JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1984, 17, 85–92 NUMBER 1 (SPRING 1984)

THE INFLUENCE OF CALORIC INFORMATION ON CAFETERIA FOOD CHOICES

PATRICIA M. DUBBERT, WILLIAM G. JOHNSON, DAVID G. SCHLUNDT, AND NONI WARD MONTAGUE

JACKSON VETERANS ADMINISTRATION MEDICAL CENTER AND UNIVERSITY OF MISSISSIPPI MEDICAL CENTER

We evaluated the effect of posting caloric information on food purchases at a cafeteria. Purchases of more than 14,300 entrees, vegetables, and salads by 6,970 customers were unobtrusively monitored via the cash register inventory control system during 15 evening observations. A quasi-multiple-baseline design across food groups was used to test the additive effect of labeling the three lowest caloric choices for vegetables, salads, and entrees. A linear logit analysis confirmed that labeling increased the probability of low calorie selections for vegetables and salads, but not for entrees. Observations of meals purchased by a subsample of 413 customers indicated labeling did not change the total caloric content of meals. The number of customers and total sales per evening were unaffected by the labeling intervention. The results suggest that manipulating environmental cues may be an effective method for changing food purchases in a cafeteria, but labeling individual items may not be the best way to decrease total calories purchased.

DESCRIPTORS: caloric information, cafeteria, eating behavior, food choices

It is now recognized that a combination of genetic, metabolic, psychological, and environmental factors are involved in the onset and maintenance of obesity (Rodin, 1981), but epidemiologic data suggest that social factors are among the most important influences on the prevalence of obesity today (Stunkard, 1980). In light of the limitations of clinical treatment of obesity (Foreyt, Goodrick, & Gotto, 1981; Wooley, Wooley & Dyrenforth, 1979), the contributions of behavioral technology toward environmental changes related to eating should receive greater attention (Stunkard, 1980). Behavioral interventions in the natural environment have proved successful in increasing exercise (Brownell, Stunkard & Albaum, 1980) and reducing cardiovascular risk factors (Meyer, Nash, McAlister, Maccoby, & Farquhar, 1980). The question remains as to whether environmental supports and prompts for restricting caloric intake change food choices.

Relatively little is currently known about the variables that influence food choices in public places. Stunkard and Kaplan (1977) reviewed three studies of food choices in naturalistic cafeteria settings and found that men chose larger meals than women and the obese chose more food than the nonobese. These studies of food selection did not provide direct information about the amount of food actually consumed; however, Stunkard and Kaplan noted that food choice does provide an indirect estimate of caloric consumption by placing an upper limit on the quantity of food available.

Zifferblatt, Wilbur, and Pinsky (1980a) used data from the cash register inventory control system of a cafeteria to obtain unobtrusive observations of food purchases. Time-series analyses over a 1-year period were used to identify the influence of ecologic factors on food purchases. The results showed both seasonal and daily variations. The overall caloric content of purchases declined during the summer months, reflecting a decrease in starchy

We thank Morrisons Incorporated, Cafeteria Division, for their cooperation in conducting this study in Jackson, Mississippi. We also thank Mary Lake for assistance with data collection and analysis.

Reprints may be obtained by writing Patricia M. Dubbert, Psychology Service (116B), VA Medical Center, Jackson, Mississippi 39216.

food and cooked vegetables and an increase in fruits, salads, yogurt, and cottage cheese selections. Throughout the year, there were more fish and dessert purchases on Fridays, an intriguing covariation of relatively low and high caloric choices.

Zifferblatt, Wilbur, and Pinsky (1980b) also attempted to manipulate food purchases with a "Food for Thought" game. Cafeteria customers were encouraged to take cards with nutrition messages as they passed the cashier; combinations of these could be traded for colorful posters. This intervention was followed by a decrease in overall calories purchased with associated decreases in desserts, and an increase in sales of skim milk. Unfortunately, interpretation of these results was compromised because the total number of customers increased, and the sales for most other items, including whole milk, remained unchanged during the intervention, raising the possibility that the decrease in calories purchased was a result of attracting new customers.

To our knowledge, only one attempt to manipulate restaurant food choices has been published. Scott, Foreyt, O'Malley, and Gotto (1979) described the successful introduction of low cholesterol foods to the menu at a steak house. Sampling of sales indicated the new menu items accounted for a small (average of 3.4%) but consistent proportion of monthly sales.

An important but as yet unanswered question is the extent to which caloric information influences food choices in restaurants and cafeterias. Self-monitoring of caloric intake is an important component in behavioral weight reduction programs (Romanczyk, 1974; Stalonas, Johnson, & Christ, 1978), and monitoring calories prior to eating can be as effective as post-meal monitoring (Green, 1978). Providing information on the caloric content of food selections can serve to inform consumers of caloric values as well as to prompt dieters to select more low calorie foods.

Our study was designed to evaluate whether posting caloric information in a cafeteria would increase the probability of the purchase of the lower calorie items. Because the management had requested that actual caloric values not be posted, only labels that identified the three lowest caloric selections within three food categories (entrees, salads, vegetables) were posted. A quasi-multiple-baseline design across food types was used to test the effect of labeling the lower caloric selections on the probability of purchasing low calorie foods. Sales of all food items were monitored unobtrusively through the cash register inventory control system.

METHOD

Customers

Customers of a cafeteria located near a large medical center and between a business area and middle-class residential neighborhood participated in the study. Cash register data showed that a total of 6,970 customers were served during the 15 observation sessions, with weekly totals ranging from 384 to 578 (M = 465 per week). Approximately 50 customers from each of eight observation periods were selected by a systematic sampling procedure to assess the effects of the intervention on individual's food choices. Of those 413 selected, 226 (54.7%) were female and 187 (45.3%) were male; 81 (19.7%) were estimated to be at least 20% overweight. Only 11 (2.6%) had eaten at the cafeteria more than once during the study observations; therefore, each observation involved an independent subject sample. The management estimated that typically about 10% of the customers were children accompanied by adults.

Materials

Identifying labels for the low calorie (LC) items were constructed of laminated bright green poster paper, 7.5 cm × 5 cm (3″ × 2″), with black lettering for the message, "LOWER CALORIE SELECTION." A 2 cm (¾″) diameter bright red dot was added to the upper right-hand corner of the labels after a pilot run indicated many customers overlooked the green and black labels. A 43 cm × 58 cm (17″ × 23″) green poster board sign, with dark green lettering, reading "FOR YOUR INFORMATION, WE HAVE LA-

BELED SOME LOWER CALORIE ITEMS. . . . Watch for these signs" (one of the LC identifying labels was attached) was posted on an easel near the cafeteria entrance. An identical smaller 30 cm × 43 cm (12″ × 17″) sign was posted on the wall near the beginning of the serving line. During baseline conditions, none of the signs or labels was posted.

Procedure

Identification of LC Food Items. Approximately 100 food items were offered at each evening meal, including salads, desserts (pastries and fresh or canned fruits), entrees (broiled, fried, and grilled beef, fish, and poultry), vegetables, and breads. Entrees and vegetables were changed on a rotating basis, and typically about two-thirds of these items were the same on succeeding weeks. The items in the remaining categories were generally available every week. Three food categories, entrees, vegetables, and salads, were selected for labeling because: (a) 50–80% of the customers usually purchased at least one item from each of these categories, and (b) there was a wide range of caloric content for food items within these categories. Desserts were not included in the labeling manipulation because, unlike the other food types, low calorie and high calorie items (e.g., fruits vs. pastries) were displayed at separate locations in the serving line. However, desserts were included in computation of total meal calories.

A registered dietician calculated the caloric content per serving for all desserts, entrees, vegetables, and salads offered on the menu by reviewing recipes supplied by the management and observing food preparation and serving procedures. Handbooks No. 456 (USDA, 1975a) and No. 8 (USDA, 1975b) and *Bowes and Church's Food Values of Portions Commonly Used* (Pennington & Church, 1980) provided the basic caloric estimates. The 12 to 15 entrees typically available ranged from about 300 to 800 calories per serving; the majority of these were in the range of 300 to 500 per serving. The 10 to 14 vegetables ranged from 60 to 450 calories per serving; but the majority were in the 100 to 200 calories per serving category. The 7 to 10 salads offered on a given evening ranged from an estimated 30 to 525 calories per serving (without added dressing); about half were less than 150 calories per serving.

At each session, the three LC items from the entree, vegetable, and salad groups were identified by choosing those with the lowest estimated caloric content from among the items available at that session. The LC items within the salad category were very stable from week to week, but vegetable and entree items varied. Examples of LC items in the three food categories are (a) entrees: lean roast beef, baked turkey, broiled fish; (b) vegetable: okra and tomatoes, green beans, broccoli; and (c) salads: sliced tomatoes, cucumber mix, tossed salad.

During baseline conditions, the three LC items in each group were identified using the caloric estimate list, but no signs or labels were posted. During labeling conditions, the large signs were posted at the entrance to the serving line and the small LC labels were placed beside the foods at the serving location in accordance with the dictates of the experimental design. At the close of each session, cash register data showed the total number of customers served, the total number of sales for each food item, and the total sales for the evening. (Children's plates were shown separately and not included in the analyses for this study.)

Experimental Design

A quasi-multiple-baseline design across food categories was used to test the additive effect of labeling the three types of foods. The randomly chosen order of intervention for food groups was as follows: baseline 1, label vegetables, label vegetables and salads, label vegetables, salads, and entrees; and baseline 2. Each phase included three Tuesday evening sessions, for a total of 15 sessions during an 18-week period in the spring. Tuesday evening were selected on the management's suggestion that these were "typical" in terms of weekday sales.

Observations of individual's food choices. Two observers were stationed at the cafeteria during the peak serving hours (5:30 to 7:30 p.m.) during the first two Tuesdays of each phase of the study except the second baseline. Approximately 50 consecutive adult customers were selected each evening as they left the cashier. To avoid being seen from the serving line, observers waited until customers were seated, then approached the individuals selected and asked if they would be willing to answer a few questions about the foods they selected. The observer showed the customers one of the low calorie labels and asked, "Did you see these labels?" Customers' responses and weight status (overweight or normal) were then recorded unobtrusively. (A third observer recorded weight status of a random sample of 60 subjects across several evenings. This reliability check showed 94% interobserver agreement on weight status.) With the customer's assistance, the observer then identified and recorded all items purchased, excluding soups, breads, condiments, and beverages. Total caloric value for an individual "meal" was defined as the sum of the caloric values for the recorded items and therefore did not include soups, breads, condiments, or beverages. When observers completed data collection for a customer, they then approached the next customer until at least 50 customers had been interviewed.

Statistical Analyses

The goal of the statistical analysis was to demonstrate that caloric labeling influenced LC food choices by comparing the conditional probability of choosing the targeted items given labeling with the unconditional probability of choosing the targeted items. A linear logistic regression analysis was used to compute chi-square tests of the overall effects of labeling and food type (vegetable, salad, entree) on the probability of choosing an LC food (see Forthofer & Koch, 1973; Grizzle, Sturmer, & Koch, 1969; Grizzle & Williams, 1972). Specific hypotheses concerning the effect of labeling on LC food choices were then examined by comparing probabilities using a z test based on the binomial approximation to the normal distribution (see Allison & Liker, 1982; Hayes, 1973).

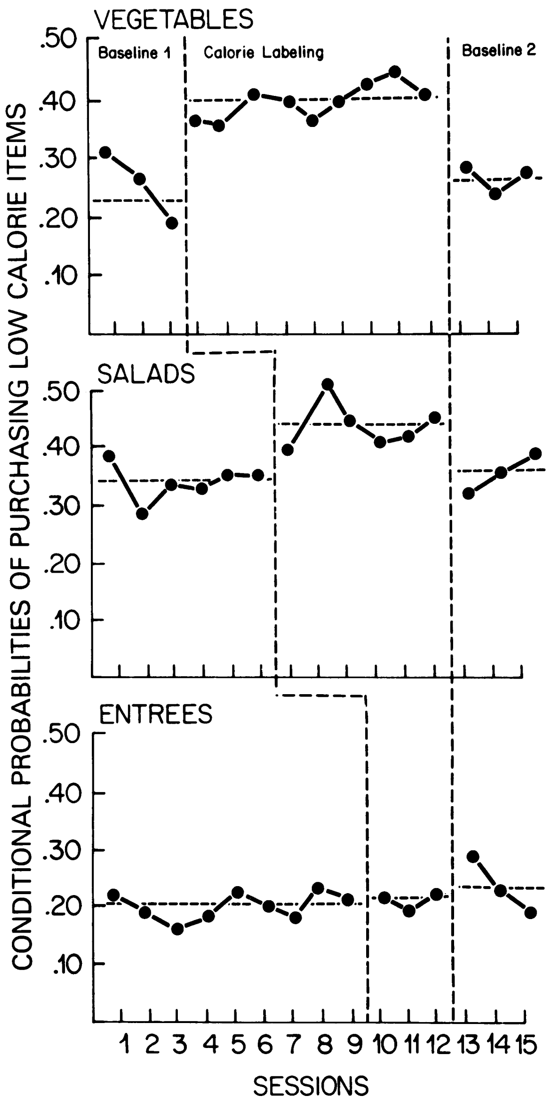

Figure 1. Conditional probabilities of purchasing low calorie items from each of the three food categories across experimental conditions.

RESULTS

The customer interviewing procedure revealed that 74% to 100% (M = 87.5%) reported seeing the labels as they passed through the line; a greater proportion of customers saw the labels when all three food groups were labeled. As shown in Figure 1, the probability of choosing an LC food item increased during labeling for two of the three food types. The labeling had a clear effect on the probability of choosing an LC vegetable, as the data points during labeling and baseline were nonoverlapping. For salads, the labeling of LC choices also led to an increase in the probability of choosing the labeled items. For entrees, however, as illustrated in Figure 1, labels had no effect on the probability of choosing LC entrees.

Statistical Analyses of Customers' Food Purchases

For the linear logistic regression analysis, the basic unit of observation was the food item. Each of the 14,367 entree, vegetable, and salad purchases during the 15-week study was cross-classified on four dimensions: (a) caloric value (low, high), (b) food type (vegetable, salad, entree), (c) labeling condition (baseline 1, vegetable, vegetable-salad, vegetable-salad-entree, baseline 2), and (d) replication within labeling condition (first, second, and third week of each phase). A four dimensional contingency table was formed and the linear logistic regression analysis was performed with caloric choice treated as the dependent variable. (The actual dependent variable in the logistic regression analysis was the difference between the logarithms of the probability of low and high calorie food choices.)

This analysis confirmed the significance of changes depicted in Figure 1. The most important parameter for evaluating the effects of the experimental manipulations was the food type by labeling interaction. This significant interaction, $\chi^2(8) = 95.17$, $p < .0001$, indicated that the probabilities of choosing an LC food depended on both the food type and the labeling condition. For vegetables, there was a significant increase in the probability of choosing an LC vegetable over the baseline conditions (data from which were combined to identify significant sources of effects in this analysis) in all three labeling conditions: for vegetable labeling, $z = 7.02$, $p < .00001$; for vegetable-salad labeling, $z = 7.05$, $p < .00001$; and for vegetable-salad-entree labeling, $z = 8.69$, $p < .00001$. For salads, there was no difference in the probability of choosing an LC salad over the baseline conditions when only vegetables were labeled, $z = .029$, N.S. However, there was a significant increase in the probability of LC salad selection during the vegetable-salad, $z = 3.54$, $p < .0005$ and vegetable-salad-entree labeling, $z = 4.39$, $p < .0001$. The probability of choosing an LC entree did not differ from baseline in any labeling condition: for vegetable, $z = -.44$, N.S.; vegetable-salad, $z = .41$, N.S.; or vegetable-salad-entree, $z = .37$, N.S. The food by labeling interaction therefore resulted entirely from the effects of labeling on the selection of LC vegetables and salads, and the probability of choosing these LC foods was increased only when these items were labeled.

Analysis of selected customers' observed food purchases. Analysis of variance was used to examine the effects of sex, weight category (normal or obese), and labeling condition on the caloric content of meals purchased by the subset of customers who were interviewed. (Total meal calories were estimated from the sum of caloric values for vegetable, salad, entree, and dessert items.) For total meal calories, there was a main effect for sex, $F(1, 387) = 6.44$, $p < .01$, with males purchasing higher calorie meals than females (M for males = 1,104, M for females = 945). There were no main effects for either weight category or labeling condition on total meal calories.

Separate analyses were then conducted for the calories contributed to the meal by vegetable, salad, entree, and dessert purchases. For entrees, there was a main effect for labeling condition $F(3, 338) = 3.98$, $p < .01$. Contrary to expectations, the calories contributed by entree choices increased as additional food items were labeled (M = 537 calories during baseline, M = 545 during vegetable labeling, M = 563 during vegetable-salad labeling, M = 607 during vegetable-salad-entree labeling). For desserts, there was a main effect for sex $F(1, 396) = 4.46$, $p < .05$, with males purchasing more dessert calories (M = 205 calories) than females (M = 134 calories). There were no significant main effects or interaction effects for vegetable calories or salad calories.

Customers and sales. Cash register data indicated that the total number of customers served and the total sales per evening during labeling observations were not significantly different from baseline. During baseline, the mean number of customers was 443.5, and during labeling the mean was 461.3, $t(13) = .71$, $p > .10$. Total sales for the baseline observations averaged $1,544.60 per evening and during labeling the sales averaged $1,612.80 per evening, $t(13) = .70$, $p > .10$.

DISCUSSION

To summarize, labeling LC vegetables and salad led to significant increases in their selections over baseline levels. Moreover, the purchases of these LC foods increased immediately with labeling, and subsequently decreased to baseline levels when the labels were withdrawn. In contrast to these changes, the selection of LC entrees did not increase as a result of labeling. The failure to find an effect for entrees is consistent with the findings of Zifferblatt et al. (1980a, 1980b) who reported that the selection of entrees did not change as a result of their "Food for Thought" game. Together, these data suggest that preferences for entrees such as meat, fish, and casserole dishes are more firmly established and resistant to change when compared to preferences for vegetables and salads.

LC labeling appears to have been both informative and motivational. The labels provided information regarding the relative caloric content of food items, and if one were limiting caloric intake, labels helped. The restrictions of this study necessitated that the labels indicate relative rather than absolute caloric value. Perhaps a more precise listing of the caloric content would have provided better information and motivation that could have also influenced entree selection.

With the exception of entrees, then, the primary goal of increasing LC food selections was realized. Accordingly, we expected that the total calories purchased would show a corresponding decrease. Unfortunately, the total calories purchased by the subset of interviewed customers was unaffected. This failure could be related to possible sampling bias, the relatively small caloric difference between some of the labeled LC foods and other selections, and the observed increase in the selection of higher calorie entrees. In the first case the 413 customers whose meals were observed may not have been representative of the nearly 7,000 who purchased meals during the study. Secondly, because the experimenters had no control over the menus, the actual difference between the caloric content of LC foods and many of the higher calorie selections was small. For example, choosing an LC salad or vegetable over an unlabeled item often resulted in a caloric difference of less than 50 calories. Finally, the observation that the caloric value of entrees increased over successive sessions of labeling could also explain the failure of total meal calories to decrease. From our data, it appeared that any decrease in meal calories resulting from the increase in LC vegetable and salad selections was compensated for by the purchase of higher calorie entrees. This observation, coupled with the failure to find a change in LC entrees as a result of labeling, further suggests that changing entree choices will require more powerful interventions. The data on entrees leave open some interesting questions as to the factors that actually influence total meal selection in cafeterias. For example, do customers decide on their entree choice prior to selecting vegetables, salads, and desserts, which are then chosen as secondary items? Also, how important are seasonal preferences, the appearance and preparation of the foods, and the price of individual items? A better understanding of the importance of these and other variables controlling food choices will facilitate design of more powerful interventions. It may well be that labeling or other interventions for promoting healthier food choices should not target specific food items but rather characteristics of complete meals, e.g., their caloric or other nutritional value. Ideally, of course, the menus of cafeterias and restaurants could be altered to increase the probability of healthier choices by all customers.

The influence of individual variables, such as weight and sex, on food selection, as well as the interactions of these variables with nutrition labeling, needs to be better ascertained. One would not expect all customers to be concerned about the caloric content of their food purchases. Sex was a major factor affecting the caloric value of food purchases observed in this study. Our finding that males purchased higher calorie meals than females was consistent with Stunkard and Kaplan's (1977) review; however, we failed to replicate early findings that obese customers chose higher calorie meals than customers of normal weight. Our results agreed with those of Coll, Meyer, and Stunkard (1979), who also found that men purchased more food than women, but found no overall differences in amounts for obese and normal weight customers across a variety of different public eating places.

Of special interest in this study were the variables indicative of the effects of the manipulations on business indicators such as the number of customers and the sale volume. Throughout the period of this experiment, no change was observed in the total number of customers or the sales volume. Thus, restaurant managers who offer LC labeling probably need not be unduly concerned about declines in customers or total sales. Total sales remained unaffected even though some LC foods were priced lower than foods higher in calories. Should a reduction of sales occur as a result of caloric labeling, it could probably be offset by a higher profit margin on many LC items. Given the current emphasis on health and weight control of the general population, caloric labeling could represent a decided business asset that restaurant managers could advertise to their advantage.

REFERENCES

Allison, P. D., & Liker, J. K. (1982). Analyzing sequential categorical data on dyadic interaction: A comment on Gottman. *Psychological Bulletin,* 91, 393–403.

Brownell, K. D., Stunkard, A. J., & Albaum, J. M. (1980). Evaluation and modification of exercise patterns in the natural environment. *American Journal of Psychiatry,* 137, 1540–1545.

Coll, M., Meyer, A., & Stunkard, A. J. (1979). Obesity and food choices in public places. *Archives of General Psychiatry,* 36, 795–797.

Foreyt, J. P., Goodrick, C. K., & Gotto, A. M. (1981). Limitations of behavioral treatment of obesity: Review and analysis. *Journal of Behavioral Medicine,* 4, 159–174.

Forthofer, R. N., & Koch, G. G. (1973) An analysis for compounded functions of categorical data. *Biometrics,* 29, 143–157.

Green, L. (1978). Temporal and stimulus factors in self-monitoring by obese persons. *Behavior Therapy,* 9, 328–341.

Grizzle, J. C., Sturmer, C. F., and Koch, G. G. (1969). Analysis of categorical data by linear models. *Biometrics,* 25, 489–504.

Grizzle, J. E., & Williams, O. D. (1972). Log linear models and tests of independence per contingency tables. *Biometrics,* 28, 137–156.

Hayes, W. L. (1973). *Statistics for the social sciences* (2nd ed.). New York: Holt, Rinehart, & Winston.

Meyer, A. J., Nash, J. D., McAlister, A. L., Maccoby, N., & Farquhar, J. W. (1980). Skills training in a cardiovascular health education campaign. *Journal of Consulting & Clinical Psychology,* 48, 129–142.

Pennington, J. A. T., & Church, H. N. (1980). *Bowes and Church's food values of portions commonly used.* Philadelphia: Lippincott.

Rodin, J. (1981). Current status of the internal-external hypothesis for obesity. *American Psychologist,* 36, 361–372.

Romanczyk, R. G. (1974). Self-monitoring in the treatment of obesity: parameters of reactivity. *Behavior Therapy,* 5, 531–540.

Scott, L. W., Foreyt, J. P., Manis, E., O'Malley, M. P., & Gotto, A. M. (1979). A low-cholesterol menu in a steak restaurant. *Journal of the American Dietetic Association,* 74, 54–56.

Stalonas, P. M., Jr., Johnson, W. G., & Christ, M. (1978). Behavior modification for obesity: The evaluation of exercise, contingency management and program adherence. *Journal of Consulting and Clinical Psychology,* 46, 463–469.

Stunkard, A. (1980). The social environment and the control of obesity. In A. J. Stunkard (Ed.), *Obesity.* Philadelphia: Saunders.

Stunkard, A., & Kaplan, D. (1977). Eating in public places: A review of reports of the direct observation of eating behavior (pp. 89–101). *International Journal of Obesity,* 1, 89–101.

United States Department of Agriculture (1975a). *Nutritive value of American foods.* Handbook #456. U.S. Government Printing Office.

United States Department of Agriculture (1975b). *Composition of foods.* Handbook #8. U.S. Government Printing Office.

Wooley, S. C., Wooley, O. W., & Dyrenforth, S. R. (1979). Theoretical, practical, & social issues in behavioral treatments of obesity. *Journal of Applied Behavior Analysis,* 12, 3–25.

Zifferblatt, S. M., Wilbur, C. S., & Pinsky, J. L. (1980a). Influence of ecological events on cafeteria food selections. *Journal of the American Dietetic Association,* 76, 9–14.

Zifferblatt, S. M., Wilbur, C. S., & Pinsky, J. L. (1980b). Changing cafeteria eating habits. *Journal of the American Dietetic Association,* 76, 15–20.

Received August 27, 1982
Final acceptance June 13, 1983