Notes:

- Only 18 children were in this study – SMALL. It takes a big change to be significant in a small study
- All of them had tested hyper using the Conners Rating Scale
- Conners rating ON DIET not given.
- They had already been on the diet more than 3 months; this would mean that there would be a "washout" effect – and a small infraction would most likely not affect them much.

- **9 of the 14 variables "showed a tendency toward deterioration for the artificial snack."** Well, that is MOST of the tests, but which ones were not specified.

- In Table 2, they added up the amounts of food dyes they claimed were in the snack, and got 26.3 mg.
- Add it up yourself, and your total will be 18.8 mg
- This was 1981. In 1977 the National Academy of Science had reported that kids ate up to more than **300** mg/day
- The kids were tested 3 – 4 hours AFTER the snack.

  Why wait so many hours, when reaction generally occurs between half an hour and 2 hours after eating it? Could it be a desire to make sure no change would be measured? Besides, wouldn't the kids be really hungry about then?

- The parent perception of behavioral change was not reported.
- **Adams concluded the DIET didn't work**; also said that instead of juice and cookies a child would get ginger ale and saltines in school and thus be labeled "strange." What's wrong with juice and cookies on the Feingold diet anyhow?

NOTE: The placebo cupcake had vanilla frosting which matched the "active" cupcake. In other words, they added SO LITTLE yellow color that the color of the frosting DID NOT CHANGE.

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LACK OF BEHAVIORAL EFFECTS FROM FEINGOLD DIET VIOLATIONS

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Summary.—Children were included in this challenge study if according to parental report (1) the child's hyperactive behavior had been noticeably improved for at least 3 mo. as a result of adherence to the Feingold diet and (2) dietary violations such as those used in the study were reported to have a noticeable negative effect. Evaluations of 14 objective measures in a double-blind, cross-over design yielded no significant differences between diet infraction and noninfraction conditions. In addition to questioning the stated efficacy of the diet, findings suggest that one should not depend solely on parental report when evaluating a dietary effect and should also weigh potential negative effect of adherence to the diet.

Several empirical studies have investigated the behavioral effects of artificial colors and flavors and natural salicylates in the diets of children since Feingold's initial anecdotal report on their negative effect (Feingold, 1975, 76). It is Feingold's contention that even small amounts of these additives have deleterious effects on a majority of children, often producing what has been described as hyperactive behavior. Experimental findings have been equivocal, some showing no or negligible negative effects of diet violations (Conners, Goyette, Southwick, Lees, & Andrulonis, 1976; Harley, Ray, Tomasi, Eastman, Matthews, Chun, Cleeland, & Traisman, 1978; Harley, Matthews, & Eastman, 1978); other studies yield significant results (Williams, Cram, Tausig, & Webster, 1978; Swanson & Kinsbourne, 1980; Weiss, Williams, Margen, Abrams, Caan, Citron, Cox, McKibben, Ogar, & Schultz, 1980). However, the results of the five to six years of careful research since Feingold's initial claims have tempered expectations of a dramatic behavioral effect in the majority of children.

The following challenge study was designed to investigate the effect of dietary infraction on a number of behaviors often associated with hyperactivity. It is possible that the equivocal findings in the literature are attributable to the tasks employed since most results supporting a dietary effect have used parents' or teachers' subjective ratings or a paired-associate learning task. Consequently, diet effects were evaluated on objective measures within the related areas of activity level, auditory, visual and on-task attention, fine-motor and gross-motor skills.

[1]Thank Robert Witt for his help in collecting data for this investigation.
[2]Request reprints from Wayne Adams, Child Diagnostic and Development Clinic, Alfred duPont Institute, P.O. Box 269, Wilmington, DE 19899.

METHOD

Subjects

Subjects were those who responded to an announcement in a monthly newsletter distributed by a local Feingold Association. The purpose of the study was described and willing parents contacted the experimenter. Each child was to have been hyperactive and improved by dietary adherence. Conners Rating Scale (Conners, 1973) results showed that for all children included pre-diet ratings were beyond the traditional total score of 15 (2 standard deviations above average). Further, parents agreed that a positive diet effect was detectable in their child for at least three months, presumably eliminating potential placebo effects attributable to novelty of new parenting and eating patterns resulting from introducing the diet. Also, since they had been on the diet this long, these children apparently met Feingold's criterion of having had time for their bodies to be "cleared" of residuals of the artificial substances. Fifteen males and three females (mean age = 91.1 mo., age range = 4 yr., 5 mo. to 11 yr., 7 mo.; average Peabody Vocabulary IQ = 116.5) were obtained and randomly assigned to one of two groups; half the sample received a Feingold-diet snack first followed by a diet violation-snack with the other half receiving the snacks in the reverse order. Analyses showed no differences in age or IQ between these "groups." Each parent subjectively reported to have witnessed a prior negative effect following a diet violation using substances the same as or similar to those employed as "challenges" in this study.

Materials and Procedure

Each child was greeted and evaluated by the same observer for each session during which all measures listed in Table 1 were administered in a random order with the exception that the procedure in the activity room began the session and the procedure with the bean bag ended it, and the digits forward and backward were given consecutively and in that order. Prior to Session 1, subjects were given a snack and asked to eat it 3 to 4 hr. prior to the session. At the conclusion of the first session, each child was told that he would return to do the same tasks again. The child was given a second appointment along with the second bag containing a snack again to be consumed 3 to 4 hr. preceding the second session. Parents were aware that the snack foods were made either with ingredients containing artificial colors and flavors or from all "natural" ingredients. Neither parent nor observer knew which snack had been given until completion of the experiment. Parents and child were asked to record all foods the child consumed during the day before the child's initial visit as well as during the usual two-day interval of the study.

The snacks given to each child were a chocolate cupcake with vanilla icing and a glass of lemonade. The cupcakes were baked by parents who were

TABLE 1
MEASURES UTILIZED TO TEST EFFECT OF DIETARY INFRACTION

Area Assessed*	Assessment Procedure or Device	Dependent Measure
Over-all Activity Level Quadrants *M* = .44; 1.00 *SD* = 1.3; 2.2 Toy Changes *M* = 4.33; 4.79 *SD* = 4.6; 4.4	An activity room, 2.74 m × 3.66 m, divided into 4 equal parts by lines of black plastic tape on the floor. In each quadrant there was a chair and a table with the same six toys on each table: a "nerf" airplane, a book about dinosaurs, crayons and paper, an "Etch-A-Sketch" game, a marble pin-ball game, and a Tinker Toy set. The child was introduced to the room and told that he could play in the room until the observer returned with some tasks they would work on, but the child should choose only one toy and play with only that one. Also, the child was requested to remain seated until the observer returned.	1. & 2. Number of quadrant and toy changes during a 10-min. waiting session. Behaviors recorded behind a 1-way mirror (after Routh, Schroeder, & O'Tuama, 1974).
Fine-motor Skill *M* = 10.8; 10.5 *SD* = 4.6; 4.4	Developmental Test of Visual-motor Integration. A design reproduction task of progressive difficulty.	3. Number of correct reproductions according to test manual scoring directions (Beery & Bukrenica, 1967).
M = 20.9; 19.3 *SD* = 12.1; 22.0	Handwriting sample obtained from child copying a short paragraph.	4. Handwriting rating by two observers according to Lerer, Lerer, and Artner (1977). (Note: interrater reliability = .91.)
M = 11.8; 12.8 *SD* = 3.9; 4.5	Draw-A-Child subtest from the McCarthy Scales of Children's Abilities ("Draw me a picture of a child and be sure to draw all of him.")	5. Total points obtained according to scoring manual (McCarthy, 1972).
Gross-motor Skills *M* = 21.1; 18.2 *SD* = 6.7; 8.3 *M* = 21.0; 15.2 *SD* = 7.1; 8.4	Hopping Ability on Right leg. Hopping Ability on Left leg.	6, 7. Total number hops before other leg touches floor, up to 25 hops.
M = 5.1; 7.6 *SD* = 6.4; 9.2 *M* = 4.0; 4.7 *SD* = 2.3; 1.9	Ball Bouncing using standard size rubber ball provided with McCarthy Scales of Children's Abilities. Bean-bag Throw: Throwing 10 × 15 cm bean-bag into "frog's mouth" opening, at a distance of 7 ft.	8. Total number of ball bounces with preferred hand. 9. Total number of bean-bags going through opening, 10 bean-bags thrown.

(continued on next page)

*Means and standard deviations are listed, with control condition preceding challenge condition.

TABLE 1 (CONT'D)
MEASURES UTILIZED TO TEST EFFECT OF DIETARY INFRACTION

Area Assessed*	Assessment Procedure or Device	Dependent Measure
Short-term Auditory Memory M = 7.3; 7.2 SD = 2.3; 1.6 M = 3.1; 2.9 SD = 1.2; 2.0	Numerical Memory subtest from McCarthy Scales consisting of repeating digits both as recited as well as in reversed order.	10, 11. Total number correct, scored according to McCarthy manual
Short-term Visual Memory M = 28.7; 31.5 SD = 12.1; 22.0	Visual-memory sequenced subtest from the Illinois Test of Psycholinguistic Ability.	12. Total number of elements ordered correctly (Kirk, McCarthy, & Kirk, 1968)
Receptive Language M = 69.3; 67.9 SD = 9.9; 11.9	Peabody Picture Vocabulary Test.	13. Total number correct, scored according to manual (Dunn, 1965)
Parental Observations M = 2.8; 2.3 SD = 0.3; 0.7	Parental Rating sheet consisting of parental rating of the effect of the substance given on their child's behavior in 10 areas. Ratings were greatly worse (assigned a score of 1), slightly worse (2), no change (3), slightly improved (4), and greatly improved (5).	14. Total score over 10 ratings, each rating assigned a score 1 to 5 depending upon extent of observed effect

*Means and standard deviations are listed, with control condition preceding challenge condition.

members of the Feingold Association. "Natural" snacks used ingredients consistent with the Feingold diet (Feingold, 1975). "Artificial" snacks consisted of commercial mixes. The artificial lemonade was a powdered mixture and the natural lemonade was prepared from frozen concentrate. In addition, the commercially available cupcake mix had added to it two additional tablespoonfuls of red food coloring per package and the artificial frosting mix had one tablespoonful artificial vanilla and one teaspoon yellow food color added. Using manufacturer supplied data, one serving of the "artificial snack" contained 26.3 mg. of food dye (see Table 2).

TABLE 2
FOOD DYES CONTAINED IN CHALLENGE SUBSTANCES

Snack Food	Dye Used	Quantity per Serving
1 glass lemonade	Yellow No. 5	.3 mg
1 cupcake (with additional food coloring)	Red No. 3 Red No. 40	3.0 mg 14.7 mg
Frosting (with additional food coloring)	a blend of Yellow No. 5 and Yellow No. 7	.8 mg
Total food dye content per serving 26.3 mg		

During the second visit, the child was again administered the same tasks just described. While their child was being evaluated each time, the parent(s) completed an observational checklist indicating the degree of change they thought they had observed during the 3- to 4-hr. period since the snack had been consumed. Parents also stated at what time and how much of the snack had been consumed by the child.

RESULTS

Within-groups analyses of variance were performed using the placebo and diet order and each of the 14 dependent measures listed in Table 1. No significant differences between the two orders or content of snack were found. No significant interaction effects were noted. Nine of the 14 dependent variables showed a tendency toward deterioration for the artificial snack (p = .40). Chi-squared analysis of the proportion of children who deteriorated on half or more of the measures was not different for the two groups ($p > .20$).

Grouping data by areas of competence, e.g., gross-motor, fine-motor, and attentional, did not yield any area which was negatively affected. Also, there were no significant differences between the variances of the groups corresponding to the substance ingested. A young vs old analysis of performance (median split on age) was also nonsignificant.

Discussion

Despite the very select group of subjects in this study, an infraction of the Feingold diet did not produce any significant generalized deterioration in areas of performance, including open field activity, fine-motor and gross-motor skills, or short-term auditory and visual memory. Even for those few children showing deterioration in half or more of the dependent measures under the artificial condition, changes were slight, and one needs to consider the importance between statistical and clinical significance. For example, most cases of "deterioration" were small differences consisting of 1 vs 2 picture vocabulary cards or 1/10 vs 2/10 of a point of drawing skill; in no case did the negative effect on a specific task for a given child result in a 25% or more decrement in performance.

Weiss and his colleagues (Weiss, *et al.*, 1980) have reported more marked negative effects to food dyes in younger children (3 or 4 yr. of age). Since the average age in the present study was almost 8 yr., the effect might have been more pronounced if younger children had been tested. However, no difference was found for an analysis of amount of deterioration by age (younger age mean = 77.8 mo.).

Swanson and Kinsbourne (1980) have recently drawn attention to the importance of the quantity of dye ingested, finding deterioration from diet infractions on a paired-associate task after ingesting 100 mg. or more of dyes. The apparent lack of significant results in the present study may be attributable to the lesser number and amount of dyes ingested. The average amount of dye ingested daily by US children is estimated to be between 27 and 36 mg. (The National Advisory Committee on Hyperkinesis and Food Additives, 1980). Nevertheless, all parents who participated in our study assured us that, if their children were in the artificial group and ate only part of the snack "we'd find out about it at home." In one sense these data do not so much call into question the veracity of whether food dyes at some quantity will affect some children's behaviors as much as they call into question the reliability of a parent's belief system of what substances negatively affect their children's behavior. It seems that parental report of the diet's positive or negligible effect should not be trusted apart from a more objective measure.

In light of these and other findings, one must consider the cost of labeling children as "different" because they are not allowed to eat like their peers. It may be that denying a youngster juice and cookies in nursery school and giving him his own ginger ale and saltine may result in more harm than good. This remains a question for future research. In addition, subjective parental impressions of changes of their child's behavior might avert attention from other treatment efforts. Without more clear-cut and consistent support, weighing costs and benefits in each individual situation becomes increasingly important.

Although the present investigation does not disprove the possibility that there may be negative effects produced by artificial food substances in some behaviors of some children, it does lend further evidence that, given the substances used in this investigation, if there is a diet effect it (1) is less reliably demonstrated than parents predict, (2) affects many fewer children than originally postulated, and (3) behaviorally has a less dramatic and pervasive effect on attentional and motor performance than originally believed.

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