measured by experimenter at time questionnaire completed)

Table 1A.

Mean (M) and Standard Deviation (SD) of Preference for and Frequency of Eating Cheese Pizza as Reported on the Prescreening Questionnaire for Groups AA, AR, RR and RA.

	Preference		Frequency	
Group	M	SD	M	SD
AA	6.10	(0.73)	3.55	(1.06)
AR	6.00	(0.81)	3.88	(1.10)
RR	6.44	(0.68)	4.55	(1.80)
RA	6.00	(0.81)	4.22	(2.34)

Form 2A.

Experimental Explanation and Instruction

"As you were told at the time you were recruited for participation in this study, the purpose of the study is to investigate the effects of appetite on salivation at mealtime. That is why you were asked to sign-up for the time slot which coincided with your regular mealtime. Dental rolls are used to measure salivation. There will be five salivation trials, and you will use two dental rolls for each trial. I'll hand you a baggie containing two dental rolls, you should remove the dental rolls and place one on each side of your mouth between the cheek and gum (gesture). During the 1.5 minute trial, you need to lean your head forward slightly, and try not to swallow or move your tongue or mouth. Then, when I tell you to remove the dental rolls, you should take the dental rolls out of your mouth and reseal them in the baggie. You will have an opportunity to practice this procedure before any actual measures are required. After the fourth salivation trial you will be given something to eat. After you have finished eating you will be asked to provide a final measure of salivation. Do you have any questions? Do you still want to participate?"

Form 3A.

INFORMED CONSENT

This study investigates salivary responses at regularly established meal times. You will be asked to provide measures of salivary response by putting two (2) dental rolls in your mouth. You will be given one slice of cheese pizza which you may or may not eat as you desire. You will also be asked to rate the palatability of the pizza on a rating scale.

There will be three (3) experimental sessions, each taking less than one hour of time. Your participation in this experiment will earn you three (3) credit points toward your credit point total in Introductory Psychology. You must attend all three (3) sessions to obtain any credit.

Your answers and responses will remain confidential. You may terminate participation at any time without penalty.

If you are willing to participate please read the following statement and sign below.

"I have read and understand the above information and instructions. I am willing to provide measures of salivation, and to complete the rating scale. I understand that I may be asked to taste some food, but that I may refuse to taste or eat the food. I also understand that I may cease participation in this study at any time without penalty."

Information about this study may be obtained from Dr. J. J. Franchina, Dept. of Psych., VPI & SU (Tel. 961-5664) or Dr. S. J. Zaccaro, Chairman of the Human Subjects Committee, Dept. of Psych., VPI & SU (Tel. 961-7916).

PRINT NAME	SIGNATURE
I. D. NUMBER	DATE

Form 4A.

Eating Habits Questionnaire

Subject ID Number _____

Time of day: _____

Date: _____

How long has it been since you ate? ----------

(if they haven't eaten today skip the rest of the questions)

When you ate, what did you have? ----------

Did you eat breakfast? ----------

When? ----------

What? ----------

(if they did eat breakfast then

Did you have a snack, or anything to drink after breakfast? -----

What? ----------

When? ----------

(If appropriate--think about what time it is now).

Did you eat lunch? ----------

What?----------

When?----------

After lunch did you have any snacks or anything to drink?--------

What?----------

When?----------

Did you have anything else to eat or drink today? ----------

What? ----------

When? ----------

Form 5A.

Subject ID Number:_____

PREFERENCE RATING SCALE

Dislike Extremely 1

Dislike very much 2

Dislike slightly 3

Indifferent 4

Like slightly 5

Like very much. 6

Like extremely. 7

	Appearance	Aroma	Taste
Monday	_____	_____	_____
Wednesday	_____	_____	_____
Friday	_____	_____	_____

Form 6A.

Dear Participant,

As per our conversation on the final day of your participation in the "Pizza Experiment" this letter is to explain fully the purpose and measurements obtained in the study.

Subjects were selected on the basis of information provided on the Lifestyle Questionnaire. Only males who indicated (a) a high preference for eating cheese pizza, (b) a frequency of eating pizza no more often than three times per week, and (c) no food allergies were recruited.

Only males were recruited because quinine sulfate was used to adulterate some of the pizza slices served. Quinine sulfate is a medicine used to treat malaria. This medicine in extreme doses is suspected to cause birth defects if administered very early in pregnancy. For this reason no women of childbearing age were allowed to participate in the study. The amounts of quinine sulfate in any slice of pizza are known to be innocuous (have no effect). The quinine sulfate was added to the pizza sauce at the restaurant prior to cooking. All pizzas were prepared at a restaurant in West Virginia.

The purpose of the study was to examine the effects of prior taste experience on subsequent measures of palatability. The measures of palatability were (a) salivation to the thought of pizza; (b) salivation to the presentation of pizza; (c) latency to start eating; and (d) amount eaten. Other measures obtained were meal duration and preference ratings of taste, appearance and aroma of the pizza slices. You were aware of all measures except the latency to start eating, meal duration and amount eaten measures. latency to start eating and meal duration measures were obtained by observation through the one-way mirror. Amount eaten was obtained by subtracting the amount of uneaten pizza from the pizza slice preweight.

Subjects were randomly assigned to one of four groups. One group received regular pizza on day 1 and adulterated pizza on day 2. One group received regular pizza on days 1 and 2. One group received adulterated pizza on day 1 and regular pizza on day 2. One group received adulterated pizza on days 1 and 2. Everyone received regular pizza on day 3. You can probably figure out the group to which you were assigned.

Thank you so much for your participation.

Appendix B

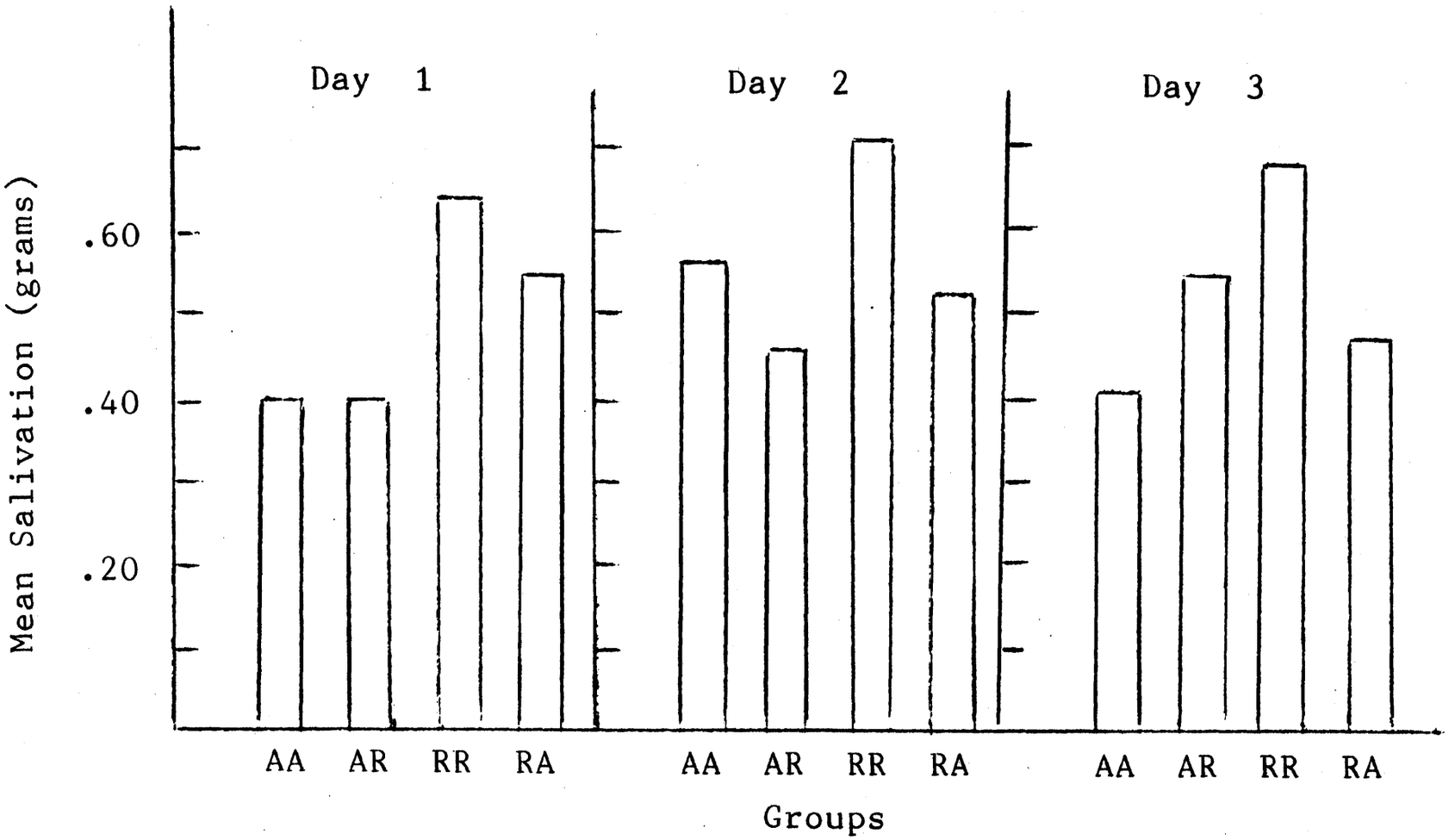

Figure 1B. Mean Salivation on the Baseline Trial on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Table 1B.

Standard Deviation of Salivation on the Baseline Trial on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Group	Day 1	Day 2	Day 3
AA	0.22	0.48	0.33
AR	0.23	0.28	0.54
RR	0.65	0.71	0.52
RA	0.52	0.41	0.41

Table 2B.

Mean (M), Standard Deviation (SD) and Grand Mean (GM) Salivary Response on the Thought (T) and Presentation (P) Trials on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

		Day 1		Day 2		Day 3	
Group		T	P	T	P	T	P
AA	M	0.09	0.27	0.03	0.08	0.01	0.31
	SD	0.17	0.38	0.14	0.20	0.53	0.59
AR	M	0.00	0.01	0.10	0.18	0.02	0.09
	SD	0.16	0.17	0.34	0.32	0.43	0.34
RR	M	0.06	0.20	-0.01	0.41	0.08	0.46
	SD	0.14	0.29	0.11	0.27	0.65	0.90
RA	M	0.13	0.16	-0.08	0.16	0.16	0.32
	SD	0.12	0.42	0.20	0.30	0.33	0.58
GM		0.07	0.16	0.01	0.21	0.07	0.30

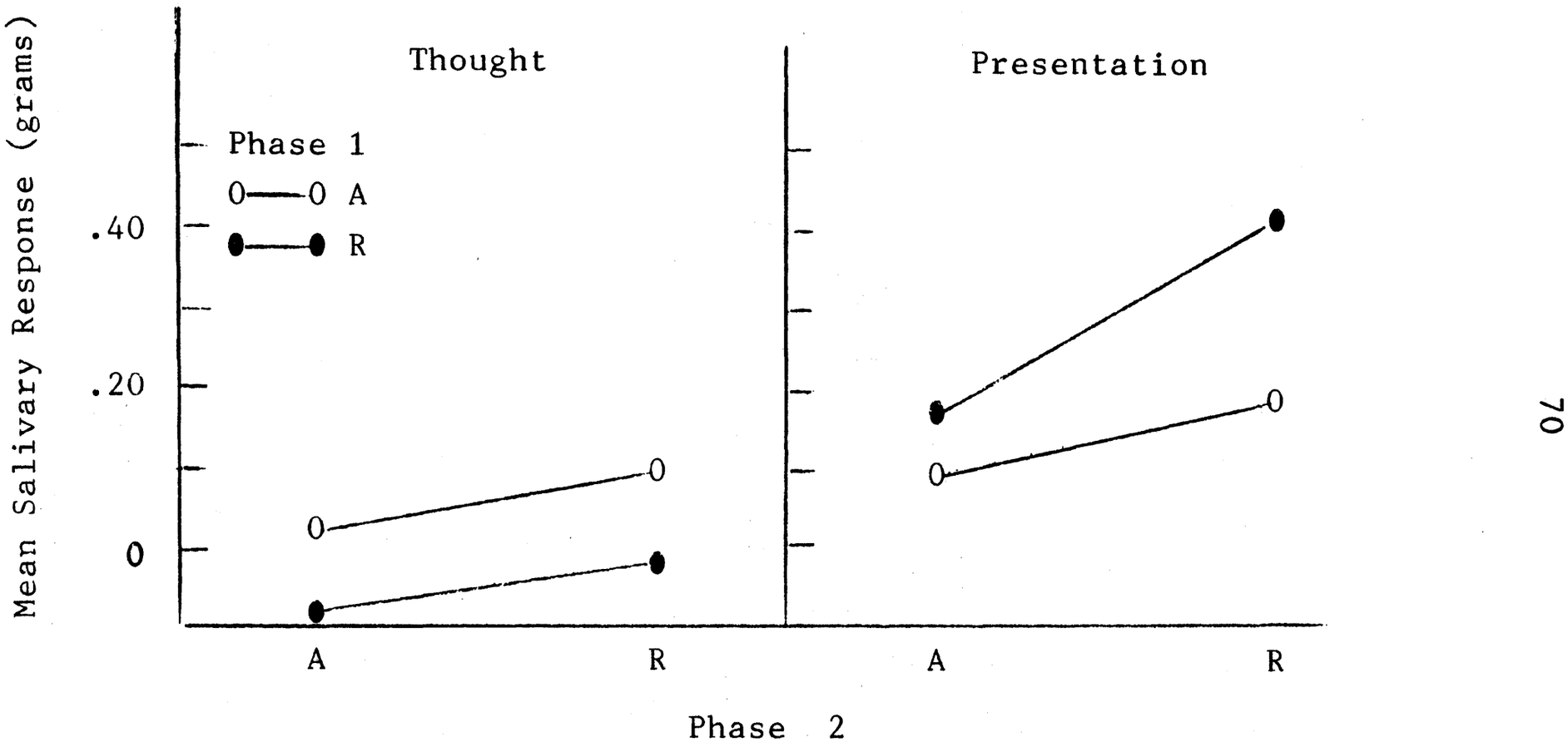

Figure 2B. Mean Salivary Response on Day 2 on Thought and Presentation Trials for Groups which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

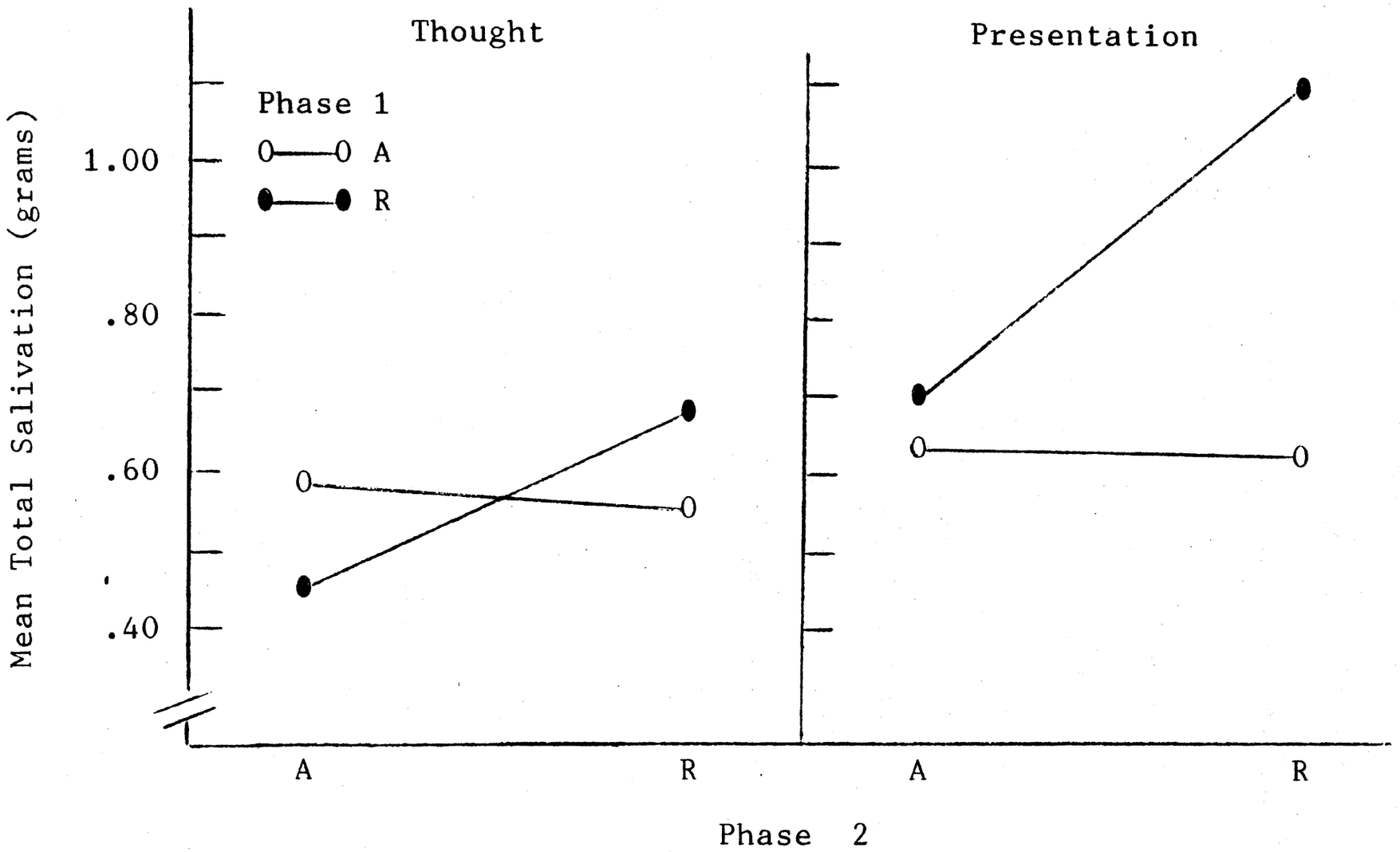

Figure 3B. Mean Amount Salivated on Day 2 on Thought and Presentation Trials for Groups which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Table 3B.

Standard Deviation of Amount Salivated on the Thought (T) and Presentation (P) Trials on Day 2 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Group	Trial	
	T	P
AA	0.53	0.59
AR	0.43	0.34
RR	0.65	0.90
RA	0.33	0.58

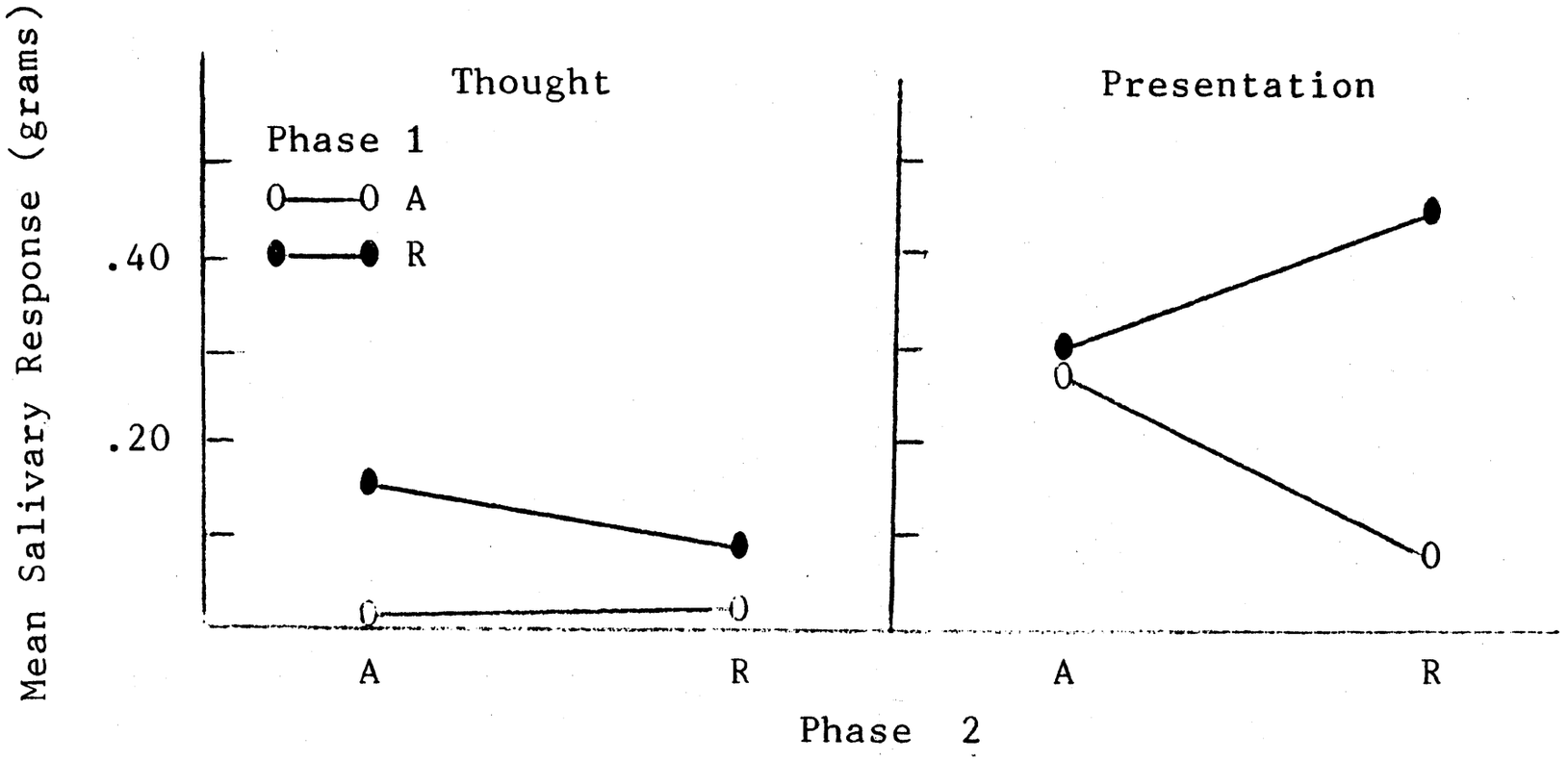

Figure 4B. Mean Salivary Response on Day 3 on Thought and Presentation Trials for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

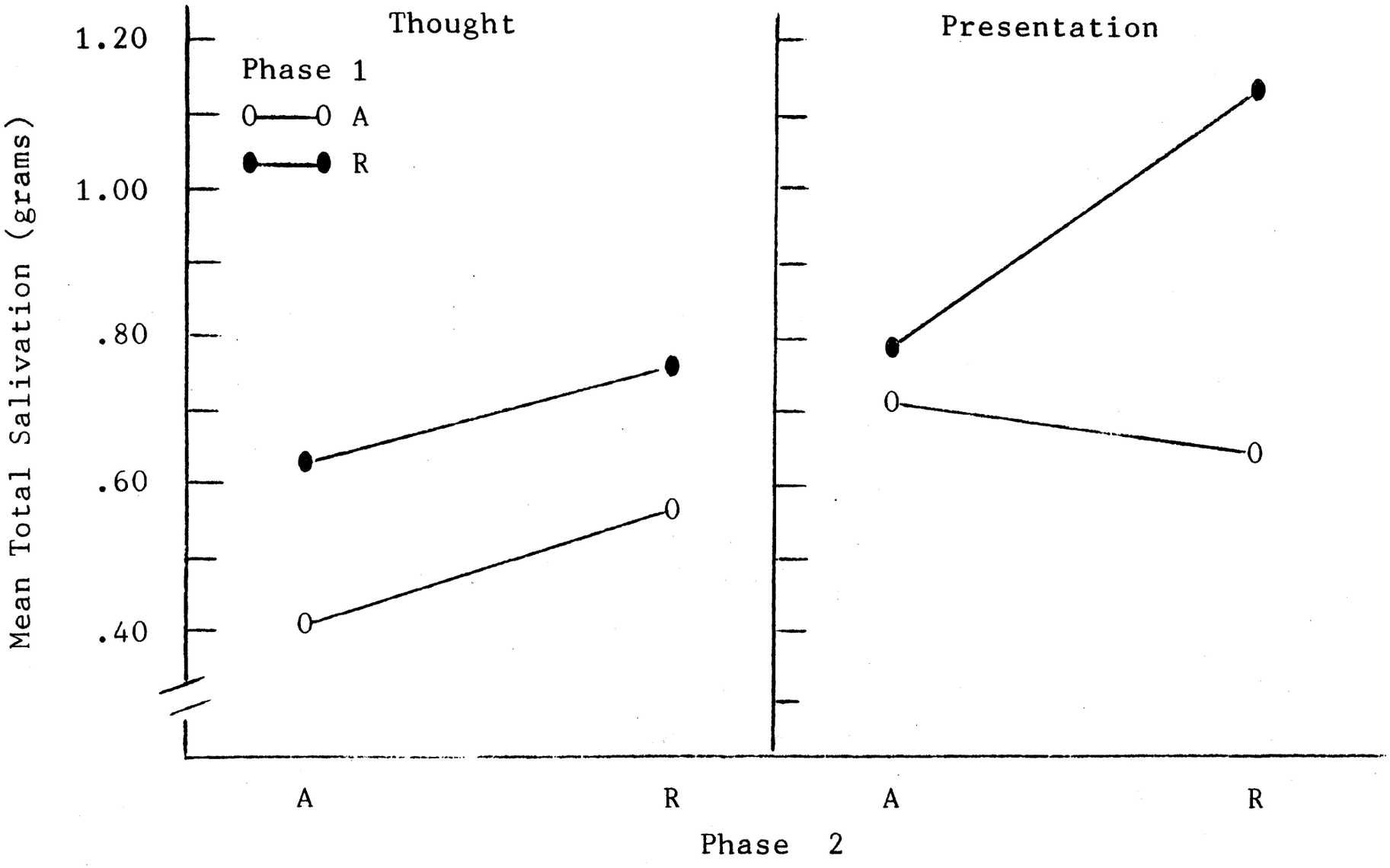

Figure 5B. Mean Amount Salivated on Day 3 on Thought and Presentation Trials for Groups which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Table 4B.

Standard Deviation of Amount Salivated on the Thought (T) and Presentation (P) Trials on Day 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Group	Trial	
	T	P
AA	0.22	0.49
AR	0.62	0.72
RR	0.57	0.86
AR	0.58	0.65

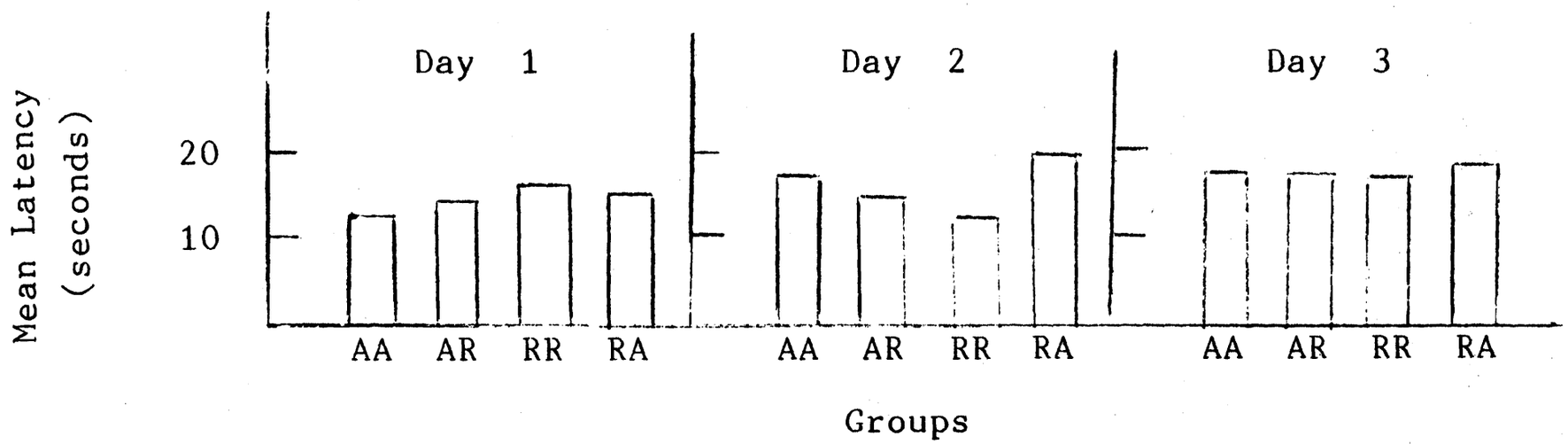

Figure 6B. Mean Latency to Start Eating on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Table 5B.

Standard Deviation of Latency to Start Eating on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Group	Day 1	Day 2	Day 3
AA	5.12	4.55	8.30
AR	7.95	6.84	7.63
RR	7.16	5.76	3.05.
RA	12.28	5.60	4.68

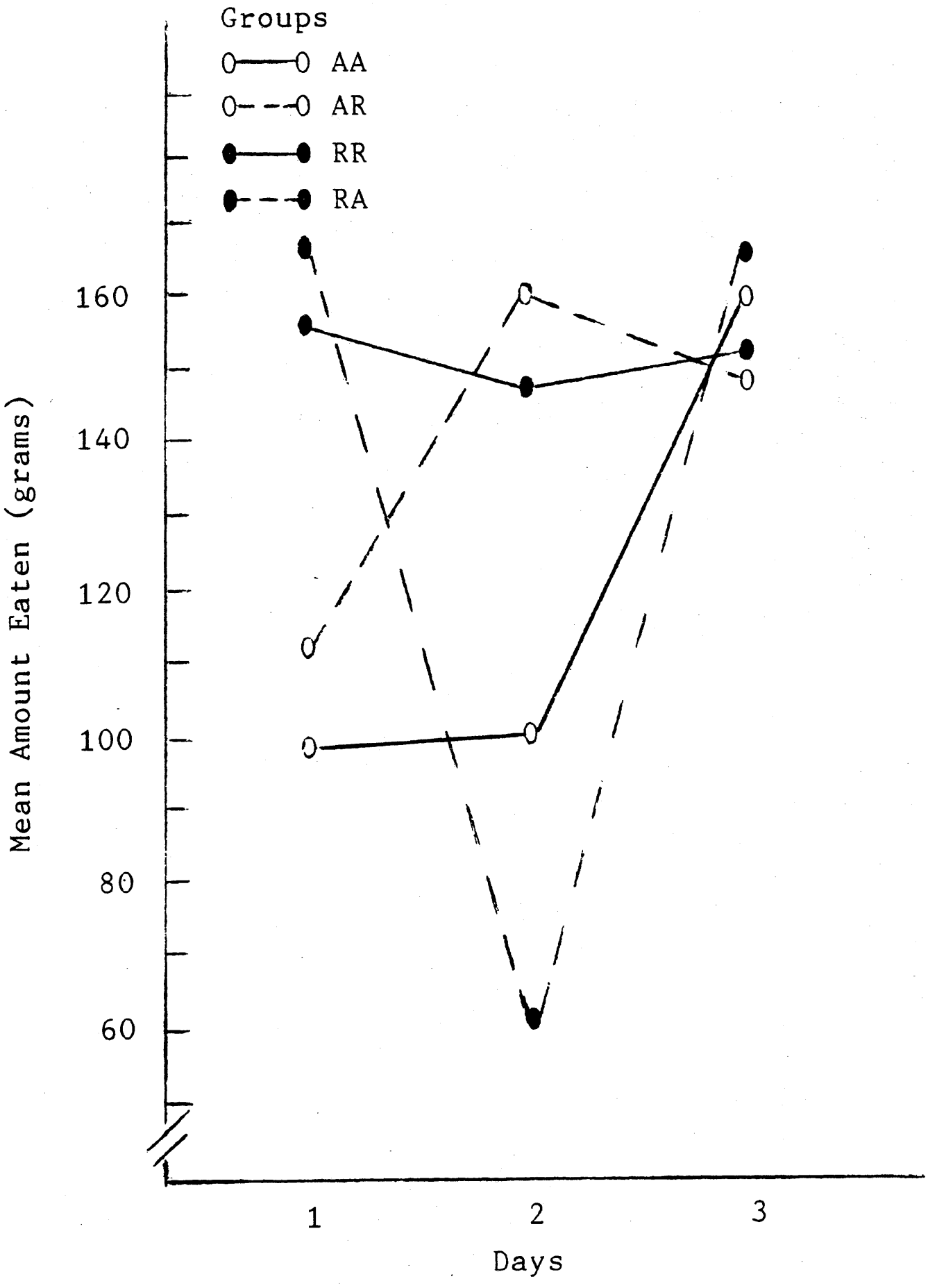

Figure 7B. Mean Amount Eaten on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Table 6B.

Standard Deviation of Amount Eaten on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Group	Day 1	Day 2	Day 3
AA	55.69	65.25	33.85
AR	57.98	54.20	16.80
RR	26.92	32.45	8.92
RA	32.55	40.83	16.06

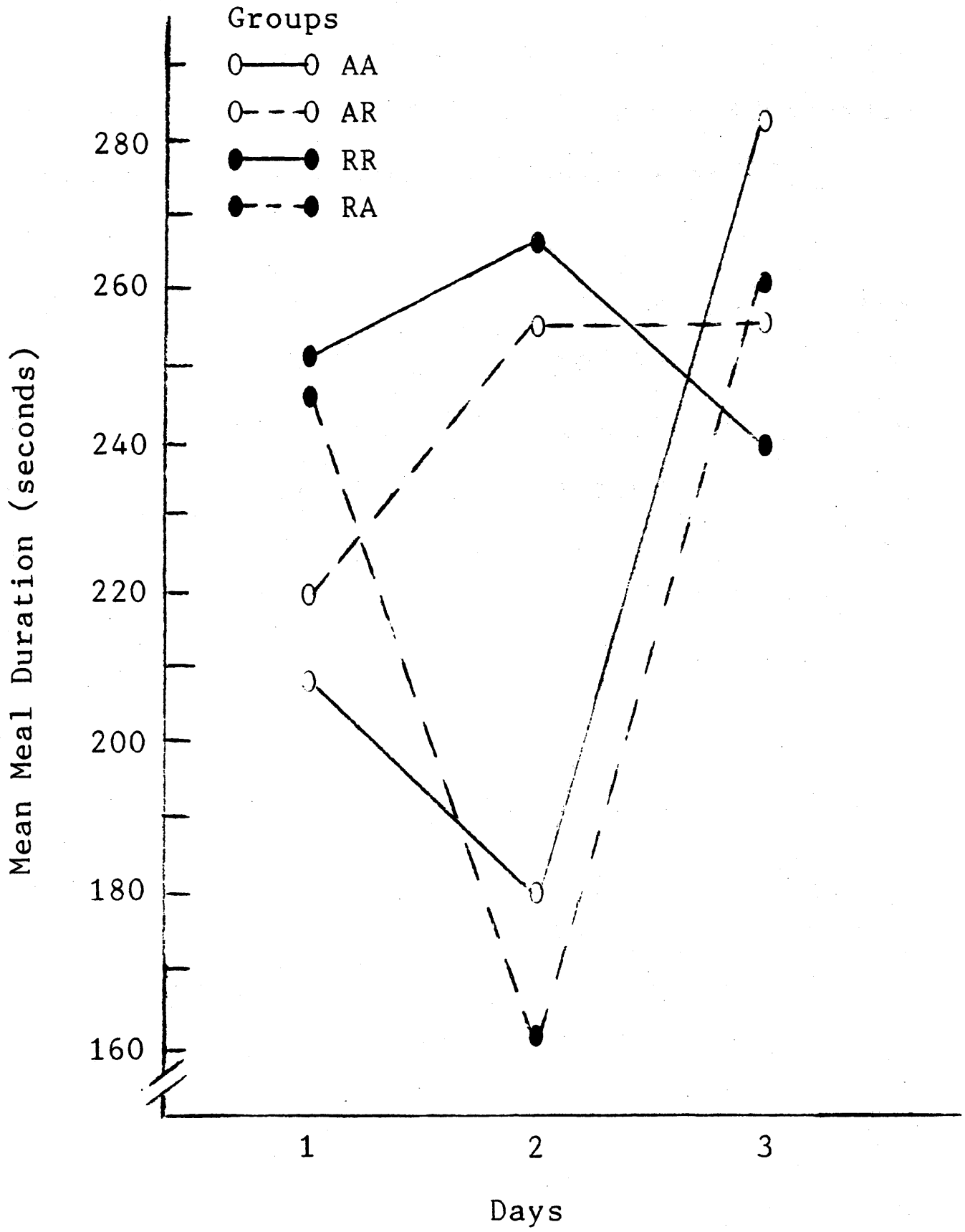

Figure 8B. Mean Meal Duration on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2.

Table 7B.

Standard Deviation of Meal Duration on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Group	Day 1	Day 2	Day 3
AA	94.37	103.94	85.60
AR	128.28	147.79	104.09
RR	92.03	101.63	73.93
RA	92.84	55.12	97.26

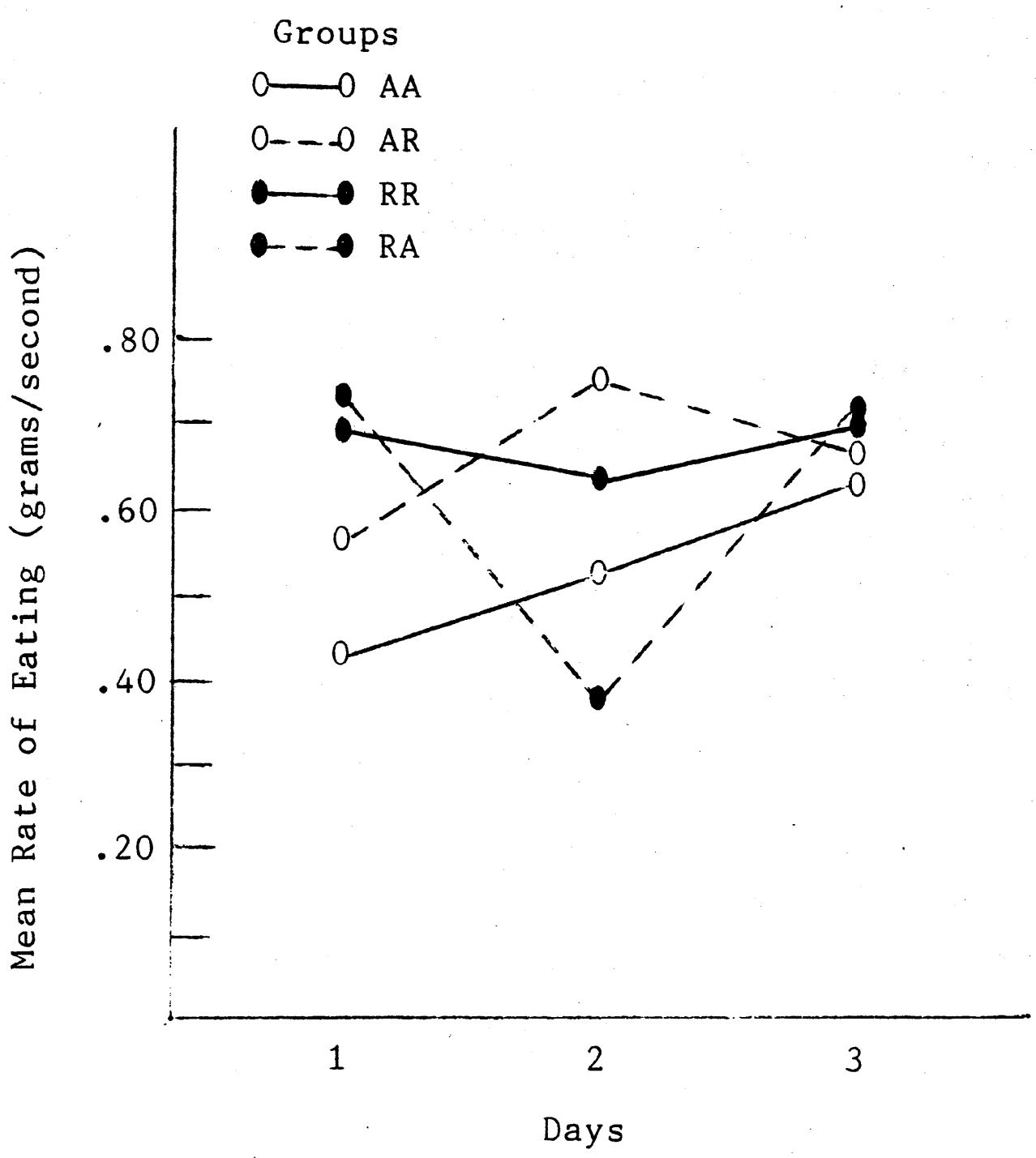

Figure 9B. Mean Rate of Eating on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Table 8B.

Standard Deviation of Rate of Eating on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Group	Day 1	Day 2	Day 3
AA	0.13	0.23	0.25
AR	0.31	0.31	0.27
RR	0.30	0.28	0.23
RA	0.22	0.20	0.24

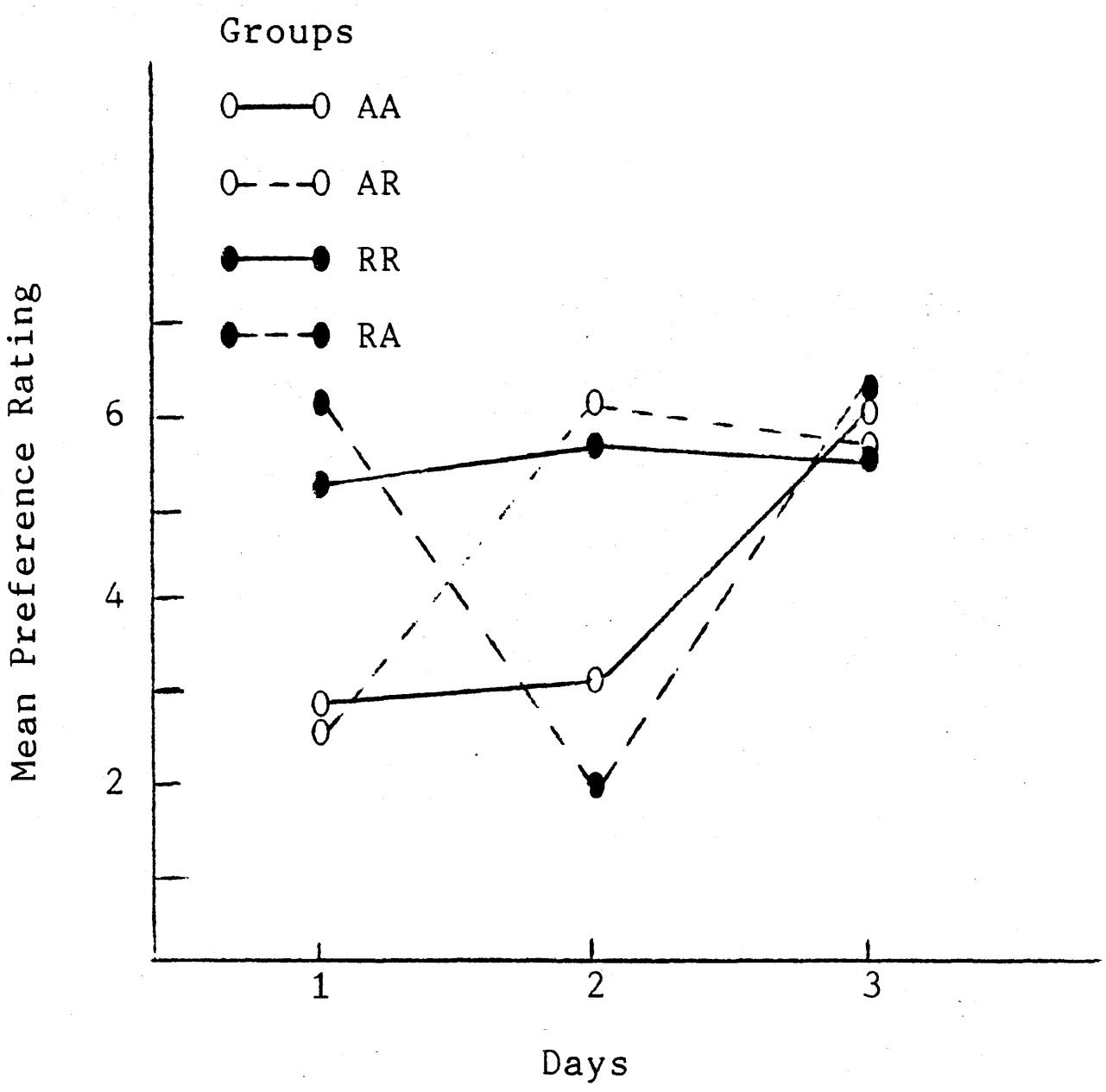

Figure 10B. Mean Preference Rating of Taste on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Table 9B.

Standard Deviation of Preference Rating on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza across Phases 1 and 2.

Group	Day 1	Day 2	Day 3
AA	1.39	1.45	0.50
AR	1.59	0.44	0.87
RR	1.01	0.83	1.01
RA	0.44	1.41	0.50

Appendix C

Table 1C

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivation on the Baseline Trial Over Days 1, 2 and 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.50	NS
$\underline{GM}_A = 0.45$			
$\underline{GM}_R = 0.59$			
Ph2	1	0.20	NS
$\underline{GM}_A = 0.48$			
$\underline{GM}_R = 0.56$			
Ph1 x Ph2	1	0.16	NS
Error	32	18.09	
Day	2	0.07	NS
$\underline{GM}_1 = 0.49$			
$\underline{GM}_2 = 0.55$			
$\underline{GM}_3 = 0.52$			
Ph1 x Day	2	0.05	NS
Ph2 x Day	2	0.10	NS
Ph1 x Ph2 x Day	2	0.06	NS
Error	64	2.85	

Table 2C

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.01	NS
$\underline{GM}_A$ = 0.09			
$\underline{GM}_R$ = 0.12			
Ph2	1	0.26	NS
$\underline{GM}_A$ = 0.04			
$\underline{GM}_R$ = 0.16			
Ph1 x Ph2	1	0.03	NS
Error	32	2.61	
Trial	1	0.68	16.42**
$\underline{GM}_T$ = 0.01			
$\underline{GM}_P$ = 0.20			
Ph1 x Trial	1	0.30	7.45*
Ph2 x Trial	1	0.05	NS
Ph1 x Ph2 x Trial	1	0.02	NS
Error	32	1.32	

*$\underline{p} < .05$. **$\underline{p} < .01$.

Table 3C

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 2 for Groups which Received Regular (R) Pizza in Phase 1 (Ph1).

Source	DF	SS	F
Ph1	--	---	----
Ph2	1	0.24	4.36*
$\underline{GM}_A$ = 0.04			
$\underline{GM}_R$ = 0.20			
Ph1 x Ph2	--	---	----
Error	16	0.86	
Trial	1	0.95	18.24**
$\underline{GM}_T$ = -0.04			
$\underline{GM}_P$ = 0.28			
Ph1 x Trial	--	---	----
Ph2 x Trial	1	0.08	NS
Ph1 x Ph2 x Trial	--	---	----
Error	16	0.84	

*$\underline{p} < .05$. **$\underline{p} < .001$

Table 4C

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 2 for Groups which Received Adulterated (A) Pizza in Phase 1 (Ph1)

Source	DF	SS	F
Ph1	--	---	----
Ph2	1	0.06	NS
$\underline{GM}_A$ = 0.06			
$\underline{GM}_R$ = 0.14			
Ph1 x Ph2	--	---	----
Error	16	1.75	
Trial	1	0.04	NS
$\underline{GM}_T$ = 0.07			
$\underline{GM}_P$ = 0.13			
Ph1 x Trial	--	---	----
Ph2 x Trial	1	0.00	NS
Ph1 x Ph2 x Trial	--	---	----
Error	16	0.49	

Table 5C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Total Salivation on the Thought (T) and Presentation (P) Trials on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.31	NS
$\underline{GM}_A$ = 0.60			
$\underline{GM}_R$ = 0.73			
Ph2	1	0.43	NS
$\underline{GM}_A$ = 0.59			
$\underline{GM}_R$ = 0.75			
Ph1 x Ph2	1	0.61	NS
Error	32	19.64	
Trial	1	0.68	16.42**
$\underline{GM}_T$ = 0.57			
$\underline{GM}_P$ = 0.77			
Ph1 x Trial	1	0.31	7.45*
Ph2 x Trial	1	0.05	NS
Ph1 x Ph2 x Trial	1	0.03	NS
Error	32	1.33	

*$\underline{p}$ < .01. **$\underline{p}$ < .0001.

Table 6C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (ph2)

Source	DF	SS	F
Ph1	1	0.37	NS
$\underline{GM}_A$ = 0.10			
$\underline{GM}_R$ = 0.25			
Ph2	1	0.02	NS
$\underline{GM}_A$ = 0.20			
$\underline{GM}_R$ = 0.16			
Ph1 x Ph2	1	0.07	NS
Error	32	3.03	
Trial	1	0.91	16.69**
$\underline{GM}_T$ = 0.06			
$\underline{GM}_P$ = 0.29			
Ph1 x Trial	1	0.03	NS
Ph2 x Trial	1	0.00	NS
Ph1 x Ph2 x Trial	1	0.22	4.16*
Error	32	1.75	

*$\underline{p}$ < .05. **$\underline{p}$ < .01.

Table 7C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 3 for Groups which Received Regular (R) Pizza in Phase 1 (Ph1)

Source	DF	SS	F
Ph1	--	---	----
Ph2	1	0.01	NS
$\underline{GM}_A$ = 0.24			
$\underline{GM}_R$ = 0.27			
Ph1 x Ph2	--	---	----
Error	16	1.74	
Trial	1	0.65	8.85*
$\underline{GM}_T$ = 0.12			
$\underline{GM}_P$ = 0.39			
Ph1 x Trial	--	---	----
Ph2 x Trial	1	0.12	NS
Ph1 x Ph2 x Trial	--	---	----
Error	16	1.18	

*$\underline{p} < .01$.

Table 8C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 3 for Groups which Received Adulterated (A) Pizza in Phase 1 (Ph1)

Source	DF	SS	F
Ph1	--	---	----
Ph2	1	0.09	NS
$\underline{GM}_A$ = 0.16			
$\underline{GM}_R$ = 0.06			
Ph1 x Ph2	--	---	----
Error	16	1.29	
Trial	1	0.30	8.27*
$\underline{GM}_T$ = 0.02			
$\underline{GM}_P$ = 0.20			
Ph1 x Trial	--	---	----
Ph2 x Trial	1	0.11	NS
Ph1 x Ph2 x Trial	--	---	----
Error	16	0.58	

*$\underline{p} < .01$.

Table 9C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 3 for Groups which Received Regular (R) Pizza in Phase 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.39	NS
$\underline{GM}_A$ = 0.06			
$\underline{GM}_R$ = 0.27			
Ph2	--	---	----
Ph1 x Ph2	--	---	----
Error	16	1.58	
Trial	1	0.46	5.89*
$\underline{GM}_T$ = 0.05			
$\underline{GM}_P$ = 0.28			
Ph1 x Trial	1	0.22	NS
Ph2 x Trial	--	---	----
Ph1 x Ph2 x Trial	--	---	----
Error	16	1.25	

*$\underline{p} < .05$.

Table 10C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials on Day 3 for Groups which Recieved Adulterated (A) Pizza in Phase 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.06	NS
$\underline{GM}_A$ = 0.16			
$\underline{GM}_R$ = 0.24			
Ph2	--	---	----
Ph1 x Ph2	--	---	----
Error	16	1.45	
Trial	1	0.45	14.50*
$\underline{GM}_T$ = 0.09			
$\underline{GM}_P$ = 0.31			
Ph1 x Trial	1	0.04	NS
Ph2 x Trial	--	---	----
Ph1 x Ph2 x Trial	--	---	----
Error	16	0.50	

*$\underline{p} < .001$.

Table 11C

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) Trial on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.09	NS
$\underline{GM}_A = 0.02$			
$\underline{GM}_R = 0.12$			
Ph2	1	0.01	NS
$\underline{GM}_A = 0.09$			
$\underline{GM}_R = 0.05$			
Ph1 x Ph2	1	0.02	NS
Error	32	0.96	

Table 12C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Presentation (P) Trial on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.32	NS
$\underline{GM}_A$ = 0.20			
$\underline{GM}_R$ = 0.39			
Ph2	1	0.01	NS
$\underline{GM}_A$ = 0.31			
$\underline{GM}_R$ = 0.28			
Ph1 x Ph2	1	0.28	NS
Error	32	3.82	

Table 13C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Presentation (P) Trial on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.32	4.23*
$\underline{GM}_A = 0.20$			
$\underline{GM}_R = 0.39$			
Ph2	1	0.01	NS
$\underline{GM}_A = 0.31$			
$\underline{GM}_R = 0.28$			
Ph1 x Ph2	1	0.28	NS
Error[a]	32	0.07	

[a]Error term represents the average of the two error terms on Table 6C.

*$p < .05$.

Table 14C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) Trial on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.09	NS
$\underline{GM}_A = 0.02$			
$\underline{GM}_R = 0.12$			
Ph2	1	0.01	NS
$\underline{GM}_A = 0.09$			
$\underline{GM}_R = 0.05$			
Ph1 x Ph2	1	0.02	NS
Error[a]	32	0.07	

[a]Error term represents the average of the two error terms on Table 6C.

Table 15C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Total Salivation on the Thought (T) and Presentation (P) Trials on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	1.11	NS
$\underline{GM}_A = 0.59$			
$\underline{GM}_R = 0.83$			
Ph2	1	0.34	NS
$\underline{GM}_A = 0.64$			
$\underline{GM}_R = 0.78$			
Ph1 x Ph2	1	0.17	NS
Error	32	22.36	
Trial	1	0.92	16.69**
$\underline{GM}_T = 0.60$			
$\underline{GM}_P = 0.82$			
Ph1 x Trial	1	0.03	NS
Ph2 x Trial	1	0.00	NS
Ph1 x Ph2 x Trial	1	0.22	4.16*
Error	32	1.76	

*$\underline{p} < .05$. **$\underline{p} < .0001$.

Table 16C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Thought (T) and Presentation (P) Trials over Days 1, 2 and 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.27	NS
$\underline{GM}_A$ = 0.09			
$\underline{GM}_R$ = 0.17			
Ph2	1	0.00	NS
$\underline{GM}_A$ = 0.13			
$\underline{GM}_R$ = 0.13			
Ph1 x Ph2	1	0.20	NS
Error	32	4.61	
Trial	1	1.58	21.47**
$\underline{GM}_T$ = 0.04			
$\underline{GM}_P$ = 0.22			
Ph1 x Trial	1	0.17	NS
Ph2 x Trial	1	0.00	NS
Ph1 x Ph2 x Trial	1	0.30	4.13*
Error	32	2.35	

*$\underline{p}$ < .05. **$\underline{p}$ < .0001.

Table continues

Table 16C continued

Source	DF	SS	F
Day	2	0.24	NS
$\underline{GM}_1$ = 0.11			
$\underline{GM}_2$ = 0.10			
$\underline{GM}_3$ = 0.18			
Ph1 x Day	2	0.14	NS
Ph2 x Day	2	0.46	3.67*
Ph1 x Ph2 x Day	2	0.01	NS
Error	64	4.00	
Trial x Day	2	0.17	NS
Ph1 x Trial x Day	2	0.17	NS
Ph2 x Trial x Day	2	0.05	NS
Ph1 x Ph2 x Trial x Day	2	0.05	NS
Error	64	1.98	

*$\underline{p} < .05$.

Table 17C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Total Salivation on the Thought (T) and Presentation (P) Trials over Days 1, 2 and 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	2.31	NS
$\underline{GM}_A$ = 0.56			
$\underline{GM}_R$ = 0.76			
Ph2	1	0.36	NS
$\underline{GM}_A$ = 0.62			
$\underline{GM}_R$ = 0.70			
Ph1 x Ph2	1	1.03	NS
Error	32	52.99	
Trial	1	1.58	21.47**
$\underline{GM}_T$ = 0.57			
$\underline{GM}_P$ = 0.75			
Ph1 x Trial	1	0.17	NS
Ph2 x Trial	1	0.01	NS
Ph1 x Ph2 x Trial	1	0.30	4.13*
Error	32	2.36	

*$\underline{p}$ < .05. **$\underline{p}$ < .0001.

Table continues

Table 17C continued

Source	DF	SS	F
Day	2	0.35	NS
$\underline{GM}_1$ = 0.61			
$\underline{GM}_2$ = 0.67			
$\underline{GM}_3$ = 0.71			
Ph1 x Day	2	0.15	NS
Ph2 x Day	2	0.46	NS
Ph1 x Ph2 x Day	2	0.07	NS
Error	64	6.46	
Trial x Day	2	0.17	NS
Ph1 x Trial x Day	2	0.17	NS
Ph2 x Trial x Day	2	0.05	NS
Ph1 x Ph2 x Trial x Day	2	0.05	NS
Error	64	1.98	

Table 18C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Salivary Response on the Post-Ingestion Trial over Days 1, 2 and 3 for Groups which received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.05	NS
$\underline{GM}_A$ = 0.13			
$\underline{GM}_R$ = 0.17			
Ph2	1	0.33	NS
$\underline{GM}_A$ = 0.20			
$\underline{GM}_R$ = 0.09			
Ph1 x Ph2	1	0.01	NS
Error	32	4.67	
Day	2	0.01	NS
$\underline{GM}_1$ = 0.14			
$\underline{GM}_2$ = 0.16			
$\underline{GM}_3$ = 0.14			
Ph1 x Day	2	0.00	NS
Ph2 x Day	2	0.30	NS
Ph1 x Ph2 x Day	2	0.11	NS
Error	64	6.03	

Table 19C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Latency to Start Eating over Days 1, 2 and 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	53	NS
$\underline{GM}_A$ = 15			
$\underline{GM}_R$ = 16			
Ph2	1	61	NS
$\underline{GM}_A$ = 16			
$\underline{GM}_R$ = 15			
Ph1 x Ph2	1	38	NS
Error	32	1657	NS
Day	2	204	NS
$\underline{GM}_1$ = 14			
$\underline{GM}_2$ = 16			
$\underline{GM}_3$ = 17			
Ph1 x Day	2	29	NS
Ph2 x Day	2	161	NS
Ph1 x Ph2 x Day	2	40	NS
Error	64	2998	

Table 20C.

Correlations between Mean Latency to Start Eating and Mean Salivary Response on the Presentation Trial on Days 1, 2 and 3 for Groups AA, AR, RR and RA which Received Adulterated (A) and Regular (R) Pizza over Phases 1 and 2

	Groups			
	AA	AR	RR	RA
Day 1	-0.28	-0.42	-0.01	-0.40
Day 2	-0.14	0.22	0.06	-0.46
Day 3	-0.04	-0.31	0.14	-0.06

Table 21C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Amount Eaten on Day 1 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	28900	14.02*
$\underline{GM}_A$ = 104			
$\underline{GM}_R$ = 161			
Ph2	1	3	NS
$\underline{GM}_A$ = 132			
$\underline{GM}_R$ = 133			
Ph1 x Ph2	1	1190	NS
Error	32	65979	

*$\underline{p} < .001$.

Table 22C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Amount Eaten on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	5816	NS
$\underline{GM}_A$ = 130			
$\underline{GM}_R$ = 104			
Ph2	1	47975	19.36*
$\underline{GM}_A$ = 81			
$\underline{GM}_R$ = 154			
Ph1 x Ph2	1	1664	NS
Error	32	79316	

*$\underline{p}$ < .0001.

Table 23C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Amount Eaten Logarithms (Base 10) on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.04	NS
$\underline{GM}_A$ = 2.00			
$\underline{GM}_R$ = 1.94			
Ph2	1	1.34	14.98*
$\underline{GM}_A$ = 1.77			
$\underline{GM}_R$ = 2.16			
Ph1 x Ph2	1	0.03	NS
Error	32	2.87	

*$\underline{p} < .001$.

Table 24C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Amount Eaten over Days 1 and 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	4392	NS
$\underline{GM}_A$ = 117			
$\underline{GM}_R$ = 133			
Ph2	1	24398	7.55*
$\underline{GM}_A$ = 106			
$\underline{GM}_R$ = 143			
Ph1 x Ph2	1	19	NS
Error	32	103421	
Day	1	4318	NS
$\underline{GM}_1$ = 132			
$\underline{GM}_2$ = 117			
Ph1 x Day	1	30323	23.17***
Ph2 x Day	1	23580	18.02**
Ph1 x Ph2 x Day	1	2835	NS
Error	32	41874	

*$\underline{p}$ < .01. **$\underline{p}$ < .001. ***$\underline{p}$ < .0001.

Table 25C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Amount Eaten on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	236	NS
$\underline{GM}_A$ = 155			
$\underline{GM}_R$ = 160			
Ph2	1	1425	NS
$\underline{GM}_A$ = 163			
$\underline{GM}_R$ = 151			
Ph1 x Ph2	1	0	NS
Error	32	14123	

Table 26C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Meal Duration over Days 1 and 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	3942	NS
$\underline{GM}_A$ = 216			
$\underline{GM}_R$ = 231			
Ph2	1	43219	NS
$\underline{GM}_A$ = 199			
$\underline{GM}_R$ = 248			
Ph1 x Ph2	1	545	NS
Error	32	531769	
Day	1	4290	NS
$\underline{GM}_1$ = 231			
$\underline{GM}_2$ = 216			
Ph1 x Day	1	6619	NS
Ph2 x Day	1	29752	5.41*
Ph1 x Ph2 x Day	1	1340	NS
Error	32	175942	

*$\underline{p} < .05$.

Table 27C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Meal Duration on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	172	NS
$\underline{GM}_A$ = 218			
$\underline{GM}_R$ = 213			
Ph2	1	72345	6.29*
$\underline{GM}_A$ = 171			
$\underline{GM}_R$ = 260			
Ph1 x Ph2	1	1797	NS
Error	32	368091	

*$\underline{p} < .05$.

Table 28C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Meal Duration on Day 1 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	10388	NS
$\underline{GM}_A$ = 214			
$\underline{GM}_R$ = 248			
Ph2	1	626	NS
$\underline{GM}_A$ = 227			
$\underline{GM}_R$ = 235			
Ph1 x Ph2	1	87	NS
Error	32	339620	

Table 29C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Meal Duration on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	2973	NS
$\underline{GM}_A$ = 268			
$\underline{GM}_R$ = 250			
Ph2	1	4540	NS
$\underline{GM}_A$ = 270			
$\underline{GM}_R$ = 248			
Ph1 x Ph2	1	29	NS
Error	32	264688	

Table 30C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Rate of Eating over Days 1 and 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.04	NS
$\underline{GM}_A$ = 0.57			
$\underline{GM}_R$ = 0.62			
Ph2	1	0.39	NS
$\underline{GM}_A$ = 0.52			
$\underline{GM}_R$ = 0.66			
Ph1 x Ph2	1	0.17	NS
Error	32	3.41	
Day	1	0.03	NS
$\underline{GM}_1$ = 0.61			
$\underline{GM}_2$ = 0.57			
Ph1 x Day	1	0.53	22.02**
Ph2 x Day	1	0.18	7.45*
Ph1 x Ph2 x Day	1	0.04	NS
Error	32	0.77	

*$\underline{p} < .01$. **$\underline{p} < .0001$.

Table 31C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Rate of Eating on Day 1 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.43	6.84*
$\underline{GM}_A$ = 0.50			
$\underline{GM}_R$ = 0.72			
Ph2	.1	0.02	NS
$\underline{GM}_A$ = 0.59			
$\underline{GM}_R$ = 0.63			
Ph1 x Ph2	1	0.05	NS
Error	32	2.02	

*$\underline{p} < .05$.

Table 32C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Rate of Eating on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.14	NS
$\underline{GM}_A$ = 0.63			
$\underline{GM}_R$ = 0.51			
Ph2	1	0.54	8.08*
$\underline{GM}_A$ = 0.45			
$\underline{GM}_R$ = 0.69			
Ph1 x Ph2	1	0.00	NS
Error	32	2.16	

*$\underline{p} < .05$.

Table 33C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Rate of Eating on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.03	NS
$\underline{GM}_A$ = 0.64			
$\underline{GM}_R$ = 0.70			
Ph2	1	0.00	NS
$\underline{GM}_A$ = 0.67			
$\underline{GM}_R$ = 0.68			
Ph1 x Ph2	1	0.00	NS
Error	32	1.97	

Table 34C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Taste on Day 1 for Groups which received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	90	63.40*
$\underline{GM}_A = 2.66$			
$\underline{GM}_R = 5.83$			
Ph2	1	2	NS
$\underline{GM}_A = 4.50$			
$\underline{GM}_R = 4.00$			
Ph1 x Ph2	1	0	NS
Error	32	45	

*$\underline{p} < .0001$.

Table 35C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Taste on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	5	4.36*
$\underline{GM}_A$ = 4.66			
$\underline{GM}_R$ = 3.88			
Ph2	1	106	85.42**
$\underline{GM}_A$ = 2.55			
$\underline{GM}_R$ = 6.00			
Ph1 x Ph2	1	1	NS
Error	32	40	

*$\underline{p}$ < .05. **$\underline{p}$ < .0001.

Table 36C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Taste over Days 1 and 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	25	13.75*
$\underline{GM}_A$ = 3.66			
$\underline{GM}_R$ = 4.86			
Ph2	1	39	20.88**
$\underline{GM}_A$ = 3.52			
$\underline{GM}_R$ = 5.00			
Ph1 x Ph2	1	0	NS
Error	32	60	
Day	1	0	NS
$\underline{GM}_1$ = 4.25			
$\underline{GM}_2$ = 4.28			
Ph1 x Day	1	70	86.91**
Ph2 x Day	1	70	86.91**
Ph1 x Ph2 x Day	1	2	NS
Error	32	26	

*$\underline{p} < .001$. **$\underline{p} < .0001$.

Table 37C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Taste on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0	NS
$\underline{GM}_A$ = 5.83			
$\underline{GM}_R$ = 5.94			
Ph2	1	3	4.88*
$\underline{GM}_A$ = 6.16			
$\underline{GM}_R$ = 5.61			
Ph1 x Ph2	1	0	NS
Error	32	18	

*$\underline{p} < .05$.

Table 38C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Aroma on Day 1 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.03	NS
$\underline{GM}_A = 5.61$			
$\underline{GM}_R = 5.66$			
Ph2	1	2.25	NS
$\underline{GM}_A = 5.88$			
$\underline{GM}_R = 5.38$			
Ph1 x Ph2	1	0.02	NS
Error	32	24.00	

Table 39C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Aroma on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.11	NS
$\underline{GM}_A$ = 5.66			
$\underline{GM}_R$ = 5.77			
Ph2	1	0.11	NS
$\underline{GM}_A$ = 5.66			
$\underline{GM}_R$ = 5.77			
Ph1 x Ph2	1	0.11	NS
Error	32	24.88	

Table 40C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Aroma on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.69	NS
$\underline{GM}_A$ = 5.55			
$\underline{GM}_R$ = 5.83			
Ph2	1	0.69	NS
$\underline{GM}_A$ = 5.55			
$\underline{GM}_R$ = 5.83			
Ph1 x Ph2	1	0.03	NS
Error	32	24.22	

Table 41C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Appearance on Day 1 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	1.36	NS
$\underline{GM}_A$ = 4.83			
$\underline{GM}_R$ = 5.22			
Ph2	1	2.25	NS
$\underline{GM}_A$ = 5.27			
$\underline{GM}_R$ = 4.77			
Ph1 x Ph2	1	0.25	NS
Error	32	55.11	

Table 42C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Appearance on Day 2 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.02	NS
$\underline{GM}_A$ = 5.38			
$\underline{GM}_R$ = 5.44			
Ph2	1	0.02	NS
$\underline{GM}_A$ = 5.38			
$\underline{GM}_R$ = 5.44			
Ph1 x Ph2	1	0.69	NS
Error	32	26.00	

Table 43C.

Summary of Grand Means (GM) and Analysis of Variance (ANOVA) of Mean Preference Rating of Appearance on Day 3 for Groups which Received Adulterated (A) and Regular (R) Pizza over Phases 1 (Ph1) and 2 (Ph2)

Source	DF	SS	F
Ph1	1	0.44	NS
$\underline{GM}_A = 5.33$			
$\underline{GM}_R = 5.55$			
Ph2	1	0.00	NS
$\underline{GM}_A = 5.44$			
$\underline{GM}_R = 5.44$			
Ph1 x Ph2	1	0.00	NS
Error	32	22.44	

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