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Changing the way our children eat: a behavior analytic approach

Zmiana nawyków żywieniowych u dzieci: podejście behawioralne

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Summary

Though related to contingencies of survival, eating is not an easily self-maintained behavior. A number of feeding and eating problems may arise early in a child life and are defined by his/her inability or refusal to eat or drink a sufficient quantity or variety of food to maintain proper nutrition. They appear as alterations in the form (frequency, duration, speed, time of the day) and in the content (type of food) of feeding/eating behavioral chains. Dysfunctional mealtime behaviors include food refusal, tantrums, food selectivity, rapid or slow eating, vomiting, coughing, or keeping mouth voluntary closed. Problematic feeding is ascribed to many causes, and it mainly arises from the interaction of biological and environmental factors.

In this paper we will discuss a wide range of strategies elaborated within a behavior analytic framework to show how feeding and eating in children can be effectively modified. We will briefly focus on how behavior analysts conceptualize problematic feeding, then examine some examples of intervention strategies for different feeding problems, and finally sketch how a behavioral based intervention on a large scale may increase fruit and vegetables consumption in children between 2 and 11 years old and ultimately help in preventing child's obesity.

Key words: obesity, children, behaviour analysis, Food Dudes

Streszczenie

Mimo iż jedzenie jest zachowaniem potrzebnym do przetrwania, nie jest ono łatwo kontrolowane przez ludzi. Już we wczesnym dzieciństwie mogą pojawić się trudności związane z karmieniem i przyjmowaniem pokarmu, które polegają na niemożności lub odmowie spożywania wystarczającej ilości i jakości jedzenia, aby dziecko otrzymało odpowiednie składniki odżywcze. Problemy te można opisać jako nieprawidłowości w formie (częstość, czas trwania, szybkość, czas dnia) i zawartości (rodzaj jedzenia) łańcuchów zachowania związanych z jedzeniem. Do niepoprawnych zachowań związanych z karmieniem należą: odmowa jedzenia, ataki złości związane z jedzeniem, wybiórczość jedzenia, zbyt wolne lub zbyt szybkie jedzenie, wymioty, ataki kaszlu, sprawcze trzymanie zamkniętych ust w celu uniknięcia jedzenia. Trudności związane z jedzeniem można przypisywać wielu powodom, ale większość z nich wynika z interakcji elementów biologicznych i środowiskowych.

W obecnej pracy, omawiamy, w ramach podejścia behawioralnego, różnorodne strategie modyfikacji zachowań związanych z karmieniem i przyjmowaniem pokarmu przez dzieci. Krótko opisujemy jak analitycy zachowania konceptualizują problemy z jedzeniem, podajemy kilka przykładów interwencji ukierunkowanych na różne trudności związane z jedzeniem, a także nakreśliłyśmy główne założenia programu behawioralnego mającego na celu zwiększenie konsumpcji owoców i warzyw przez dzieci w wieku 2-11 lat, i – w związku z tym – zmniejszenie problemu otyłości dziecięcej.

Słowa kluczowe: otyłość, dzieci, analiza zachowania, program Food Dudes

INTRODUCTION

Eating is the way in which chemical and biochemical constituents and energy in form of food are swallowed, metabolized and delivered to the body cells. The mother starts to feed a baby right after birth and some components of the child behavior, the suction reflex for example, are genetically embedded, others, such as orienting the head towards the nipple, in

the case of breast feeding, are quickly learned. A little later in life we learn how to feed ourselves with chains of behavior of increasing complexity.

Though related to contingencies of survival, eating is not an easily self-maintained behavior and it is commonly taken for granted as a simple and automatic activity. A number of feeding and eating problems may arise early in a child life and are defined by

the child inability or refusal to eat or drink a sufficient quantity or variety of food to maintain proper nutrition. They appear as alterations in the form (frequency, duration, speed, time of the day) and in the content (type of food) of feeding/eating behavioral chains. Dysfunctional mealtime behaviors include food refusal, tantrums, food selectivity, rapid or slow eating, vomiting, coughing, or keeping mouth voluntarily closed. Commonly a distinction is made between mild and severe problematic feeding (1). The mild ones are temporary and easily solvable, while the severe ones are linked to an inadequate amount of food intake and may lead to life-threatening conditions in the long run.

It is estimated that between 20 to 40% of children show some form of feeding problems and the prevalence can increase up to 80% among children with mild to severe mental cognitive impairment (1). Problematic feeding is ascribed to many causes, and it mainly arises from the interaction of biological and environmental factors. Medical conditions like gastroesophageal reflux, anatomical abnormalities (e.g., cleft-lip and palate), cerebral palsy or dysphagia are associated with feeding problems (2). Problematic feeding may occur as a function of combining both child anatomical and physical (fine and gross motor skills) problems, if present, with environmental contingencies. In cases when the cause of food refusal is a painful medical condition, caregiver responses to children during meals may maintain or exacerbate the problem. Once problematic behavior is established environmental contingencies are enough to produce and maintain the behavior itself even when medical conditions are removed (see following section).

When biological conditions are lacking still problematic feeding may develop because of the same set of environmental events. However if the child is growing adequately, many medical professionals may not agree on whether or not problems related to eating resulting from parent-child interaction constitutes a feeding problem. Therefore, feeding problems are often defined in medical literature as a function of clinical judgment, and they are diagnosed on the basis of the topography of the behavior rather than of the environmental events they are a function of (3).

In this paper we will discuss the clinical behavior analytic framework of problematic feeding ranging from food refusal to low preference for fruit and vegetables during infancy. We will briefly focus on how behavior analysts conceptualize it, then examine some examples of intervention strategies for different problems. Since healthy eating habits may contrast the rise of obesity in children, which is reaching epidemic dimensions (4) we will end sketching how a behavioral based intervention on a large scale may increase fruit and vegetables consumption in kids between 2 and 11 years old and hopefully contribute in preventing child obesity.

PROBLEMATIC FEEDING: PRODUCTION AND MAINTENANCE

Behavior analysis is a natural science of behavior (5, 6) that has been now developed for 75 years (7).

It aims to identify the manipulable (independent) variables of which a behavior (dependent variable) is a function. Antecedent events signal to an organism that the emission of a specific behavior may produce reinforcing or punishing consequences. While consequent events that follow a specific behavior may increase (reinforce) or reduce (punish) the probability of occurrence of that specific behavior in the future.

Likewise behavior analysts conceptualize functionally or disfunctionally eating and feeding as related to a set of antecedents and consequences. Feeding problems may arise from learned behaviors that develop as a result of a child's interactions with the environment (e.g., through negative reinforcement, such as escape from eating, or through positive reinforcement, such as attention or access to tangible items) (8). According to LaRue, Stewart, Piazza, et al. (9) they represent one class of behavior in children that is mainly maintained by negative reinforcement. In a typical negative reinforcement experimental paradigm a response produce the removal, reduction or prevention of aversive stimulation, and as a consequence the probability of the same response to occur again in the future in the same conditions is increased. Children who suffer from gastro-esophageal reflux, for example, might exhibit refusal of food when retrosternal pyrosis makes eating painful. In these cases parents show a tendency to respond by removing food, postponing or terminating feeding (8, 10). Usually the refusal is accompanied by other behaviors like tantrums, crying, head turning or batting at the spoon on the table. In the long run parent's behavior of removing food and halting the meal becomes more frequent and food refusal too.

What parents notice and appreciate is that all the strategies they apply produce a stop in the problematic behavior. Woods et al. (11) observed inappropriate and appropriate attention given by parents of 25 children, including tube dependent children, liquid dependent children and food selective children enrolled in an intensive feeding program. They showed that the forms of parental attention resulted in a temporary decrease (probability and frequency) of inappropriate behaviors. The decrease was temporary and eventually the feeding problem emerged again.

When the effects produce by parent's are temporarily on child's behaviors they worsen mealtime problems in the long term and a vicious cycle is created. Both attention to problematic behavior (positive reinforcement) and removal of food (negative reinforcement) increase the probability of that eating problem followed by those classes of consequences will occur more frequently in the future. On the other hand the cessation of the child behavior following parents actions will increase (negative reinforcement) the parent's behavior (e.g. attention to problematic behavior or removal of food).

In these conditions medical interventions may fail not because they are not effective, but just because the child neglect to test their effectiveness. Thus, another vicious cycle may add up to the previous one.

Food refusal under negative reinforcement conditions provided by parents leads to a failure to appreciate that eating may no longer be painful in the presence of an appropriate medical intervention, and the child, by refusing to eat, misses the opportunities to practice all the behaviors that are related to feeding and eating and does not develop the repertoire of oral motor skills or strengths to become capable eater, further worsening the clinical picture.

For example Piazza, Fisher, Brown et al. (8) applied a functional analysis to identify and quantify consequences of inappropriate mealtime behaviors of 15 children who had been referred to a treatment program for severe feeding disorders. The procedure of functional analysis described by Iwata, Dorsey, Slifer, et al. (12) manipulates systematically the conditions (antecedents and consequences) under which a problematic behavior may occur, thus helping identifying the environmental context that leads to problematic feeding. The Authors first identified a wide range of consequences used by parents for inappropriate mealtime behaviors: coaxing and reprimanding, allowing the child to periodically take a break from or avoid eating, and giving the child preferred food or toys following inappropriate behavior. Then systematically tested the effects of these consequences on children mealtime behavior, alternating conditions where inappropriate mealtime behavior was or was not followed by one of the consequences typically used by parents. Results indicated that those consequences actually worsened behavior for 10 of the 15 participants (67%) who displayed high levels of problematic feeding behaviors during one or more of the test conditions relative to the baseline condition, suggesting that consequences played a role in the child's feeding problem.

Even when food ingestion is not related with heartburn or other medical conditions, parents use a variety of strategies to motivate their children to eat. Faced with problematic behaviors they may put a stop to the meal and wait for the child to "calm down" before continuing. Or they may give more attention to the child, only when exhibiting the problematic mealtime behavior. For example, a mother may turn the head and attend to other duties in the kitchen waiting for the child to finish eating and provide attention to the child's behavior only when food refusal occurs. Some parents may offer to their child a more preferred food, when the child refuses to eat a less preferred one. The shared vision in these and other examples is that it is better for the child to eat something rather than nothing. Parents may also provide toys during the meal or use the food like an airplane to calm or distract the child from behaving inappropriately.

PROBLEMATIC FEEDING: INTERVENTION STRATEGIES

There is no "one fits all" intervention strategy to treat problematic feeding. Tailored solutions based on a functional analysis of the behavior and the context

in which it occurs are generally suggested from an Applied Behavior Analysis point of view. ABA is an applied science "in which tactics derived from the principles of behavior are applied systematically to improve socially significant behavior and experimentation is used to identify the variables responsible for behavior change" (13 p. 20). A basic assumption of any ABA based intervention is that the child does his/her best given the conditions under which he/she is functioning. These conditions are usually assessed by descriptive analysis and direct observation to identify target behaviors and functionally related antecedents and consequences (13). Some studies, like the one by Fisher et al. above mentioned have attempted to apply more formal functional analysis methodology to problematic feeding. Thus by identifying and manipulating antecedents or consequences dysfunctional feeding can be decreased or healthier choices in eating can be taught and maintained in the long term.

Using a functional analysis in the treatment of food refusal is important to identify the variety of consequences that follow children feeding behavior to maintain it. This brings to more effective treatment because different strategies may be empirically based based on the function of the target behavior. In addition different strategies can be compared to identify the most effective, Plummer et al. (14) for example, evaluated how appropriate and inappropriate eating behavior of two 5-years-old boy and girl, both being diagnosed in the autistic spectrum, and the first one with comorbidity of brain damages, varied as a function of three independent variables: reinforcement, a typical time out procedure, and regularly paced teacher instructions. They were also assessed for other problematic play behaviors. No response decrement was observed during timeout, and response increment was recorded for reinforcement conditions. In the condition where timeout was ineffective paced instructions, coupled with reinforcement, resulted to be effective in increasing appropriate and reducing inappropriate eating behaviors close to zero levels.

Another study implemented time out procedures to decrease inappropriate noon and evening mealtime behaviors of sixteen retarded children, adolescence and young adults. Inappropriate feeding behaviors treated were timed out in a fixed order for all participants, for example by removing the person from the meal-room until he/she finished or with a 15-seconds removal of the plate. The choice of one or another procedure was depending on the health status of the subject or of the initial behaviors rates. Both procedures were successful in decreasing the percentage of occurrence of problematic mealtime behaviors (15).

Reinforcement based procedure were also used to treat four handicapped children with a history of food refusal and nutritionally at risk (16). During baseline a number of problematic behaviors were identified, namely: children accepted very little or no food, expelled it frequently, and showed a number of disruptive

behaviors. The treatment consisted of social praising, giving access to preferred foods, brief moment to play, and forced feeding. All treatment plans were tailored on child's needs and one or more of the above procedures were used for each child. A marked behavioral improvement was seen along with an increase of food consumption and further improvements were observed up to 30 months follow-ups.

One might ask if reinforcement procedures need to be applied forever. The aim of any contrived procedure is to produce in the fastest possible way stable levels of the target behavior and make a transition as quick as possible to conditions where natural consequences may maintain the acquired behavior. For example one typically developing child was refusing milk during pre-school meals. Milk consumption during that time was increased by mixing a small amount of chocolate with milk and then gradually eliminated. The treatment was effective in increasing milk consumption at school and the behavior easily generalized at home (17).

A behavior intervention may help also when altered biological conditions are present, for example in patients with esophageal stricture. Shore, LeBlanc, and Simmons (18) report of a 14-year-old boy with moderate to severe developmental disability, Trisomy 21, a history of gastro esophageal reflux, and esophageal stricture required careful supervision during meals, and who was given mashed table food only. The child was undergoing periodical surgical procedure to remove food that was stuck in his esophagus. By controlling at first bite size and rate, and the prompting (antecedent) and differentially reinforcing with social praise (consequences) self-feeding behavior the Authors were able to help the subject to safely engage in feeding himself alone. At a 3-month follow-up, the boy continued to safely consume chopped, regular texture food, and reinforcement for bite size and bite rate had been faded.

A BEHAVIORAL BASED INTERVENTION FOR HEALTHY EATING

A combination of food refusal and restriction of preferences, maybe initially favored by biological conditions, but mainly maintained by parents negatively or positively reinforcing child's eating patterns may lead to health problems. Children food preferences can develop very early in their infancy learning from genetically determined predispositions to like sweet and salty flavours and foods with high-energy density (19). In children aged 3-5 y the preference for fatty foods was found to be associated with intake and directly related to skin-fold thickness, an index of adiposity (20). Studies have also found that overweight children consume a high proportion of energy in the form of fat and it is higher in children who have fat parents when compared to lean parents (21).

In a report issued in the year 1999 the World Health Organization stresses the importance of acting as earlier as possible to counteract child obesity epidemic (22). Prevention and treatment of child obesity ulti-

mately involves choosing and eating those healthier food and being more physically active. Offering a diet rich in nutrient-dense fruits, vegetables, low-fat or non-fat (for children over two years of age) milk and dairy products, and whole grains, and low in energy dense, nutrient-poor foods, makes obesity less like to occur in children (23). Though this action sounds simple, long-term results have proven difficult to achieve and family and school based interventions seem to be hard to implement (24).

We learn food preferences by direct contact with the food, but also through language (25, 26). Children can influence each other with imitation or with language. The evidence suggests that pre-school children may learn food preferences from their peer group (27). It can be enough for a child to hear a peer or an adult that a fruit or vegetable is not good, to state that he/she doesn't like it and to further refuse to taste it. However direct experience with the fruit and vegetables can overcome the effect of language.

To design a program that aims to counteract these effect of language by putting the child in direct contact with the natural consequences of eating fruit and vegetables it is necessary that the variables manipulated are consistent with children's psychology, the procedures implemented are evidence based and evaluated and actually change children behavior.

The Food Dudes Behavior Change Program for Healthy Eating is such a program. It is a school-based group intervention package developed by the Food and Activity Research Unit at the Psychology Department of the University of North Wales in Bangor (UK). It aims to encourage children aged four to eleven years old to taste fruit and vegetables, discovering their intrinsic properties and learning to appreciate their flavor. This occurs mainly at school during lunch or snack time. Parents are involved in changing their home strategies to lead the child to freely choose to eat fruit and vegetables. The Food Dudes Program uses behavioral strategies with the aim to develop an environment where children who usually don't taste those foods can do it in a way that is encouraging and fun to do.

Component analysis researches of the program have identified three basic underlying principles (fig. 1):

- Repeated tastings. To get used to a new flavor of a specific food. About 10 tastings are physiologically needed (28).
- Role Modeling. Experimental literature in social psychology shows that learning by imitation is very effective if a model perceived as similar (peer or a slightly older child) by the child is used and the imitated behavior is reinforced (29-32). Following these principles 6 video episodes were developed.
- Rewards. There is evidence that the use of extrinsic reinforcers can change the behavior of an individual (13). The program uses to increase the probability that each child will taste again and again fruit and vegetable. To be effective rewards must

be meaningful to the child (e.g. pencils, rulers, and other objects that are related to the school daily routines) and contingent to eating fruit and vegetables. In addition the conditions (eating a specific amount of fruit and vegetables) under which each child can receive reinforcers must be clearly specified (6, 26, 33).

Typically the program is usually divided into two phases. The first phase lasts 16 days and the second may go on indefinitely (26, 35). During the first phase six video episodes of the superheroes Food Dudes are showed in the classroom and a small portion of fruit and vegetables is offered and if the child eats it a small reward is presented. Each fruit/vegetable couple is rotated every four days to give a reasonable number of opportunities to the children to taste what is offered. At the end of the 16 days in the snacktime protocols lunch boxes are provided for children to bring fruit and vegetables from home. In Phase 2 a wallchart is placed in the classroom and marks placed on it record if the child is bringing and eating fruit and vegetables at school, or eating them at lunch in the cafeteria giving additional opportunities to receive diplomas for "Fruit and Veg super eater". In addition teachers are encouraged to elaborate a wide range of activities to maintain and increase the behaviors acquired in the first phase. In some research protocol additional material was sent to parents to provide other opportunities of generalizing eating fruit and vegetables at home.

A number of researches have proven the efficacy of the program over a period of nearly 20 years starting from very early exploratory studies and the effect has been constantly replicated, even in cultures different from the one in which it was originated. Early researches with this program focused on the home environment and on the possibility of implementing a program that was manageable by parents (26). In the first study a group of 4 children aged 5-6 years was observed during a period of 2 weeks. The intervention was targeted only to certain fruit and vegetables while other types

were used as non-target control to evaluate generalization of the newly learned behaviors. At 2-month follow-up the children ate all targeted foods also during the second phase and even if they never ate any of them at baseline. Horne et al. 1998 demonstrated the feasibility of the whole school program and showed that the quantity of fruit and vegetables doubled between baseline and follow-ups.

Horne et al., (35) measured fruit and vegetable consumption in school at lunchtime and snacktime and at home using parental recall. Both at lunchtime and at snacktime consumption increased from baseline ($p < 0.001$ in all instances). Following the intervention, children's liking for fruit and vegetables also showed a significant increase ($p < 0.001$). It was also demonstrated that the higher consumption was reached by the poorest eaters at baseline. Control school showed no differences in the consumption at the follow up.

The Food Dudes Program proved effective also in Irish schools (36). 228 children in the experimental school and 207 in the control school aged four to 11 years were enrolled. In both schools, parental provision and children's consumption of fruit and vegetables in the lunchboxes were assessed at baseline and 12-month follow-up. Figure 2 shows the lunchbox mean quantity (grams) of fruit, vegetable and juices (FVJ) eaten. FVJ quantity was significantly higher in the experimental school during the 12-months follow-up than during the baseline ($t = -5.5, p < 0.001$) and there was no difference in the consumption in the control school ($t = -0.1, p = 0.915$). Differently from UK based studies the Irish study was implemented during snack time only, implicitly demonstrating the flexibility of the program, while maintaining its effectiveness. Given the results achieved the Irish Government decided to progressively extend the program to all Irish schools.

A validation Italian study involving 672 children aged between 5 and 11 attending three elementary schools demonstrated that the behavioral principles behind the Food Dudes program hold true also in other

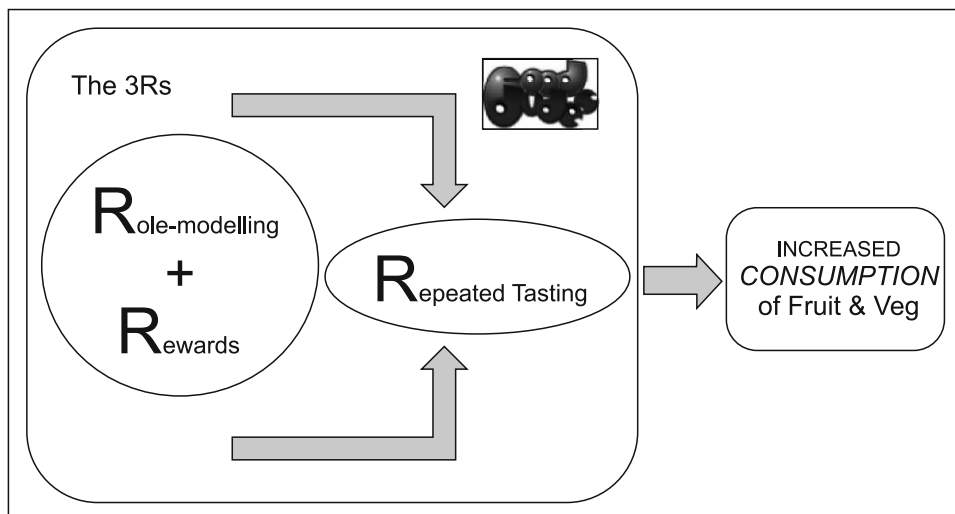


Fig. 1. Schematic representation of the 3Rs, the principles underlying the Food Dudes program. Role modeling and reward support repeated tasting leading to an increase in consumption of fruit and vegetables (33).

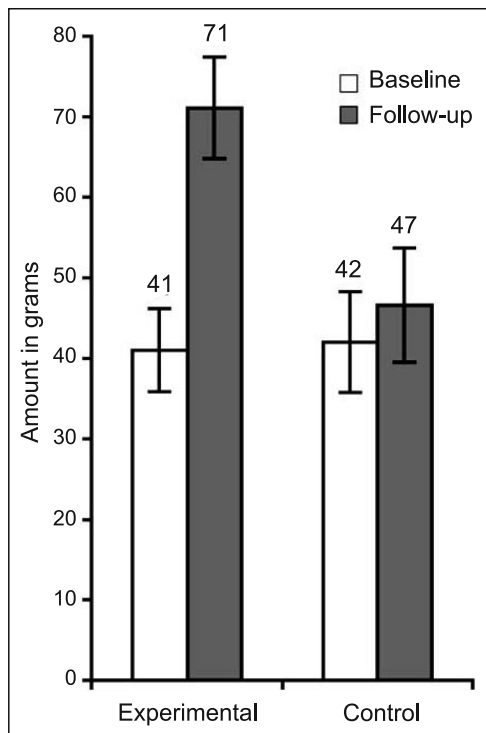


Fig. 2. Mean grams of fruit, vegetables and juice (FVJ) consumed by children at snack-time before and after the Food Dudes program (1 year follow-up). Error bars represent ± 1 s.e. of the mean (36).

cultural, school and feeding contexts (37). Two schools ($N = 221$ and $N = 124$) were assigned to the experimental condition (Food Dudes Program) and one ($N = 327$) to the control condition. The program was implemented during snack time. During 16 days children watched motivational videos of peers eating fruit and vegetables, and received small rewards for eating 1 portion (40 g each) of both them. In the control school only fruits and vegetables were provided for the same period and no intervention. Additional material was sent at home to stimulate parents to expand at home the healthy behavior acquired at school. Primary end-point was parental provision and children consumption assessed at baseline, at 17 days and 1 month after intervention. Questionnaires were also distributed at the end of the research for the families of the children of the intervention group.

Relative to baseline, at 17 days and 1 month follow-ups a statistically significant ($p < 0.0001$) difference in consumption of provided food was observed in the experimental but not in the control, schools.

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For the intervention group mean consumption of fruit at snack time was g 6.50 at baseline and g 75.38 at follow-up while it was 3.59 and 5.43 for the control school respectively. The same happened for vegetables consumption which arose from zero grams at baseline to g 54.17 at follow-up, while it remained at zero level for the control school. Summing fruit and vegetables consumption a quantity close to about three child-sized portions was consumed at snack-time by the children. A 50 fold increase was observed in poor eaters. Data from questionnaires distributed after one year demonstrated changes in the family routine too.

Finally the Food Dudes programs works also with two to four years old children in nursery settings (38). In this study the videos showed two animated cartoons, named Jass and Jarvis, and each video was targeted to two foods and the efficacy of the intervention was evaluated by comparing the consumption of targeted and non-targeted foods. Targeted foods were rewarded only at snack time, but not at lunch time. The interventions produced large and significant increase in target fruit and vegetable consumption with smaller, but significant, changes for the paired, opposite category, non-target foods. The behavior generalized to the no-rewards lunchtime context, where increase in consumption of fruit and vegetables was observed and maintained at follow up, six months after rewards were withdrawn.

Overall Food Dudes studies contribute to demonstrate that simply supplying fruit and vegetable, as it happens in most educational programs at school, does not produce long-lasting changes.

CONCLUSIONS

Behavioral based programs are effective in modifying children feeding eating behaviors. They do so by analyzing and manipulating antecedent and consequences. A wide range of eating behaviors and feeding related behaviors have been studied at the single and group level. This behavioral technology is widely available, is applicable in all cultures and is compatible with medical practice in a GP setting. It can be implemented by nurses or any professional adequately trained in applied behavior analysis. Some packages like the Food Dudes are designed in such a way that they can be applied by teachers without any previous knowledge of behavior analytic principles and may represent a solution to prevent child obesity, a medical problem that is attracting the attention of increasingly worried paediatricians because of the epidemic observed in western world.

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