AN EXPLORATORY STUDY OF SNACKING HABITS AND SCHOOL BEHAVIOR AMONG MIDDLE SCHOOL STUDENTS

PHILIP DULBERG

To the Graduate and Research Council:

I am submitting herewith a Field Study written by Philip Dulberg entitled, "An Exploratory Study of Snacking Habits and School Behavior Among Middle School Students." I have examined the final copy of this paper for form and content, and I recommend that it be accepted for the degree of Education Specialist with a major in School Psychology.

Garland E. Blair
Major Professor

We have read this field study and recommend its acceptance:

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A Field Study

Presented to the

Graduate and Research Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Education Specialist in

School Psychology

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by

Philip Dulberg

July, 1994

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ABSTRACT

This study investigated the snacking habits of a group of middle school students, comparing those habits to school behaviors. Subjects completed a questionnaire which listed all snacks available from the vending machines in the school. Teachers completed a behavior rating scale to assess the following school-related behaviors: overactivity, disruptiveness in class, off-task, energy swings, tense/anxious apppearance, and current letter grade.

Results indicated significant correlations between some snacks and certain behaviors, notably Mellow Yellow and both overactivity and tense/anxious appearance. Cheese puffs correlated positively with overactivity and current letter grade. Total number of snacks showed a positive relationship to overactivity and energy swings. Additionally, the behavior rating scale was measured for internal consistency, and it proved sufficiently high in this regard.

This exploratory research can only suggest possible connections. However, it does provide preliminary evidence that certain snacks are related to the behaviors studied here. Further investigation is warranted.

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CHAPTER 1

Review of the Related Literature

Nutrition and Behavior/Cognition

The relationship of nutrition and behavior has interested psychologists, educators, and parents for many years. However, the strength of such a connection, even its very existence, remains both inconclusive and controversial.

Attempts to link diet with behavior and learning have diverged into two areas, centering on indirect and direct relationships. Research indicating a direct relationship (wherein diet has an effect on development of the central nervous system) has been done mainly in countries with large numbers of deprived people. In a review of such research, Pertz and Putnam (1982) concluded that protein-poor diets produce children with lower IQs, diminished learning capacities, and diminished language development, as compared to diets higher in protein.

For example, a longitudinal study done in Guatemala (Freeman, cited in Pertz & Putnam, 1982) revealed significant differences in cognitive abilities (memory, recognition, perception, inference, and verbalization) when protein supplements were added to the diets of three- and four-year old children. Language development improved significantly as well.

Research performed by Pereira, Sundararaj, and Begum (1977) on children in India, ages six to twelve, compared children deprived of protein in early childhood to normal counterparts. Results showed lower performances on cognitive tasks by the protein-deprived group; a follow-up study two years later showed no improvement.

Protein deficiency is by no means the only factor suspected to directly influence learning ability. General malnutrition is also highly correlated with poor intellectual development and academic achievement (Pertz & Putnam, 1982). A study by Stoch and Smythe (1967) indicated that malnourished American school-age children had IQ scores averaging 22.6 points lower than normal children. Similar results were revealed in other countries as well, as reported by Turini (cited in Pertz & Putnam, 1982) in research performed on Brazilian children, and by Booyens (cited in Pertz & Putnam, 1982) in South Africa.

Duration and severity appear to be important in the influence of malnutrition on learning, as is the developmental period in which the deprivation occurs. Cravioto and Robles (1965) examined Mexican children who had suffered from malnutrition at different ages, finding that those affected prior to six months of age improved their intellectual abilities relatively little over time. McKay (1978) studied malnourished Colombian children who were subsequently treated with nutritional supplements and

educational activities to alleviate intellectual deficits. Findings indicate that such treatments were effective, but the age at which the children were treated influenced the degree of success.

Equally important to the direct relationship of nutrition to learning is the indirect effect, manifested in several ways. A diet with adequate nutritional value supplies energy, which optimizes the ability to learn. A highly nutritional breakfast was found by Morrell and Atkinson (1977) to improve attention among students during late morning lessons. Latham and Cobos (1971) concluded that nutritional deficits lower activity levels among preschoolers, which in turn lowers verbalizations, peer relationships, sensory stimulation, and, ultimately, readiness to learn in school.

Inadequate nutrition also indirectly affects learning by increasing absenteeism. Martinez and Chavez (1979) investigated the hypothesis that malnutrition lowers the ability to resist illness and infection, finding that poorly nourished Mexican children recorded twice as many sick days as normal children. It was concluded that poor nutrition indeed causes absenteeism, and absenteeism causes learning deficits which are difficult to correct.

Iron deficiency may also indirectly influence learning ability. When blood lacks proper iron levels, it fails to provide adequate oxygen to the body, including brain cells.

Research by Eames (1953) indicates that iron deficiency anemia may be a contributing factor in reading disability.

It is possible for an individual to eat an adequately nutritional diet and still suffer from the disabling symptoms of malnutrition. This occurs among those whose metabolism prevents proper utilization of nutrients. Williams (1956) discovered wide variations in metabolic rates, concluding that extremely low rates may inhibit learning.

Thorley (1988), in a review of literature, noted that malnutrition, especially in early childhood, does appear to be associated with cognitive and behavior deficits. However, he pointed out methodological problems with much research in this area. Diet was confounded "with impoverished environmental circumstances and disrupted child-rearing patterns" (Thorley, 1988, p. 148). Thorley concluded that none of the claims made over the last two decades have been substantiated by adequate research and should be viewed with caution.

Food Intolerance

Related to the indirect influences of nutrition on cognition is a hotly disputed topic: food intolerance. The term may refer to either toxic or allergic reactions to foods or additives. While it is generally agreed that allergic reactions produce physical symptoms which make learning more difficult, it has been most difficult to

establish what causes these reactions and the extent to which they influence the behavior of affected students. Thorley (1988) noted poor methodology and equivocal results in in research related to food intolerance.

Certain ingredients in certain foods have been widely researched. For example, caffeine, when taken in high doses, has been shown to produce symptoms identical to those of generalized anxiety disorder (Kruesi & Rapoport, 1986). The effects of moderate doses, however, remain unclear.

Another ingredient which has been frequently scrutinized is sugar. Goldman (1986) studied behavioral differences in preschool children given fruit juice sweetened on alternate days with sucrose and artificial sweetener. Play behavior for 90 minutes following was monitored. Findings indicated that increased levels of inappropriate behavior and decreased performance in learning tasks resulted when the children received sucrose, and differences were most marked from 45 to 60 minutes after dosage was administered. The authors concluded that while their correlational research cannot claim causality, it may suggest that certain children may be adversely affected by sucrose, and reaction may be age-related: the younger the child, the more likely the sensitivity.

Schoenthaler (1985) studied behavior of juvenile delinquents in detention centers before and during alterations to their daily diet in which sugar content was

reduced by 11 percent and nutritional content was improved generally. A marked improvement in behavior was noted, with the average weekly number of disruptive incidents falling from 56 to 25.

Prinz, Roberts, and Hantman (1980) investigated behavioral effects of sugar intake on the behavior of normal, healthy preschoolers. Results indicated a positive correlation between sugar consumption and aggressive or destructive tendencies.

However, for every study supporting the hypothesis that there is a link between sugar and behavior, there appears to be another to refute it. Wolraich, Milich, Stumbo, and Schultz (1985), for example, found no such relationship, explaining the inconsistency of research is due to four factors: age differences in subjects studied (suggesting that younger children show stronger effects); differences in the clinical status (normal versus hyperactive) in subjects, implying that behavioral effects may be more observable in non-hyperactives than in hyperactives; differences in time allowed between administration of sugar and observation of behavior; differences in research settings, wherein a child might be less likely to misbehave in a clinic or hospital than at home.

Kruesi and Rapoport (1986) reviewed literature regarding behavioral effects of both sugar and aspartame, finding no conclusive evidence that high or low sugar or

aspartame levels affect cognition or behavior. The researchers concluded that "acute sugar challenge does not cause hyperactivity and few or no cognitive effects are seen..." (Kruesi and Rapoport, 1986, p. 125).

Vitamin-related Research

The role of vitamins in behavior and cognition is also controversial. While considerable research has been done in this area, very little is widely accepted due to great difficulty in methodology. Adler (1979) stated that most clinical studies are accused of bias, and the widely varied individual differences among children make it nearly impossible to determine which treatment affects which subject, and why treatment worked (or did not). Adler further pointed out that these individual differences make double-blind experiments difficult, since optimal dosages must be determined over time, and if the experimentor knows the dosage, he/she is no longer "blind".

Despite the lack of solid findings, vitamin-related research is of interest here. Benton and Roberts (1988) studied the diets of 12-13 year olds by having them keep daily diaries of what thay consumed. Results revealed dietary deficiencies (less than the recommended daily allowance) in vitamin D, folic acid, and most minerals; supplements were provided to alleviate the deficiencies for half the children, the rest received a placebo. IQ tests were administered before and nine months after treatment.

While no significant increase was observed in verbal IQ mean scores, a significant increase was found in nonverbal IQ mean scores, leading the investigators to conclude that learning ability may indeed benefit from vitamin supplementation.

The work of Benton and Roberts provoked much attention and criticism, so Crombie et al (1990) replicated the study, correcting methodological weaknesses of the earlier work. Crombie et al found no significant effects in any area from supplementation, leading to the conclusion that mild malnutrition may adversely affect cognitive ability, but vitamin supplements do not alleviate the problem.

Schoenthaler (1991) performed similar research, giving vitamin supplements of varying strengths (50, 100, or 200 percent of recommended daily dosage, or placebo) to 12-16 year olds. IQ testing before and after treatment (practice effects were taken into account) revealed significant improvements in nonverbal IQ scores for the group receiving the 100 percent supplement over the control group, leading the investigators to conclude that supplements do improve cognitive abilities among reasonably well-nourished children.

Even if such findings are questioned and discounted, it is difficult to reject the hypothesis that diet is linked to learning. Flynn (1987) found that mean IQ scores have risen

markedly over the last 30 years, explaining the increase to a general improvement in diet.

Yet while general dietary improvements may well aid learning, specific deficits or overabundance in certain nutrients and chemicals may inhibit cognition. Grant and Chasty (1988) discovered that disabled readers, when compared to controls, had significantly higher levels of cadmium and lead (both considered toxic metals), and lower levels of zinc and chromium (considered beneficial trace elements). Such research highlights the widely held opinion that toxic metals like lead inhibit learning while adequate quantities of needed nutrients are necessary for optimal learning.

The Role of Food Additives: The Feingold Controversy

At the center of the diet-behavior debate is the work of Benjamin Feingold. An allergist by profession, Feingold theorized that artificial colorings and flavorings are causally related to hyperactive behavior among children. He claimed that elimination of the additives would decrease the hyperactive behavior (Feingold, 1975).

Feingold theorized that "numerous accessory substances occurring in varying concentrations" (p. 797) might influence hyperkinesis and learning difficulty. Initially, he targeted salycilates, found in aspirin and many other foods either naturally or as an additive, as problematic,

particularly when combined with tartrazine (yellow dye No.5). A salycilate-free diet, designed for those allergic to the chemical, was listed in the article, proscribing apples, oranges, tomatoes, ice cream, candy, toothpaste, soda, tea, among many other products.

Feingold then shifted his focus to artificial additives, in the form of colorings and preservatives, theorizing that they are responsible for hyperkinesis, or hyperactivity, and learning disabilities (Feingold, 1975) To underscore the point that children's daily diets are loaded with chemical additives, Feingold suggested the following scenario as typical: a child begins the day with a breakfast consisting of cereal full of added colors and flavorings, a beverage artificially sweetened and colored, or perhaps pancakes or French toast, full of tartrazine and other chemical additives; then the child's concerned mother provides vitamins, which are also high in additives. Following this, the hyperactive child might be given a dose of methylphenidate before school. At lunch the chemical additives continue, in foods such as hot dogs and ice cream. Is it any wonder, Feingold speculated, that our children are "jumping" and failing to learn? (Feingold, 1975). Feingold concluded with two recommendations: a means to make the public aware of the additives contained in all food products, and research to examine the possible link between these additives and child behavior.

From this hypothesis emerged the "Feingold Diet", which strictly avoids the undesirable chemicals. Many parents reported observing improvement in behavior, leading to widespread popularity of the diet and creation of local Feingold Associations across the country.

Extensive research has been done regarding Feingold's hypothesis, but it remains highly controversial to say the least. Mattes (1983) reviewed research on the subject, noting that several approaches have been utilized to evaluate the merits of the Feingold diet. Conners, Goyette, and Southwicke (1976, as cited in Mattes) compared behaviors of 15 diagnosed hyperactive (the term used for the disorder by the researchers) children over one month trials on the Feingold diet and a control diet. Significantly favorable results were observed for the Feingold diet by teachers but not by parents.

Research by Harley et al (1978) regulated the diets of entire families, administering Feingold and control diets for one month periods in random order to 46 hyperactive children, 10 of whom were preschoolers, 36 between six and twelve years old. Behavior was evaluated by teacher and parent questionnaires, neuropsychological tests, and direct observation in the classroom. While parent ratings showed significant improvements in behavior, no significant overall effects were discovered. The researchers then selected nine children who had responded favorably to the Feingold diet,

"challenging" them with doses of food coloring. Interestingly, no effects were observed, leading the researchers to conclude that their work offers little support to the Feingold hypothesis.

The "challenge" technique was also used by Goyette, Conners, Petti, and Curtis (1978) and Conners (1980). Both studied hyperactive children who had benefited from the Feingold diet as rated by parents. Artificial additives and placebos were then administered in double-blind experiments. Results were highly inconclusive, fraught with contradictory observations by teachers and parents, and differences between short- and long-term effects noted. Further confusing the findings was the fact that some subjects did show highly significant reactions to the artificial additives.

An interesting variation on this technique was performed by Williams and associates (1976, 1978, as cited in Mattes), wherein hyperactive children who had responded to the Feingold diet were given various combinations of medication (methylphenidate or dextroamphetamine) and placebos, and food additives and placebos. The medications produced significant improvements in behavior, as expected, but all findings regarding responsiveness to additives were inconclusive and at times confusing. For example, responsiveness to additives was found only on teacher ratings, not by parents, and only when combined with placebo

medication. As in other studies, certain children did react strongly to the additives; however, parents and teachers showed disagreement as to which children reacted strongly.

Similar research by Weiss et al (1980) studied children diagnosed as hyperactive who had shown improvement on the Feingold diet. The double-blind study administered food coloring randomly for eight days in a 77-day period, a placebo administered on the other days. No significant findings were observed overall, with 21 of the 22 subjects showing no effects. One child, the youngest in the sample (three years old), did show strong and consistent reaction to the additives.

Research by Mattes and Gittelman-Klein (1978) centered on a single diagnosed hyperactive child who was reported by his parents to have made marked improvement on the Feingold diet. The child was administered cookies over 11 trials, some cookies containing artificial coloring, others using natural ingredients. No significant behavioral effects were found.

Research of the types mentioned above is assessed by Rimland (1983), who offers several criticisms. First, Rimland considers most such studies to be irrelevant because they insufficiently test the more than 3,000 additives which the Feingold diet eliminates. Not only are artificial colors and flavors excluded from the diet, but

preservatives, thickeners, moisteners, etc. must be considered as well, according to Rimland.

A second point of rebuttal offered by Rimland to the many studies refuting Feingold's hypothesis is that dosages in most of the research are much too small. Rimland contends that not only are dosages "ridiculously small" (p. 331), but the number of additives studied (usually between 7 and 10) is inconsequential when compared to the more than 3,000 identified by Feingold (Rimland, 1983).

Reaction to the work of Egger, Carter, Graham, Gumby, and Soothill (1985) illustrates the lack of agreement on the importance of research regarding diet and behavior. Egger et al found a significant relationship between additives and behavior, linking artificial flavors and colors, cow's milk, wheat, and other food products to hyperactivity and even seizure activity. Pollock (1988) reviewed these findings and argued that the results were invalid due to the lack of double-blind conditions. Schauss (1988), on the other hand, also reviewed the study of Egger et al, finding it to be of major importance. Firman (1989) concurred, pointing out that Egger and associates' work shows that elimination of certain foods from certain children's diets can change behavior presumed to be caused by family or psychoscocial problems.

Taylor and Hepinstall (1990) reviewed research on the issue, also noting a lack of consistent findings. However,

the authors acknowledge that changes in behavior do occur in certain subjects, and these changes are often lost in otherwise negative findings. Taylor and Hepinstall believe that research neither proves nor disproves Feingold's hypothesis, and they speculate that dietary modifications may be effective not because they eliminate additives but because they eliminate foods which instigate immune responses.

Graham (1987), in a review of research, noted a general failure to prove Feingold's claims, stating that success appears mostly in parental perceptions rather than in more scientific conditions, such as double-blind experiments. Graham does point out, though, that negative outcomes must be viewed with caution for two reasons: first, some children do seem to genuinely benefit from the dietary changes; second, subjects may not have received adequate doses of the additives in question to yield observable effects.

Perhaps the one conclusive statement which can be made regarding the influence of additives on behavior is that results are inconclusive. However, one conclusion was reached in many of the studies mentioned above: certain children are strongly and adversely affected. Hobbis (1991, cited in Connor) suggests that approximately 15 in 1,000 children, or 1.5 percent, fall into this category. While he concluded that the problem cannot be considered a major

health concern, Hobbis conceded that the difficulties encountered by this 1.5 percent (and their families) are enormous.

Children commonly eat snack-foods containing the ingredients studied in the above research. This study sought to examine these habits in a group of middle school students to determine preferences of items available from in-school vending machines. Students' behaviors, as rated by teachers, are also of interest; patterns between types and amounts of snacks consumed and types of behavior are to be examined.

Chapter 2

Methods and Results

Subjects consisted of 52 middle school students at Sycamore Middle School, in Pleasant View, Tennessee. Two classes were selected to participate, one a sixth grade and the other an eighth grade class. Subjects ranged in age from 12 to 14.

Students received a parental permission form to be signed and returned to the researcher. Those complying were given a questionnaire listing all snack items sold in the school vending machines and asked to indicate which items they typically consume, how many, and at what time of day; subjects were also asked to indicate what they typically eat for breakfast. Subjects were told that they were participating in a research project to determine snack preferences, that participation was voluntary, and that all responses were confidential, not to be seen by school personnel.

One of the responding students' teachers was then asked to complete a rating scale to determine various aspects of behavior: overactivity (fidgety, restless); disruption of class by speaking or acting out; ability to stay on-task; swings of fatigue and alertness; tense/anxious appearance; and current academic performance. Rated items were on a five-point Likert scale.

Due to a lack of normative data regarding the reliability of the behavior rating scale, a number of statistical measures was performed. Behavior rating scales were completed for an additional 62 students. An internal consistency reliability estimate was as follows: coefficient Alpha = 0.879.

To further assess the test instrument, an analysis of variance was performed. Partition of variance using analysis of variance was done under the framework of generalizability theory in a one facet model. Findings showed the following: differences between subjects accounted for 60.4% of variance; differences in items accounted for 3.0% of variance; error accounted for 36.6% of variance. Thus, it may be seen that measurement error and possible interaction between items accounted for 36.6% of total variance, indicating that the behavior rating scale utilized here is a reasonably reliable instrument which tapped meaningful differences between subjects. These data suggest a high degree of internal consistency for the measure.

Table 1

Snack Preference Questionnaire Frequencies.

Item	Amount Consumed/ Person	Frequency	Percent
Coca-Cola	0	32	61.538
	1	16	30.769
	2	2	3.846
	3	2	3.846
Cherry Coke	0	51	98.077
	1	1	1.923
Dr. Pepper	0	41	78.846
	1	9	17.308
	2	2	3.846
Mellow Yellow	0	32	61.538
	1	11	21.154
	2	5	9.615
	3	3	5.769
	4	1	1.923

Item	Amount Consumed/ Person	Frequency	Percent
Sprite	0	42	80.769
	1	10	19.231
Apple Juice	0	49	94.231
	1	3	5.769
Cranberry Drink	0	49	94.231
	1	3	5.769
Potato Chips	0	22	42.308
	1	20	38.462
	2	10	19.231
Pretzels	0	43	82.692
	1	8	15.385
	2	1	1.923
Cheese Puffs	0	49	94.231
	1	2	3.846
	3	1	1.923
Cookies/No choc.	0	51	98.077
	1	1	1.923
Cookies w/choc.	0	47	90.385
	1	4	7.692
	3	1	1.923

Item	Amount Consumed/ Person	Frequency	Percent
Brownies	0	48	92.308
	1	4	7.692
Chocolate Bars	0	36	69.231
	1	13	25.000
	2	3	5.769
Crackers	0	47	90.385
	1	4	7.692
	2	1	1.923
Trail Mix/Raisin	0	49	94.231
	1	3	5.769

Results of the snack preference questionnaire are indicated in Tables 1 and 2. Mellow Yellow emerged as the most frequently consumed beverage among the sample (28 total), with Coca-Cola second (24 total) and Dr.Pepper third (14 total). Among food items, potato chips was the clear favorite (39 total), followed by chocolate bars (16 total) and pretzels (10 total). The mean number of snacks consumed per person was 3.558. It should be noted that these totals reflect the fact that many subjects typically purchase two or more of the same item: for example, four students

consume two or more Coca-Colas daily; eight consume two or more Mellow Yellows each day.

Correlational information between snacks consumed and school behavior was obtained by Pearson product moment technique. Results are summarized in Table 3. A positive correlation between Item 1 on the behavior rating scale (overactivity, restlessness) and the total number of snacks consumed daily was discovered (P=.0142). Item 4, swings of fatigue and alertness, also correlated positively with total snacks consumed to a significant degree (P=.0434).

Consumption of Trail Mix with raisins correlated significantly with Item 4, swings of fatigue and alertness (P=.0364). Also, chocolate bars were found to correlate significantly with Item 5, tense or anxious appearance (P=.0393).

Mellow Yellow produced interesting and highly significant results: a high positive correlation with Item 1, overactivity (P=.0019), and with Item 5, tense, anxious appearance (.0002). Cheese Puffs also showed a positive and significant relationship to Item 1, overactivity (P=.0476), and to Item 6, the student's current letter grade in the evaluating teacher's class (P=.0488).

Table 2.

Relative Frequency of Snack Preferences

Item	Total Consumed Daily
Coca-Cola	24
Cherry Coke	1
Dr. Pepper	14
Mellow Yellow	28
Sprite	10
Apple Juice	3
Cranberry Cocktail	3
Potato Chips	39
Pretzels	10
Chese Puffs	2
Cookies/No Chocolate	1
Cookies/with Chocolate	7
Brownies	4
Chocolate Bars	16
Crackers	6
Trail Mix/Raisins	3

Table 3.

Intercorrelation of School Behaviors To Snack Preferences

Snack	Behavior Rating Scale Item					
	1	2	3	4	5	6
	Over-active	Disrupts Class	Off-task	Energy Swings	Tense/ Anxious	Grade
Coke	-.010	-.099	.169	.026	-.180	.067
Cherry Coke	.204	.007	-.027	-.027	-.018	-.025
Dr.Pepper	.160	.088	.153	.362	.043	.147
Mellow Yellow	.420#	.264	.240	.225	.492#	.204
Sprite	-.044	-.101	-.052	-.145	-.152	.065
Apple Juice	.092	.012	-.115	-.048	-.031	-.131
Cran.Cocktail	-.177	-.058	-.115	-.133	-.108	-.131
Potato Chips	.074	-.015	.269	.139	-.081	.083
Pretzels	.138	.096	.097	.181	-.014	.012
Cheese Puffs	.276*	.157	.030	.220	.172	.275*
Cookie/No Choc.	-.138	-.113	-.141	-.170	-.148	-.025
Cookie w/Choc.	.114	-.089	-.118	-.055	-.109	-.009
Brownies	-.226	-.109	-.173	-.204	-.103	-.128

	1 Over-active	2 Disrupts Class	3 Off-task	4 Energy Swings	5 Tense/ Anxious	6 Grade
Choc. Bars	.265	.170	.097	.145	.287*	.195
Crackers	-.053	-.073	-.100	.149	-.229	-.002
Trail Mix	.088	.080	.085	.294*	.196	.036
Total Snacks	.338*	.115	.213	.281*	.128	.222

*p<.05

#p(.01

Chapter 3

Conclusions

Several interesting findings emerged from this research. One is the unexpectedly large quantity of snack foods and beverages consumed in a typical day by the sample group: more than 3.5 snacks per person. This finding raises questions as to what, if anything, these children eat for lunch. It may be speculated that the snack foods provide a substitute, albeit a poor one, for lunch in many cases. While foods from the vending machines are tasty and convenient, they are undeniably low in nutritional value, high in fat, calories, and sugar content. They are also expensive, ranging from $.50 to $.65 each. The typical subject, then, spends in excess of $1.50 each day on snacks (multiplied by the 180 days in the school year, this child spends more than $270 per year on snacks).

Subjects were asked to list a typical breakfast, and 38 so indicated, with cereal as the predominant food choice (22 of the 38 who eat breakfast) and juice, mostly orange, as the most frequently consumed beverage (11). Pop-tarts (9) and sausage/biscuits (9) were frequent choices as well. Several unusual items appeared, such as a grilled cheese sandwich (1), potato chips (1), brownie (1), and water (1). Only one subject listed soda (Coca-Cola) as part of his/her

typical breakfast, a somewhat surprising finding given the popularity of such beverages.

Perhaps a more important finding of this research is the suggestion that some problem school behaviors may have a relationship to the quantity and quality of items consumed. Of particular interest is Mellow Yellow, which appears to show such a strong correlation to overactivity and tense/anxious appearance. This soft drink, the favorite of this sample, contains approximately 18% more caffeine than the other snacks available (54 mg/12 ounce can compared to 46.5 mg for Coca-Cola). The effects of caffeine on behavior and cognition are well-researched but highly inconclusive. However, Rapoport, Berg, Ismond, Zahn, and Neims (1984) researched this relationship, concluding that children may regulate caffeine selectively but subconsciously. It is wondered if the remarkable popularity of Mellow Yellow seen in the present research might stem from more than its taste: perhaps the children, consciously or subconsciously, choose it for its stimulating properties.

Mellow Yellow also contains tartrazine, the artificial coloring agent also known as FDC Yellow No. 5. A common food additive, it is present in 26.9% of all dyes (Nutrition Foundation, cited in Fiorito, 1983). Levy and Hobbes (1978) examined the effects of this substance on children diagnosed as hyperactive who had been helped by the Feingold diet. Results indicated that those who had shown the most

improvement on the diet also showed the strongest effect of tartrazine vs. placebo. Other research (Swanson and Kinsbourne, 1980, Goyette et al, 1978, Harley et al, 1978) further suggests a connection between tartrazine and hyperactive behavior.

The connection between tartrazine and overactivity has also been researched using rats as subjects. Golden, Mitchell, Murphy, and Peacher (1982) discovered an increase in activity levels of rats injected with tartrazine. Fiorito (1983) also found hyperactive-like behavior in tartrazine-injected rats. Shaywitz, Goldenring, and Wool (1978) observed that rats given food colorings (including tartrazine) displayed increased activity in a shuttle box and decreased efficiency in a maze.

A significant relationship was also seen in the present study between consumption of cheese puffs and two problem areas: overactivity and low grades. Cheese puffs also contain tartrazine, which strengthens the supposition that the substance may be related to behavioral difficulties.

Three subjects in the present study indicated a daily consumption of three Mellow Yellows. One, a female eighth grader, also typically consumes one Dr. Pepper, two bags of potato chips, one chocolate bar, and two packages of crackers. Her scores on the behavior rating scale were as follows: overactive = 3; disruptive = 3; on-task = 3; energy swings = 4; tense/anxious appearance = 2; grade = C.

This child, then, displays moderate behavior difficulties in class while consuming a large quantity of snack food.

Another child who consumes three Mellow Yellows per day, a sixth grade male, additionally eats two bags of potato chips and one chocolate bar. His behavior was evaluated as follows: overactive = 2; disruptive = 2; on-task = 3; energy swings = 3; tense/anxious appearance = 2; grade = C. This student's behavior problems might then be described as mild to moderate while his daily consumption of snacks is considerable.

A third subject who consumes three Mellow Yellows daily, a sixth grade female, also drinks one Coca-Cola, and eats three bags of cheese puffs and two chocolate bars. Her behavior was rated as follows: overactive = 5; disruptive = 4; on-task = 3; energy swings = 4; grade = D. The child's teacher underlined the word "overly" in the phrase "overly active" on the rating scale, and added that the girl is "very excited at all times." The child indicated that a typical breakfast consists of: pop-tarts, chips, cereal, cinnamon rolls, and sausage. Here, then, is a child who displays serious behavior difficulties while consuming very large quantities of snack foods daily.

Examples like these may lend support to the contentions of many researchers (Graham, 1980, Taylor and Hepinstall, 1990, Weiss et al, 1980) who, while stopping short of endorsing Feingold's (1975) hypothesis, did note dramatic

effects of exposure to and withdrawal from snack food additives. While the first two cases showed only moderate difficulties despite high intake, the third child combines major problems and high intake.

This research is both correlational and exploratory in nature. Therefore, no inferences as to cause and effect can be made, nor can solid conclusions be drawn. The suggestion can be made, however, that there may be a connection between consumption of snack foods and problem behaviors in school. This possibility is drawn from the significant positive correlation found between total number of snacks consumed and certain behaviors (overactive and energy swings). The correlations found between certain foods and beverages and problem behaviors (cheese puffs correlated with overactivity and poor grades, for example) might also point toward such a connection.

Some results must be considered as abberational. For instance, the positive correlation (P=.0364) discovered between Trail Mix and mood swings is difficult to explain, but the low frequency as a snack selection (three over the entire sample) makes the finding dubious. Similarly, the correlation between consumption of chocolate bars and tense/anxious appearance is enigmatic. While it might be tempting to attribute the presence of caffeine in chocolate to such a connection, it must be considered that many other snacks studied here also contain caffeine (Coca-Cola, Dr.

Pepper, Brownies, etc.) but did not produce such correlations.

Other results of this study may be of greater value, however. The significant correlations between Mellow Yellow and overactivity and tense/anxious appearance are noteworthy for their strength ($P<.01$ in both cases) and the fact that Mellow Yellow contains tartrazine as well as higher amounts of caffeine than any other product studied. The significant correlations between cheese puffs and both overactivity and poor grades adds to curiosity over the role of tartrazine, which is also present in cheese puffs.

The purpose of exploratory research is to open doors for further study, to raise questions to be answered in subsequent investigation. This study asks questions concerning the effects of snack foods on children's behavior and ability to learn. Do they eat too much of this nutrition-poor food (and not enough healthy food)? What causes the observed connections between consumption and behavior? Does such a diet affect ability to learn at an optimal level? Should these foods be sold in schools at all? Does tartrazine play a role?

These questions cannot be answered in the scope of this investigation. Further research, in more controlled settings, is suggested.

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