ASSESSING FACTORS THAT INFLUENCE FOOD CHOICES BY YOUNG CHILDREN

BY

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Abstract

The prevalence of childhood obesity has tripled in the last 30 years (National Center for Health Statistics, 2011). This is particularly problematic given that obesity is associated with increased health risks. In addition to the increased health risks associated with obesity, several researchers contend that food preferences learned early in life are likely to influence long-term patterns of dietary intake (e.g., Haire-Joshu, Kreutter, Hold, & Steger-May, 2004; Skinner, Carruth, Bounds, & Ziegler, 2002). Therefore, a preventive approach to obesity that focuses on factors that influence food choices by young children is warranted. The current series of experiments were conducted to (a) empirically identify young children's preference for healthier and less-healthy foods within and across five food groups, (b) assess the relative influence of quality, magnitude, and immediacy of food on choices made by young children, and (c) determine whether results of the assessment are differentially affected by dense and lean schedules of reinforcement.

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Assessing Factors that Influence Food Choices by Young Children

Obesity is a disease that results from an energy (i.e., caloric) imbalance between energy consumption and energy expenditure (Epstein, 1995). That is, obesity occurs when more energy is consumed than is expended. The prevalence of obesity is on the rise (Visscher & Seidell, 2001). Specifically, the prevalence of obesity in adults has more than doubled since 1980 (Baskin, Ard, Franklin, & Allison, 2005). An even bleaker situation exists for children given that the prevalence of childhood obesity has tripled in the last 30 years (National Center for Health Statistics, 2011). The increase in the prevalence of obesity is a particularly problematic situation given that there are serious medical complications associated with obesity (Office of Surgeon General, 2010). Specifically, obese children are susceptible to breathing difficulties, increased risk of fractures, increased risk of cardiovascular disease, hypertension, insulin resistance, and psychological effects such as depression and anxiety (World Health Organization, n.d.). In addition, obese children are susceptible to obesity in adulthood, which is concerning given that obese adults are susceptible to cardiovascular disease, Type 2 diabetes, musculoskeletal disorders, increased risk of mortality, and some cancers (World Health Organization, n.d.). As a function of the increased prevalence of obesity, medical-care costs (e.g., diagnostic, preventive, and treatment services) associated with obesity have also increased. In fact, the annual medical-care cost associated with obesity increased from $78.5 billion per year in 1998 to $147 billion per year in 2008 (Finkelstein, Trogdon, Cohen, & Dietz, 2009).

Childhood Food Preferences

Obesity is a complex phenomenon wrought with health risks that cannot be attributed to a single factor or cause (Faith, Fontaine, Cheskin, & Allison, 2000). Rather, obesity is influenced by a variety of psychological, genetic, physiological, and social factors (Faith et al., 2000).

Further, because obese children have a longer history of making less-healthy food choices than individuals whose obesity begins later in life, early onset obesity may be more resistant to treatment than adult-onset obesity (Epstein et al., 1976). Therefore, understanding the myriad of environmental factors that may influence childhood obesity may yield potential targets for the early intervention or prevention of obesity. As such, a preventive approach to the obesity problem seems warranted. A preventive approach based on the assessment of (a) young children's eating habits and (b) the relative influence of response and reinforcer parameters on young children's food choices seems particularly appealing given that interventions based on these assessments could be designed to increase the consumption of healthier foods during childhood.

Most research that has assessed the eating habits of young children has focused on the types of food consumed by children. These researchers have found several important patterns of preference in children, as they relate to food type. For example, Forestell and Mennella (2007) noted that prenatal exposure to different types of flavors has been found to increase infants' consumption of those flavors after birth. Further, consuming the breast milk of mothers who consume a variety of flavors has also been found to increase infants' consumption of those flavors (Forestell & Mennella, 2007). In addition to prenatal and early postnatal development of preferences, infants seem to display an apparent innate preference (determined by infant's facial expressions) for sweet and salty tastes and an avoidance of bitter and sour tastes (e.g., Benton, 2004; Rosenstein et al., 1988). The authors noted that these innate preferences (or lack thereof) presumably serve an evolutionary function. That is, sweet flavors are associated with a source of energy and bitter flavors are associated with toxins (Benton, 2004). In addition to innate food preferences, several researchers contend that food preferences learned early in life are likely to

influence long-term patterns of dietary intake (e.g., Haire-Joshu, Kreutter, Hold, & Steger-May, 2004; Skinner, Carruth, Bounds, & Ziegler, 2002). For example, Haire-Joshu et al. (2004) suggested that repeated exposure to certain foods is likely to establish a preference for those foods, which subsequently increases the probability that those foods will continue to be consumed into adulthood. Therefore, establishing healthier eating habits early in life seems critical to prevent obesity and reduce the subsequent health risks associated with obesity.

The observation that young children's food preferences are likely to influence their long-term eating patterns is particularly problematic given that young children have also been found to prefer less-healthy to healthier foods (Skinner et al., 2002; Skinner et al., 1998) and to show a non-preference for vegetables and, to a lesser extent, fruits (Domel, Baranowski, Davis, Leonard, Riley,& Baranowski, 1993; Kirby, Baranowki, Reynolds, Taylor, & Binkley, 1995; Skinner et al., 1998). These preferences are exacerbated for children of obese parents (Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001). For example, Wardle et al. (2001) assessed the food and activity preferences in 200 children with obese parents and 228 children with lean parents. Maternal ratings were obtained for children's liking for meats, sweet desserts, fruits, and vegetables; children's eating styles (positive and negative reactions to food and enjoyment of food); the frequency of children's intake of high- and low-fat foods and high- and low-fiber foods; and children's preference for a variety of high- and low-impact physical activities. Children were asked to sample and provide a rank order of preference for six foods (three of which were high-in-fat and three of which were low-in-fat). Finally, a direct measure of children's food intake within 1 hour of their last meal was collected in order to identify children's intake under a condition of satiety. Results showed that, relative to children of lean parents, children of obese parents (a) showed a higher preference for fat-dense foods, (b) showed

a lower preference for vegetables, (c) were reported to engage in more overeating, and (c) reported to have a stronger preference for sedentary activities.

Several other environmental factors have been found to influence young children's food preferences or consumption of previously unfamiliar or non-preferred foods. For example, Kratt, Reynolds, and Schewchuk (2000) stated that parents are the most influential variable with respect to the development of young children's food preferences. Presumably, parents play such a critical role in the development of young children's preferences because they arrange their children's environments (e.g., type of food present in the home; type, variety, and amount of food offered to children during meals; frequency of meals and snacks). In particular, Kratt et al. found that children of parents who made fruits and vegetables available were reported to consume more fruits and vegetables than children of parents who did not make fruits and vegetables readily available in the home.

Another environmental factor found to influence young children's food preference is peer modeling. For example, Greenhalgh et al. F(2009) evaluated the effects of (a) peers modeling consumption of novel foods plus making a positive statement about the food and (b) peers modeling consumption of novel foods plus making a negative statement about the food on the consumption of novel food by young children. The authors found that modeling plus positive statements about food increased young children's consumption of novel foods, whereas modeling plus negative statements about food inhibited young children's consumption of novel foods. These results suggest that parents can improve their children's eating patterns simply by making healthier food available in the home. In addition, parents may consider modeling the consumption of healthful foods while making a positive statement about the healthy food;

although, because previous researchers have assessed the effects of peer models, it is unclear if parent models would have the same effect on children's consumption of healthier foods.

The amount of exposure children have to various foods has also been found to increase consumption of those foods (e.g., Horne, Lowe, Fleming, & Dewey, 1995; Osborne & Forestell, 2012). For example, Nicklaus, Boggio, Chabanet, and Issanchou (2005) examined the relationship between food variety seeking (FVS) at 2 to 3 years of age and FVS at an older age. Food variety seeking was calculated by dividing the number of different foods the child selected by the total number of different foods offered to the child. Specifically, Nicklaus et al. recorded the foods chosen (and consumed) by 339 toddlers during lunch at their nursery schools for a 1-year period (ages 2-3 years old). These data were then compared to follow-up data obtained by means of a questionnaire on FVS, food neophobia, and attitude towards food. Initial observations of toddlers took place between 1982 and 1999. Follow-up questionnaires took place between 2001 and 2002. Results showed that toddlers who engaged in FVS behaviors were more likely to report FVS at follow up than toddlers who did not engage in FVS during the initial observation. These findings highlight the importance of encouraging young children to consume a wide variety of foods. In addition, Birch, McPhee, Shoba, Pirok, & Steinberg (1987) compared the effects of visual exposure to food, taste exposure to food, and no exposure to food on the preferences in young children (2-, 3-, and 5-year-olds). The authors found that taste exposure resulted in an increase in the preference for food; whereas, visual exposure to food did not increase the preference for the food. Further, Pelchat and Pliner (1995) found that providing children information regarding the taste of food (e.g., "It tastes good") increased children's consumption of food; however, providing children information regarding nutritional content (e.g., "A good source of iron") did not increase children's consumption of food. These results

suggest that parents and caregivers should repeatedly expose their children to foods, even if their children do not initially prefer the foods, and provide their children with information regarding the taste of food rather than on the nutritional value of the food.

Although these findings provide important information about common aspects of young children's eating habits, at least two methodological aspects of these studies limit a thoroughgoing understanding of young children's food preferences. First, all of the studies mentioned above used a group design, which precludes the identification of children's preferences at the individual level. That is, aggregated data were reported in terms of the "average child." Second, many of the studies relied on indirect assessment methods: child-reported questionnaires (e.g., Skinner et al., 2002) and parent-reported questionnaires (e.g., Kratt et al., 2000; Skinner et al., 2002; Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Skinner et al., 1998). Although some research has suggested that parents can predict their child's food choices with *reasonable* accuracy (e.g., Mata, Scheilbehenne, & Todd, 2008), a relatively large body of literature has demonstrated a lack of correspondence between the direct assessment of preference and child-reported preference assessments (e.g., Northup, 2000), caregiver-reported preference assessments (e.g., Green, Ried, White, Halford, Brittain, & Gardner, 1988), and pictorial preference assessments (e.g., Higbee, Carr, & Harrison, 1999). Because food preference and food choices directly affect childhood obesity, a more systematic, direct method of assessing individual children's food preferences seems warranted. In addition, a systematic assessment of the influence of other parameters of food magnitude and immediacy of food access (in addition to quality of food) on individual children's food choices also seems warranted.

Assessing Competing Parameters of Reinforcement

The reinforcing efficacy of reinforcement (including food) is influenced by a wide variety of variables. Various parameters of reinforcement and responding have been found to differentially affect the efficacy of reinforcers. For example, researchers have observed higher rates of responding toward response alternatives associated with higher *quality* reinforcers (e.g., Fisher, Ninness, Piazza, & Owen-DeSchryver, 1996). Quality of reinforcement refers to the relative preference for different reinforcers. For example, high-quality (HQ) items are those that are consistently selected as highly preferred in SPAs and low-quality (LQ) items are those that are reliably selected as low-preference items in SPAs. For example, if, during a paired-choice preference assessment consisting of skittles, chips, cucumbers, and strawberries, and individual consistently selects chips over the other items, chips would then be considered a HQ item for that individual. Conversely, if the individual rarely selects skittles relative to the other items, skittles would be considered a LQ item for that individual. Researchers have also observed higher rates of responding toward response alternatives associated with higher *magnitudes* of reinforcement (e.g., Trosclair-Lasserre, Lerman, Call, Addison, & Kodak, 2008). Magnitude of reinforcement refers to the number, intensity, or duration of reinforcement. Researchers have also observed higher rates of responding toward response alternatives associated with more *immediate* access to reinforcers (e.g., Neef, Mace, & Shade, 1993). The immediacy of reinforcer delivery refers to the amount of time or the latency between the response and the reinforcer. Finally, researchers have observed higher rates of responding toward response alternatives associated with reinforcers that are less *effortful* to obtain (e.g., DeLeon, Iwata, Goh, & Worsdell, 1997). Effort refers to the amount of exertion involved in a response and a common way to manipulate effort is to employ differed schedules of reinforcement.

The efficacy of a given reinforcer is not fixed; rather, its' efficacy is contextual and depends, in part, on the availability of alternative reinforcers (Green & Freed, 1993; Neef & Lutz, 2001b). Therefore, several investigators have conducted competing parameters assessments (CPA) in which various parameters of reinforcement are placed in direct competition with each other such that the parameter that most influences responding can be identified. For example, in a series of studies conducted between 1992 and 2005, Neef and colleagues refined the assessment of competing parameters methodology while evaluting the relative influence of rate and quality (Neef, Mace, Shea, & Shade, 1992); rate, quality, and immediacy (Neef et al., 1993); and rate, quality, immediacy, and effort (Neef, Shade, & Miller, 1994; Neef & Lutz, 2001a) on the responding of children diagnosed with emotional disturbances, learning difficulties, and behavioral difficulties. Over the course of the continued refinement of the CPA methodology, Neef and colleagues identified the utility of the CPA for (a) assessing impulsivity and (b) developing treatments (based on the CPA results) to promote self-control behavior in children diagnosed with attention deficit hyperactivity disorder (ADHD). For example, Neef, Bicard, and Endo (2001a) conducted a brief, computerized CPA to evaluate the influence of quality (Q), rate (R), immediacy (I), and effort (E) on the responding of 3 children diagnosed with ADHD. Each parameter was placed in direct competition with every other parameter which yielded six separate conditions (QvI, QvE, QvR, RvI, RvE, IvE). Results of the CPA showed that immediacy of reinforcement was the most influential parameter governing the choices made by all 3 subjects. Subsequently, a treatment based on the results of the CPA was evaluated in which subjects were taught to tolerate delays (up to 24 hours) to reinforcement. These findings demonstrate the utility of the CPA methodology in identifying the most influential parameter governing children's choices among concurrently available reinforcers. Further, the treatment

results validated the CPA as an effective assessment tool given that the treatment informed by the assessment was found to be effective for all subjects.

Other researchers have used the CPA methodology to evaluate the relative influence of magnitude and quality (Glover, Maltzman, & Williams, 1996) on the food choices made by individuals with Prader-Willi syndrome (PWS) and individuals with mental retardation. Glover et al. found that when 1 container of HQ food was placed in direct competition with 3 containers of MQ food, the responding of individuals with PWS was most influenced by magnitude (i.e., individuals with PWS allocated more responding toward the larger, less preferred food). Conversely, the responding of individuals with mental retardation was most influenced by the immediacy of food access (i.e., individuals with mental retardation allocated more responding toward the smaller, higher quality food). Next, Glover et al. arranged a condition in which 1 container of HQ food was placed in direct competition with 3 containers of LQ food. Under this arrangement, subjects with PWS and mental retardation allocated more responding toward the lower magnitude but higher quality food. These results indicate that, under these conditions, quality of food was more influential than magnitude of food. Taken together, these results suggest that, under some conditions (i.e., when the large-magnitude choice consists of LQ foods), choice responding of subjects with PWS is more influenced by food quality.

In a similar investigation, Joseph, Egli, Keppekin, and Thompson (2002) found that when subjects with PWS were presented with choices between smaller, more immediate reinforcers and larger, more delayed reinforcers, all subjects allocated more responding toward the larger magnitude, more delayed option. These results indicate that magnitude was more influential than immediacy of reinforcement in governing these subjects' food choices. Further, Glover et al. (1996) and Joseph et al. identified an effective method for evaluating the relative influence of

competing parameters of reinforcement in a single assessment. However, they presented aggregate data, which precludes the identification of response patterns at the individual level. That is, it is possible that the aggregated data may not accurately represent the choice responding of all subjects.

Finally, Thomason (2007) used the CPA methodology to evaluate the relative influence of quality, magnitude, and immediacy on the food choices made by 11 individuals with PWS. A dense schedule of reinforcement (variable interval 30 s) was used during all conditions. Unlike previous researchers utilizing the CPA, Thomason first conducted a baseline phase in which responding toward two different values of a given parameter was compared to identify subject's sensitivity to quantitative (magnitude and immediacy) and qualitative (quality) changes within that parameter. For example, during the quality baseline, one response option was associated with 1 piece of ***HQ food*** delivered immediately after the session and the other response option was associated with 1 piece of ***LQ food*** delivered immediately after the session. During the assessment phase, each parameter was compared to every other parameter such that all possible combinations of the three parameters were evaluated (QvM, QvI, IvM). When two parameters were evaluated, the value of the other parameter was held constant. For example, during the comparison of immediacy versus magnitude, one response option was associated with 1 piece of HQ food delivered ***immediately*** and the other response option was associated with ***5 pieces*** of HQ food delivered 50-min after the session. Results of the CPA showed that quality of food was the most influential reinforcement parameter for 9 of 11 subjects, and immediacy was the most influential for 2 subjects. Reinforcer magnitude was never identified as the most influential parameter. These results add to the existing literature demonstrating the differential efficacy of

various parameters of reinforcement across subjects by assessing the relative influence of parameters of food on choice responding.

Taken together, these results suggest that there may be unique characteristics of certain populations of individuals who exhibit specific behavioral disorders (e.g., impulsivity, over eating, etc.) that increase the likelihood that one parameter of reinforcement may be more influential than other parameters. The importance of the CPA methodology is that it could be easily extended beyond the assessment of (a) impulsivity among individuals with ADHD and (b) the influence of competing reinforcer parameters on food choices made by individuals with PWS. In particular, this assessment methodology could be easily extended to other populations of individuals that share common issues of concern for the purposes of intervention or prevention. Specifically, the competing parameters assessment could be used as a tool to identify influential parameters of food such that the influential parameters of food could be easily arranged to promote the consumption of healthier foods. For example, if it were determined that an individual's food choices were determined primarily by the immediacy of food access, an intervention could be designed to increase the individual's tolerance to delays to food access. Conversely, if it were found that an individual's food choices were determined primarily by the quality of food, several potential interventions could be implemented. For example, a contingency could be arranged in which HQ foods are delivered contingent on the consumption of LQ food, HQ and LQ food could be presented simultaneously (and the HQ food could be gradually faded such that the individual only consumes the LQ food), the less-healthy HQ food could be replaced with a qualitatively similar but healthier option (e.g., turkey bacon could replace bacon), or several bites of HQ food could be presented to increase the probability that the individual would consume the LQ food item. If it were found that an individual's food choices

were primarily determined by the magnitude of food, an intervention consisting of presenting a large amount of LQ foods could be implemented. Finally, if it were determined that an individual's food choices were primarily governed by effort, healthier food options could be made more readily available (e.g., pre-cut and placed on the kitchen table) or less-healthy food options could be made more effortful to obtain (e.g., placed in the basement).

Finally, although the CPA methodology has proven useful in identifying the relative reinforcing value of various parameters of reinforcement, what remains unknown is whether the CPA methodology can be extended for use in identifying the relative influence of various parameters of food in young typically developing children. Further, because the CPA discussed thus far incorporated dense schedules of reinforcement (e.g., FR 1), it is unknown if the relative influence of various parameters of reinforcement identified under dense schedules will hold under leaner (and more naturalistic) schedules of reinforcement. Therefore, Experiment 2 of the current series of studies attempted to determine whether dense and lean schedules of reinforcement differentially affected the relative influence of quality, magnitude, immediacy, and effort on the food choices made by young children. This is particularly relevant because previous research has shown that, as schedule requirements increase, subjects may shift responding to an alternative reinforcer (DeLeon et al., 1997; Tustin, 1994). These results are particularly relevant to the study of childhood obesity because they suggest a potential strategy to increase the consumption of less preferred foods. For example, a potential intervention could consist of increasing the effort required to obtain less-healthy food while ensuring the effort required to obtain healthier foods remain low.

Purpose

The purpose of the current study was two-fold. Experiment 1 was designed to determine

young children's food preferences based on food quality (types of food). Specifically, choices for healthier and less-healthy foods within and across five food groups were observed via a series of two systematic direct assessments. Subsequently, 8 subjects from Experiment 1 participated in Experiment 2, which consisted of an assessment methodology designed to compare the relative influence of several reinforcer characteristics (quality, magnitude, immediacy, effort) of food choice. This assessment seems particularly relevant to the study of childhood obesity prevention and treatment because it may be a useful tool to identify influential parameters of food such that individually tailored strategies can be designed to promote more healthy eating habits (e.g., consumption of healthier foods). Specifically, a *competing parameters assessment* was conducted in order to (a) determine whether young children's food choices were influenced by these parameters in isolation, (b) evaluate the effects of changes in more than one parameter on food choice, and (c) assess whether response effort influences the results of the assessment. The study was intended to be an analogue arrangement that approximates situations in which children make eating choices such as whether to eat, what to eat, how much to eat, and when to eat.

General Method

Subjects, Setting, and Materials

Twenty-one typically developing toddler and preschool-age children (ranging in age from 14 to 58 months) participated in Experiment 1, and 8 typically developing preschool-age children (ranging in age from 32 to 56 months) participated in Experiment 2. All children attended the Edna A. Hill Child Development Center at the University of Kansas. Parental consent was obtained for each subject prior to his or her participation in the current series of experiments. In addition, child assent was obtained prior to participation in each session. During Experiment 1, all sessions were conducted either in a segregated area of the subjects' classroom or a small

therapy room. During Experiment 2, all sessions were conducted in a small therapy room equipped with a one-way observational window and contained task materials relevant to each condition. A graduate or undergraduate research assistant was present in the session room with the child at all times.

Given that food items were delivered to the children, dietary restrictions for each child were identified prior to the start of their participation. Food restrictions or allergies to a particular food item were not reported for any child that participated in the current series of experiments.

Experiment 1: Food Preference Assessments

Purpose

The purpose of Experiment 1 was to identify young children's eating habits among a large number of foods. Specifically, preference for 40 food items across five different food groups was assessed using the paired choice preference assessment procedure (Fisher et al., 1992). This was accomplished in a series of two phases. During the first phase, a within-food group paired-choice SPA was conducted to determine whether children showed a relative preference for (a) a particular food group and (b) healthy or less-healthy food within five food groups (protein, grain, fruit, vegetable, and snack [for the purposes of the current investigation, snacks have been classified as a food group]). During the second phase, a between-food group paired-choice SPA was conducted in order to identify children's high-preference and low-preference foods among their most preferred foods from each of the five food groups, as determined by the results of the within-food group SPA.

Methods

Stimuli. In order to achieve or maintain good health, the U.S. Department of Agriculture (USDA) recommends that children (and adults) consume a balanced diet that includes food from

the protein, grain, fruit, vegetable, and dairy food groups (n.d.). Therefore, healthier and less-healthy foods from these food groups were assessed, with the exception of foods from the dairy food group. Dairy foods were omitted because several subjects were either allergic to various dairy products or their parents required that they consume non-dairy milk substitutes (e.g., almond milk, coconut milk). In addition, healthier and less-healthy snack foods were included in the assessment because researchers assessing young children's food choices have found that many children's high-preference foods consist of snack foods (Skinner et al., 1998, 2002; Wardle et al., 2005). Cross-referencing the recommendations made by the USDA and the Child and Adult Care Food Program (the food program followed by the Edna A. Hill Child Development Center) identified the specific healthier foods included in the assessments. In order to compare these healthier foods to less-healthy foods, caloric-dense foods (e.g., chocolate, cheese, butter) were added to the healthier foods such that each food group consisted of four healthier foods and four less-healthy versions of the healthier foods (e.g., broccoli with cheese served as the less-healthy version of steamed broccoli). The foods included in the assessments are listed in Table 1. Nutrition facts for each food item included in the assessments are listed in Table 2.

Response measurement and reliability. Data were recorded separately for the frequency of consumption, selection, and expulsion. The primary dependent variable was the frequency of consumption. Consumption was defined as the subject (a) selecting one of the two food items presented, (b) consuming the chosen item, and (c) not expelling the item. Selection was defined as the subject grasping a food item. Expulsion was defined as removing a food item from the mouth (using fingers or tongue) or spitting the food item out of the mouth prior to the start of the next trial.

Trained observers collected data using paper and pencil. Data were recorded on a form that

listed all possible food-pair combinations (See Figure 1). Observers recorded the frequency of selection, consumption, and expulsion of food items. A second independent observer collected data during at least 49% (range, 36% to 100%) of all within-food group preference assessments and 47% (range, 32% to 100%) of all between-food group preference assessments to assess interobserver agreement. Observers' records were compared on a trial-by-trial basis. Interobserver-agreement coefficients were calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100%. During the within-food group preference assessments, interobserver agreement for all subjects' consumption, selection, and expulsion of food averaged 99.0% (range, 96% to 100%). During the between-food group preference assessments, interobserver agreement for all subjects' consumption, selection, and expulsion of food averaged 99.5% (range, 95% to 100%).

Procedure. Prior to conducting the paired-choice preference assessments, subjects were provided with pre-session exposure to each food item included in upcoming assessment. Pre-session exposure consisted of presenting the subject with a dime-sized piece of food, labeling the food, and asking the subject to try the item. Acceptance to try the item resulted in access to the dime-sized piece of food. Refusal to taste the item during pre-session exposure resulted in no programmed consequence (i.e., subjects were not required to try each item prior to the start of session). During the paired-choice preference assessments (Fisher et al., 1992), each food item was paired with every other item such that all possible pairs of items were presented. During each trial, the experimenter placed two, dime-sized samples of food in front of the subject. The experimenter prompted the subject to select an item (e.g., "Pick your favorite"). Selection of one item resulted in the delivery of that item; the other item was removed. If the subject did not make a selection within 30 s of the prompt, the experimenter provided a second prompt. If the subject

did not make a selection after the second prompt, the experimenter removed the food items, denoted the refusal to make a choice on the data sheet, and presented the next pair of food items to be assessed (See Figure 1 for a sample paired-choice preference assessment data sheet).

Within-food group assessment (Phase 1). The purposes of the within-food group preference assessments were to identify whether subjects show (a) a preference for a particular food group to the exclusion of other food groups and (b) a preference for healthier or less-healthy food items within and across five different food groups. Five separate paired-choice SPAs were conducted such that a preference hierarchy within each food group was generated. That is, a separate SPA was conducted for the protein, grain, fruit, vegetable, and snack food groups. Percentage of consumption was compared both within and across the five separate preference hierarchies generated for each subject. Eight items were included in each within-food group SPA (See Table 1). For example, during the vegetable preference assessment, all food items consisted of vegetables. Four of the vegetables were healthier (e.g., steamed broccoli, steamed cauliflower, steamed green beans, a baked yam) and the other four vegetables were the less-healthy versions (e.g., broccoli with butter and cheese, cauliflower with butter and cheese, green beans with butter and cheese, and tater tots) of the healthier food.

Within-Food Group Assessment Results

The results of the within-food group preference assessments are summarized in Table 3. Specifically, the table lists the percentage of trials in which healthier and less-healthy foods were consumed during each within-food group preference assessment. In addition, Table 3 lists the Healthy Eating Index scores for each food group for all subjects. The Healthy Eating Index refers to the difference between the percentage of consumption of healthier foods and the percentage of consumption of less-healthy foods, such that it provides an index of the strength of preference for

healthier versus less-healthy foods (i.e., negative values indicate preference for less-healthier food items). Figure 2 graphically depicts the Healthy Eating Indices for each food group. Figures 3 to 5 graphically depict the overall percentage of trials in which healthier and less-healthy foods were consumed during the series of 5 (fruit, protein, grain, vegetable, and snack) within-food group preference assessments. Within the snack food group, 14 of 21 subjects preferred less-healthy over the healthier snacks. Four of 21 subjects preferred the healthier versions of snacks over the less-healthy versions and 3 of 21 subjects did not show a preference for either healthier or less-healthy snacks. Within the grain food group, 12 of 21 subjects preferred the less-healthy over the healthier grains and 7 of 21 subjects preferred the healthier versions of grains over the less-healthy versions. Two of 21 subjects did not show a preference for either healthier or less-healthy grains. Within the protein food group, 15 of 21 subjects preferred the less-healthy proteins relative to the healthier versions. Three of 21 subjects preferred the healthier proteins and 3 of 21 subjects did not show a preference for either healthier or less-healthy versions of proteins. Within the fruit food group, 9 of 21 subjects preferred less-healthy fruits over healthier fruits and 9 of 21 subjects preferred healthier fruits relative to the less-healthy versions. Three of 21 subjects did not show a preference for either healthier or less-healthy versions of fruits. Finally, 15 of 21 subjects showed a preference for less-healthy vegetables relative to the healthier vegetables. Five of 21 subjects showed a preference for the healthier vegetable options relative to the less-healthy versions and 1 of 21 subjects did not show a preference for the healthier or less-healthy versions of vegetables.

Figures 6 to 26 graphically depict the results of the within-food group preference assessments in which *all* trials (including trials in which two healthier and two less-healthy foods were compared) were analyzed. The overall results of the within-food group preference

assessments and the Healthy Eating Index scores collapsed across food groups are summarized in Table 4. Figure 27 graphically depicts the overall Healthy Eating Index scores collapsed across all food groups. Although results were idiosyncratic across all subjects, some interesting preference patterns were observed across subjects. For example, across all food groups, 17 of 21 children showed a preference for the less-healthy foods relative to the healthier foods. The mean difference in overall preference (across all food groups) for less-healthy foods over healthier foods was 16.8% (range, 1.3% to 42.5%). In addition, 4 of 21 subjects showed a preference for healthier foods over less-healthy foods. The mean difference in overall preference (across all food groups) for healthier foods relative to less-healthy foods was 9.7% (range, 2.5% to 20.0%).

Finally, the number of trials comparing healthier and less-healthy foods in which no choice was made are summarized in Table 5. Analysis of trials comparing healthier and less-healthy foods in which no choice was made revealed that more subjects did not make a choice between healthier and less-healthy vegetables, and to a lesser extent, fruits and proteins relative to snacks and grains. Further, and perhaps as a result of the larger number of subjects who did not make a choice between healthier and less-healthy foods, a larger number of trials between healthier and less-healthy vegetables, fruits, and proteins in which no choice was made relative to snacks and grains was observed. Specifically, 12 of 21 subjects did not make a choice on a total of 111 trials during the vegetable preference assessment, 7 of 21 subjects did not make a choice on a total of 33 trials during the fruit preference assessment, and 7 of 21 subjects did not make a choice on a total of 26 trials during the protein preference assessment. Comparatively, 3 of 21 subjects did not make a choice on a total of 5 trials during the grain preference assessment and 4 of 21 subjects did not make a choice on a total of 8 trials during the snack preference assessment.

Between-food group assessment (Phase 2). The purpose of this assessment was to identify young children's preferences among their most-preferred foods from each food group. Unlike the within-food group paired-choice preference assessments in which the both options consisted of foods from the same category, the between-food group preference assessment assessed young children's preferences for healthier and less-healthy foods from each food group such that the alternative option included foods from other categories. This information is particularly important given that the USDA recommends that children (and adults) consume foods from a wide variety of food groups (U.S. Department of Agriculture, n.d.). In addition, including the most-preferred foods from each food group allowed for a more (a) stringent test of young children's preferences and (b) naturalistic choice arrangement given that individuals typically make choices among preferred alternatives in the natural environment (Goldfield & Epstein, 2002). Fifteen items were included in the between-food group preference assessment. Specifically, the top 3 selections made from each of the five food groups during the within-food group preference assessments made up the 15 items included in the between-food group preference assessment. That is, the food items included in the between-food group preference assessment consisted of the top 3 selections made during the snack, vegetable, protein, fruit, and grain within-group preference assessments.

Between-Food Group Assessment Results

The results of the between-food group preference assessments are listed in Table 6. Specifically, the table lists the top 3 items from each food group that were included in the between-food group preference assessment, the rank order of each food, and the rank order for each food group for each subject. Table 6 lists the summary of results of the between-group preference assessments. Specifically, the table lists the percent of times healthier and less-healthy

foods were consumed during trials in which 1 healthier and 1 less-healthy food were compared. Figures 28 to 31 graphically depict the results of the between-food group preference assessments in which *all* trials (including trials in which two healthier and two less-healthy foods were compared) were analyzed. A few noteworthy preference patterns were observed during the between-food group preference assessments. Namely, snack was ranked as the most-preferred food group for 14 of 21 subjects, protein was ranked as the most-preferred food group for 4 of 21 subjects, grain was ranked as the most-preferred food group for 2 of 21 subjects, fruit was ranked as the most-preferred food group for 2 of 21 subjects, and vegetables were never ranked as the most-preferred food group for any subject. For 1 (Ivy) subject, protein and fruit were both ranked as her most-preferred food group. Vegetable was the lowest-ranked food group for 10 of 21 subjects, fruit was the lowest-ranked food group for 10 of 21 subjects, grain was the lowest-ranked food group for 2 of 21 subjects, protein was the lowest-ranked food group for 1 of 21 subjects, and snacks were never the lowest-ranked food group for any subject. For 1 (Brea) subject, fruit and protein were both ranked as her least-preferred food groups and for another (Cristy) subject, fruit and vegetables were both ranked as her least-preferred food group.

The overall percentage of trials in which healthier and less-healthy foods were consumed and the Healthy Eating Index scores collapsed across food groups are summarized in Table 7. Figure 32 graphically depicts the overall Healthy Eating Index scores collapsed across all food groups. Similar to the results obtained from the within-food group preference assessments, results were idiosyncratic across subjects, but some interesting preference patterns were observed. For example, 16 of 21 subjects showed an overall preference (across all food groups) for less-healthy foods over healthier foods. The mean difference in overall preference for less-healthy foods relative to healthier foods was 26.1% (range, 3.7% to 80.4%). Three of 21 subjects

showed an overall preference (across all food groups) for healthier foods. The mean difference in overall preference for healthier foods over less-healthy foods was 7.7% (range, 1.8% to 14.8%).

General Implications

Taken together, results of the within- and between-food group preference assessments confirm indirect reports that many children prefer less-healthy foods relative to healthier foods, are unwilling to try some foods, and that many children's least-preferred foods are vegetables, and to a lesser extent, fruits. Certain eating habits may be considered particularly problematic; namely, a preference for less-healthy food within and across food groups, or both. For example, preference for less-healthy food (even if preference is not shown for less-healthy food in all food groups) is problematic because less-healthy food often contains additives (e.g., sodium, fat, preservatives, excessive calories) that can have deleterious effects on one's health (U.S. Centers for Disease Control and Prevention, n.d.). Therefore, children showing relatively problematic eating habits were included in Experiment 2 such that we could investigate several factors (i.e., immediacy, magnitude, quality, and response effort) that may influence children's food choices.

Experiment 2: Competing Parameters Assessment

Purpose

Experiment 2 was designed to extend the competing parameters reinforcer assessment conducted by Thomason (2007) to (a) assess food-reinforcement parameters with typically developing young preschool children and (b) assess the effects of response effort on response allocation to determine whether results of the competing parameters assessment are differentially influenced by dense and lean schedules of reinforcement.

Procedure

Subjects and setting. Eight subjects from Experiment 1 participated in Experiment 2. Six (Cece, Cristy, Ivy, Jackie, Laurie, and Mitch) of 8 subjects showed an overall preference for less-healthy foods. Two (Benny and Carrie) subjects showed no clear preference for healthier or less-healthy foods, defined as less than a 5% difference in the preferences between healthier and less-healthy foods.

Stimuli. Two high-quality food items and two low-quality food items were selected from the results of the between-food group preference assessment (Experiment 1; Phase 2). The two high-quality items were those that were selected on at least 10 of the 14 trials in which the item was presented, with the additional criterion that these foods were *less-healthy* foods. The two low-quality items were those that were selected on 4 or fewer of the 14 trails in which the item was presented, with the additional criterion that these foods were *healthier* foods. Three of eight subjects (Benny, Cristy, and Jackie) did not meet the criterion to have two healthier, low-quality foods; therefore, only one healthier, low-quality food item was used during the CPA for these subjects. Prior to the start of each session, the experimenter presented the subject with the two high-quality items and asked the subject to pick his or her favorite. The item selected was used in the subsequent session. During sessions in which the effects of quality of food on responding was assessed (i.e., quality baseline, quality vs. magnitude, and quality vs. immediacy), both high- and low-quality foods were used. Therefore, the experimenter also presented the subject with the two low-quality items and asked the subject to pick his or her favorite. The item *not* selected was used in the subsequent session to ensure that the lowest quality food item was used. Subjects were given a choice between their two-highest preferred and their two lowest-preferred items (except for those cases in which only one healthier, low-quality item was identified) prior to the start of session in order to mitigate abolishing operation effects (North & Iwata, 2005).

Experimental arrangement. A concurrent-operants arrangement was used during all conditions. Two identical sets of task materials were placed in front of subjects. Each set of task materials was associated with a different reinforcement contingency. Discriminative stimuli were included to signal the consequences associated with each response option. First, pictures depicting the consequences associated with each response option were placed behind each set of task materials. Second, either a small round plate (56.5 cm in circumference) or a small plastic sandwich bag (16.5 cm x 14.9 cm) was placed behind each picture depicting the consequences associated with each response option to signal the immediacy with which the food earned during the session would be delivered. A plate signaled that the reinforcers earned during the session would be provided immediately after the session. A sandwich bag signaled that the reinforcers earned during the session would be provided 60-min after the session. Third, the food associated with each response option was visible such that the subject could see the type of food associated with each response option. The food was placed behind each stimulus used to signal the immediacy with which the food earned during the session would be delivered (i.e., the plate or the sandwich bag). Fourth, a strip of paper depicting a black bar was placed beside either the plate or the plastic bag assigned to each response option to signal the reinforcement schedule in effect for that session - the longer the bar, the leaner the schedule of reinforcement in effect. Specifically, a strip of paper depicting a 2.5 cm black bar signaled that the FR 1 schedule of reinforcement was in effect. A strip of paper depicting a 7.6 cm black bar signaled that the FR 4 schedule of reinforcement was in effect. A strip of paper depicting a 15.2 cm black bar signaled that the FR16 schedule of reinforcement was in effect and a strip of paper depicting a 22.9 cm black bar signaled that the FR 32 schedule of reinforcement was in effect. Finally, prior to the start of the session, subjects were provided a rule describing the contingencies associated with

both response options (e.g., "If you step on this block [while pointing to one of the blocks], this much [while pointing to the bar on the strip of paper], you will get X number of X food. If you step on this block [while pointing to the other block], this much [while pointing to the bar on the strip of paper], you will get X number of X food"). Next, subjects were prompted to complete the response requirement twice for both sets of task materials. The reinforcer associated with that set of task materials was either placed on a plate and was delivered immediately or was placed in a bag and was not delivered. Next, subjects were told that they could do whatever they wanted during the session. Once the session began, no other prompts were provided.

During all phases, sessions were 5-min in length. Subjects were exposed to at least two sessions per condition. If subjects responded inconsistently across both sessions (i.e., if subjects responded toward a different response option across both sessions), additional sessions were conducted until stable responding (i.e., two consecutive sessions during which subjects allocated responding toward the same response option) was observed. To ensure that subjects did not consume a large number of calories, the food was cut into dime-size pieces and no more than three sessions were conducted per day. In addition, all sessions took place at least one hour after the child's last meal in order to mitigate satiation effects. Finally, conditions were conducted in a random order within and across subjects to control for order effects.

Response Measurement, Interobserver Agreement, and Procedural Integrity. The World Health Organization (2004) stated that obesity should be prevented or combated by (a) decreasing consumption of calorically dense foods and (b) increasing physical activity. Therefore, the target response was a physical activity response (i.e., stair stepping) in order to enhance the health benefits of the current experiment. Stair stepping was defined as stepping onto and off of a 3" wood block with both feet. Trained observers collected data using ABC Data

Pro™ software on Apple iPods™. Observers recorded the frequency of correct performance of stair stepping (by the subject) and reinforcer delivery (by the therapist) associated with each response option separately. Reinforcer delivery was scored when a reinforcer was placed on the paper plate or into the plastic bag placed in front of the subject.

A second independent observer recorded the frequency of correct performance of stair stepping and the therapist's correct delivery of reinforcement during at least 43,7% (range, 43.7% to 66.7%) of all sessions to assess interobserver agreement. Observers' records were compared on an interval-by-interval basis. Interobserver reliability was calculated by dividing each session into 60 consecutive 5-s intervals. Agreement between observers was assessed by dividing the smaller number of responses recorded in each interval by the larger number. These fractions were averaged across the session and multiplied by 100% to yield the percentage of agreement between observers. Interobserver agreement for all subjects' correct performance of stair stepping averaged 93.3% (range, 74.6% to 100%). Interobserver agreement for all therapists' correct delivery of reinforcement averaged 94.3% (range, 75.8% to 100%). In addition, procedural integrity was calculated in order to determine the therapist's correct delivery of reinforcement. Procedural integrity data were collected during at least 66% (range, 66% to 100%) of all sessions and was calculated by dividing the number of reinforcer deliveries by the total number of responses divided by the schedule requirement in effect for a given session. This quotient was then multiplied by 100%. For example, if an FR 16 schedule of reinforcement was arranged for a session in which 32 responses occurred and 1 reinforcer delivery occurred, the procedural integrity quotient would be: [1 / (32/16)] X 100% = 50%. Procedural integrity for all therapists' correct delivery of reinforcement averaged 99.3% (range, 0% to 100%).

Baseline. The purpose of this phase was to determine whether subjects' responding was

sensitive to the favorable value of each reinforcer parameter. During baseline, a concurrent-operants arrangement was used in which each reinforcer parameter was evaluated in isolation in order to identify the subject's sensitivity to quantitative (magnitude and immediacy) or qualitative (quality) changes within that given dimension. When evaluating each parameter, the values of the other parameters were held constant and were either at their favorable (quality and immediacy) value or a modest (magnitude) value. Magnitude was held at a modest value (one piece of food) rather than its favorable value (five pieces of food) to ensure that subjects did not consume an excessive number of calories. An FR 1 schedule of reinforcement was used during each baseline condition. Conditions were conducted in a random order within and across subjects.

Quality. Quality refers to the relative preference for the reinforcers associated with each response option. During the quality condition, responding toward one response option resulted in the delivery of one piece of the ***high-preference*** item immediately following the session (i.e., the optimal response option). Responding toward the other response option resulted in the delivery of one piece of the ***low-preference*** item immediately following the session.

Quality Baseline

	Magnitude	Quality	Immediacy
Response Option 1	1 piece	**High-quality**	Immediately after session
Response Option 2	1 piece	**Low-quality**	Immediately after session

Magnitude. Magnitude refers to the number of reinforcers associated with each response option. During the magnitude condition, responding toward one response option resulted in the delivery of ***five pieces*** of the high-preference item immediately following the session (i.e., the optimal response option). Responding toward the other response option resulted in the delivery

of ***one piece*** of the high-preference item immediately following the session.

Magnitude Baseline

	Magnitude	Quality	Immediacy
Response Option 1	**5 pieces**	High-quality	Immediately after session
Response Option 2	**1 piece**	High-quality	Immediately after session

Immediacy. Immediacy refers to the time in which reinforcers earned for the respective set of tasks were delivered. During the immediacy condition, responding toward one response option resulted in the delivery of one piece of high-preference food ***immediately*** following the session (i.e., the optimal response option). Responding toward the other response option resulted in the delivery of one piece of food ***60 min*** after session.

Immediacy Baseline

	Magnitude	Quality	Immediacy
Response Option 1	1 piece	High-quality	***Immediately after session***
Response Option 2	1 piece	High-quality	***60-min after session***

Assessment. Previous research has demonstrated that various parameters of reinforcement can influence choice responding: quality (e.g., Piazza, Fisher, Hanley, Remick, Contrucci, & Aitken, 1997), magnitude (e.g., Penrod, Wallace, Reagan, Betz, & Higbee, 2010), immediacy (e.g., Ainslie, 1974), effort (e.g., Neef, Bicard, & Endo, 2001a), and rate (e.g., Neef, Mace, Shae, & Shade, 1992). Further, previous research has demonstrated the differential efficacy of reinforcers under dense and lean schedules of reinforcement for different reinforcers (e.g., DeLeon et al., 1997; Roane, Lerman, & Vorndran, 2001; Tustin, 1994) and for similar reinforcers of varying magnitudes (Trosclair-Lasserre, 2008). Therefore, the purpose of this phase was to (a) evaluate the relative influence of quality, magnitude, and immediacy of

reinforcement on young children's food choices and (b) determine if reinforcer-parameter efficacy was differentially affected by dense and lean schedules of reinforcement. Subjects whose responding was found to be sensitive to the favorable values of each parameter of reinforcement during baseline participated in the assessment phase.

During the assessment phase, the relative influence of quality (Q), magnitude (M), and immediacy (I) on the food choices made by young children was evaluated using a concurrent-operants arrangement. Disparate values of two of the three parameters were compared during each condition. When comparing different values of two of the three parameters, the value of the other parameter not included in the assessment was held constant and was at its favorable (quality and immediacy) or modest (magnitude) value. Magnitude was held at a modest value (one piece of food) rather than its favorable value (five pieces of food) to ensure that subjects did not consume an excessive number of calories. Separate but identical FR schedules were arranged for both response options. Subjects were exposed to at least two sessions; however, if subjects allocated responding toward a different response option across both sessions, sessions were continued until stable responding (i.e., responding toward one response option across two sessions) was observed.

Immediacy v. Quality (IvQ). During the IvQ condition, responding to one response option resulted in the delivery of one piece of the ***high-preference*** item delivered ***60 min*** following the session. Responding toward the other response option resulted in the delivery of one ***low-preference*** item delivered ***immediately*** following the session.

Immediacy v. Quality

	Magnitude	Quality	Immediacy
Response Option 1	1 piece	**High-quality**	***60-min after session***
Response Option 2	1 piece	**Low-quality**	***Immediately after***

	session

Magnitude v. Quality (MvQ). During the MvQ condition, responding to one response option resulted in the delivery of ***one piece*** of the ***high-preference*** item delivered immediately following the session. Responding toward the other response option resulted in the delivery of ***five pieces*** of the ***low-preference*** item delivered immediately following the session.

Magnitude v. Quality

	Magnitude	Quality	Immediacy
Response Option 1	**1 piece**	**<u>High-quality</u>**	Immediately after session
Response Option 2	**5 pieces**	**<u>Low-quality</u>**	Immediately after session

Immediacy v. Magnitude (IvM). During the IvM condition, responding to one response option resulted in the delivery of ***one piece*** of the high-preference item delivered ***immediately*** following the session. Responding toward the other response option resulted in the delivery of ***five pieces*** of the high-preference item ***60 min*** following the session.

Immediacy v. Magnitude

	Magnitude	Quality	Immediacy
Response Option 1	**1 piece**	High-quality	***Immediately after session***
Response Option 2	**5 pieces**	High-quality	***60-min after session***

Schedule Manipulation

FR 1. For all subjects, an FR 1 schedule of reinforcement served as the dense schedule of reinforcement during all phases in which the relative reinforcing efficacy of the parameters of reinforcement were evaluated under a dense schedule of reinforcement (Phase A and Phase C).

FR 16. An FR 16 schedule of reinforcement served as the lean schedule of reinforcement (Phase B) for five of six subjects.

FR 4. An FR 4 schedule of reinforcement served as the lean schedule of reinforcement (Phase B) for one of six subjects (Cece). Cece was exposed to an FR 4 rather than an FR 16 because she repeatedly revoked assent following pre-session exposure to both the FR 16 and FR 8 schedule requirements.

FR 32. An FR 32 schedule of reinforcement served as an even *leaner* schedule of reinforcement (Phase D) for one of six subjects (Ivy). Ivy was also exposed to an FR 32 schedule because the effect of the lean (FR 16) schedule of reinforcement on reinforcer–parameter efficacy was not replicated during the reversal to the lean (FR 16) schedule of reinforcement phase.

Experimental Design

In order to determine whether dense and lean schedules of reinforcement differentially affected the efficacy of reinforcer parameters, a concurrent-operants arrangement within an ABAB reversal design was used to compare assessment results under dense (Phase A) and lean (Phase B) schedules of reinforcement with five of six subjects. One of six subjects (Ivy) was exposed to an ABABCDCD reversal design because the effect of the lean schedule of reinforcement on reinforcer–parameter efficacy was not replicated during the reversal to the lean schedule of reinforcement phase. Therefore, a second series of reversals were conducted under the only condition (IvQ) in which (a) an initial shift in responding from the dense to lean schedules and (b) the failure to replicate this effect was observed. Specifically, the IvQ condition was conducted under a dense (Phase C) and a leaner schedule requirement (Phase D) to

determine if a leaner schedule of reinforcement would influence the efficacy of the parameter of reinforcement assessed.

Data analysis. Data were analyzed in three separate ways. First, data were analyzed by comparing the relative proportion of responding toward both response options within a given condition. For example, if a subject responded more towards the high-quality response option relative to the more immediate response option during the IvQ condition, quality of food was said to influence choice responding more than immediacy of food access under the current experimental conditions. Second, data were analyzed within a given phase to identify the most-influential parameter of food governing children's food choices. Specifically, comparing the relative proportion of responding toward both response options across conditions, within each phase, identified the most-influential parameter. Continuing with the same example above, if the subject also responded more towards the high-quality response option relative to the high-magnitude response option during the MvQ condition such that the subject allocated more responding toward the high-quality response option during both conditions in which quality is assessed (IvQ, MvQ), quality of food was said to be the most-influential parameter of food under the current experimental conditions. Finally, the differential efficacy of dense and lean schedules on reinforcer efficacy was determined by comparing assessment results across phases of dense and leans schedules. Specifically, the results of the competing parameters assessment conducted under a dense schedule were compared to the results of the competing parameters assessment conducted under the lean schedule.

Results & Implications

Results of the competing parameters assessment are depicted in Figures 33 to 35. The figures show the final session of each condition because these data depict response allocation

following a history of exposure to the contingencies arranged in each condition. Because subjects did not actually contact the reinforcement contingencies arranged in a given session until the session ended, it is unlikely that first-session data represent responding under the control of the contingencies arranged in the first session of any condition. Therefore, because the effects of a given reinforcement contingency cannot emerge, or be observed, until subjects contact the contingency (i.e., at least the second session per condition), it seemed (a) unnecessary to depict first-session data and (b) more accurate to provide data from the last session of each condition, particularly because all conditions were run until stable responding (i.e., responding toward the same response option across two consecutive sessions) was observed.

The behavior of 2 (Cristy and Jackie) of 8 subjects was not sensitive to the favorable values of each parameter of reinforcement during baseline (See Figure 33). Specifically, during baseline, Cristy responded exclusively toward the favorable value of quality and more toward the favorable value of immediacy. However, she allocated more responding toward the unfavorable value of magnitude. Jackie allocated more responding toward the favorable magnitude value, but more toward the unfavorable quality and immediacy values during baseline. Because these subjects demonstrated a lack of sensitivity to the favorable values of all three reinforcement parameters, it was (a) likely that factors other than the parameters of reinforcement being assessed were influencing their responding during baseline and (b) unlikely that their assessment results would yield useful information. Therefore, Cristy and Jackie were excluded from the subsequent assessment.

Initial Dense Schedule of Reinforcement Assessment Results

The behavior of the remaining 6 (Benny, Carrie, Cece, Cristy, Ivy, Jackie, Laurie, and Mitch) subjects was sensitive to the favorable value of each parameter of reinforcement during

baseline (See Figures 34 and 35); therefore, these 6 subjects participated in the subsequent assessment. One (Benny) of these 6 subjects responded exclusively toward the favorable quality, magnitude, and immediacy response options during baseline. However, during the initial dense schedule of reinforcement assessment phase, Benny allocated responding toward a different parameter of reinforcement across each condition. Therefore, it was not possible to identify the relative influence of a specific parameter of reinforcement on Benny's food choices. For 3 (Cece, Carrie, and Mitch) subjects, immediacy of food access was found to most influence their food choices. That is, under a dense schedule of reinforcement, Cece, Carrie, and Mitch allocated all or most of their responding toward the immediately (after session) available food, even when doing so produced (a) a smaller magnitude of food (during the IvM condition) and (b) a LQ food (during the IvQ condition). Further, when magnitude and quality (during the MvQ condition) were compared, all three subjects allocated more or exclusive responding toward the HQ option, indicating that quality of food was the second-most influential parameter of food governing these subjects' responding. Finally, for 2 (Laurie and Ivy) subjects, quality of food was found to most influence their food choices. That is, under a dense schedule of reinforcement, Laurie and Ivy allocated all or most of their responding toward the quality option, even when doing so produced (a) a 60-min delay to food access (during the IvQ condition) and (b) a smaller magnitude of food (during the MvQ condition). Further, when immediacy and magnitude (during the IvM condition) were compared, both subjects responded exclusively toward the immediacy option, indicating that immediacy of food access was the second-most influential parameter of food governing their food choices.

Finally, although results of the initial dense schedule of reinforcement assessment phase were idiosyncratic across subjects, one noteworthy finding was that quality and immediacy were

identified as the top-two influential parameters for all 5 (Carrie, Cece, Ivy, Laurie, and Mitch) subjects for whom the assessment methodology was able to identify parameters of reinforcement that differentially affected their food choices. Therefore, magnitude of food was not found to be the most or the second-most influential parameter of food governing any subjects' responding under the initial dense schedule of reinforcement phase.

Effort Manipulation Assessment Results

The assessment methodology (as determined by the results of the initial dense schedule of reinforcement assessment phase) was able to identify parameters of reinforcement that differentially affected the food choices made by 5 of 6 subjects. For 3 (Cece, Carrie, and Laurie) of these 5 subjects, the assessment results under a lean schedule of reinforcement replicated those of the dense schedule assessment phase. Specifically, under both dense and lean schedules of reinforcement, immediacy was found to be the most-influential parameter of reinforcement and quality was found to be the second-most influential parameter of reinforcement governing both Cece and Carrie's food choices. Under both dense and lean schedules of reinforcement, quality was found to be the most-influential parameter of reinforcement and immediacy was found to be the second-most influential parameter of reinforcement governing Laurie's food choices. These findings suggest that effort did not influence the Cece, Carrie, or Laurie's food choices.

For 2 (Mitch and Laurie) subjects, the assessment results under a lean schedule of reinforcement did not replicate those of the dense schedule assessment phase. During the initial dense schedule of reinforcement assessment phase, Mitch responded exclusively toward the response option that produced the food immediately after the session during both conditions in which immediacy was assessed, indicating that immediacy of food access is the most-influential

parameter governing Mitch's food choices. When magnitude and quality (during the MvQ condition) were compared, Mitch responded exclusively toward the quality option, indicating that quality of food is the second-most influential parameter governing his food choices. However, during the lean (FR 16) assessment phase, Mitch responded more toward the response alternative associated with quality during both conditions in which quality was assessed indicating that, under a lean schedule of reinforcement, quality of food is the most-influential parameter of food governing Mitch's food choices. The data from the first two phases (FR 1 and FR 16 assessment phases) initially suggested that dense and lean schedules differentially affect the most-influential parameter of reinforcement governing Mitch's food choices. However, when the dense schedule assessment phase was re-introduced, the initial pattern of responding was not recaptured. That is, Mitch did not allocate more responding toward the response options associated with the immediately available food during both conditions in which immediacy was assessed, indicating that, quality was now identified as the most-influential parameter governing his food choices.

Although we were unable to identify the exact conditions that controlled Mitch's responding, two possible explanations for Mitch's pattern of responding exist. First, it is possible that the initial assessment phase conducted under a dense schedule yielded a false positive outcome. That is, it is possible that the initial dense schedule assessment phase may have inaccurately identified immediacy of food access as the most-influential parameter governing Mitch's food choices. First, it is important to note that the only condition in which a shift in responding was observed (from the initial FR 1 to the FR 16 schedule assessment phases) was during the IvQ condition; responding across all other conditions remained the same under both dense and lean schedules of reinforcement. Second, pre-session exposure to the IvQ

contingencies consists of (a) placing one piece of **LQ** food on a plate and providing that item **immediately** after the subject completes the FR requirement associated with that response option and (b) placing one piece of **HQ food** in a small plastic bag that signals the food is delivered at a delay (i.e., the food placed in the bag was **not** delivered to Mitch during pre-session exposure). Therefore, Mitch did not actually contact the consequence associated with the **HQ food** item available after a **60 min delay**. Third, during the initial dense schedule of reinforcement assessment phase, Mitch responding exclusively toward the response option associated with the **LQ food** delivered **immediately** after the session. Therefore, Mitch did not contact the contingency associated with the **HQ food** available after a **60 min delay** during the initial dense schedule assessment phase. Taken together, it is possible that the lack of exposure to the consequences associated with the **HQ food** available after a **60 min delay** prior to (pre-session exposure) and during the initial dense schedule assessment phase may have produced the inaccurate identification of immediacy of food access as the most-influential parameter of reinforcement governing Mitch's food choices. Second, it is possible that changing the response requirement from lean (FR 16) back to dense (FR 1) influenced Mitch's responding. Specifically, it is possible that increasing the response requirement (a) decreased the value of immediacy of food access as a reinforcer and (b) increased the value of quality of food as a reinforcer. Thus, when the response requirement subsequently decreased, the value of quality of food as a reinforcer maintained and overrode the value of immediacy of food access as a reinforcer.

Finally, during the dense (FR 1) schedule assessment phase, Ivy responded exclusively toward the high-quality option during both conditions in which quality was assessed, indicating that under dense schedules of reinforcement, quality is the most-influential parameter of food in determining Ivy's food choices. However, during the first lean (FR 16) assessment phase, Ivy

responded more toward the immediate option during both conditions in which immediacy was assessed, indicating that under lean schedules of reinforcement, immediacy of food access is the most-influential parameter of food in determining her food choices. When the FR 1 and FR 16 schedule of reinforcement assessment phases were re-introduced, Ivy responded exclusively toward the high-quality option during both conditions in which quality was assessed (i.e., replication of the effects under the initial FR 16 schedule of reinforcement phase on reinforcer efficacy was not observed). Therefore, we increased the schedule requirement to FR 32 to determine if a leaner schedule of reinforcement would influence the efficacy of the parameters of reinforcement assessed. Under both FR 32 assessment phases, Ivy either allocated more or all of her responding toward the more immediate response option, suggesting that, under these conditions, immediacy is the most-influential parameter governing Ivy's food choices. Therefore, it is possible that, after repeated exposure to the FR 16 schedule of reinforcement, Ivy habituated to the amount of effort required by the schedule. Because the effects of the FR 32 schedule were replicated across both FR 32 phases, it appears that (a) Ivy did not habituate to the more effortful FR 32 schedule requirements and (b) the influence of immediacy of food access was durable when the schedule requirement was doubled. Further, these findings demonstrate that disparate amounts of effort influenced the outcome of the assessment for Ivy in a predictable way. That is, the four administrations of the assessment under the FR 1 schedule identified quality as the most influential parameter and both administrations of the assessment under the FR 32 schedule identified immediacy as the most influential parameter of reinforcement governing Ivy's food choices.

General Implications

The current series of experiments attempted to (a) identify aspects of food (e.g., food groups, healthier and less-healthy options) that influence children's relative preferences and (b) replicate and extend the work of Thomason (2007) and Neef and colleagues (1992, 1993, 1994, 2001a, 2001b 2005) on competing parameters assessment to evaluate parameters of food reinforcement that may influence children's food choices. The series of food preference assessments conducted in Experiment 1 established empirical evidence of food preference patterns in very young children (under age 5) that confirmed indirect reports that children's food preferences are often dictated by types of foods. For example, snacks were the top-ranked food group for 14 of 21 subjects, whereas vegetables and fruits were ranked as one of the bottom-ranked categories (or both) for 21 of 21 subjects, confirming indirect reports that some children prefer less-healthy relative to healthier food options. These finding highlighted the need for further investigation into various factors that may influence young children's food preferences such that strategies to promote the consumption of healthier foods can be developed.

The competing parameters assessment conducted in Experiment 2 extended the work of previous researchers in three important ways. First, previous researchers have used the CPA to evaluate the relative influence of various parameters of reinforcement on the responding of individuals diagnosed with (a) PWS (Glover et al., 1996; Joseph et al., 2002; Thomason, 2007), (b) mental retardation (Glover et al.), (c) ADHD (Neef et al., 2001b, Neef et al., 2005a; Neef et al., 2005b) , and various emotional and behavioral difficulties (Neef et al., 1992; Neef et al., 1993; Neef et al., 1994; Neef et al., 2001a). In the current investigation, the CPA was used to evaluate the relative influence of various parameters of reinforcement on the responding of *young typically developing children*. Second, the CPA extended the series of studies conducted by Neef and colleagues by evaluating the relative influence of various parameters of

reinforcement on *food choices*. Specifically, the items used as reinforcers in the series of studies conducted by Neef and colleagues consisted of program money that could be exchanged for toys, leisure items, activities, or snacks. Third, whereas Glover et al., Joseph et al., and Thomason did not manipulate effort in their respective investigations, Neef and colleagues did manipulate effort in several of their investigations (Neef et al., 1994; 2001a. 2001b, 2005a; 2005b). However, the effort manipulation consisted of difficult versus easy math problems rather than effort in the form of schedule requirement manipulation. Therefore, the current experiment extended the work of previous researchers by evaluating the relative influence of parameters of reinforcement under dense and lean schedules of reinforcement. Glover et al., Joseph et al., Neef and colleagues, and Thomason (2007) all used dense schedules of reinforcement during their respective investigations; therefore, they only evaluated the relative influence of various parameters under conditions in which only a low amount of effort was required to obtain the reinforcers. Because several researchers have demonstrated the differential efficacy of reinforcers under dense and lean schedules (e.g., DeLeon et al., 1997; Roane et al., 2001; Tustin, 1994), it seemed prudent to evaluate the influence of various reinforcer parameters under dense and lean schedules of reinforcement so as to be able to more accurately inform intervention strategies designed based on the CPA results. For example, if the results of CPA conducted under a dense schedule identified quality as the child's most-influential parameter of reinforcement but if the results of the CPA conducted under a lean schedule identified immediacy as the child's most-influential parameter, developing an intervention based on the results of the CPA conducted under a dense schedule may not yield the most appropriate intervention strategy for that child. As such, the child would most likely continue to consume less-healthy food choices.

Second, the CPA conducted during Experiment 2 (a) never identified magnitude of reinforcement as one of the top-two most influential parameters for any subject and (b) identified quality and immediacy as the top-two influential parameters of reinforcement for all subjects for whom the assessment methodology was able to identify parameters of reinforcement that differentially affected their food choices. However, the CPA conducted in Experiment 2 only evaluated two different values of each parameter with all subjects. That is, only two values of quality (high- and low-preference items), magnitude (1 piece of food and 5 pieces of food), immediacy (delivery of food immediately after session and 1 hour after session), and effort (FR 1 and FR 4 or FR 16). One subject (Ivy) was also exposed to a FR 32 schedule of reinforcement because it was hypothesized that she habituated to the amount of effort required to obtain reinforcers during the FR 16 assessment phase; however, all other subjects were only exposed to two different schedules of reinforcement. It is possible that evaluating a wider variety of values of each parameter may have yielded different outcomes. For example, magnitude of reinforcement was not found to govern any of the subject's food choices. It is possible that the favorable value of magnitude (5 pieces of food) was insufficient to exert control over any of the subjects' food choices. Therefore, it may be the case that magnitude of food could actually serve as an influential parameter in determining some children's food choices; however, the highest value (5 pieces) of magnitude used in the current experiment may not have been sufficient to capture this potential influence. Similarly, the differential efficacy of parameters of reinforcement was only partially observed with 2 subjects. Therefore, it is possible that the lean schedule requirement was not sufficiently effortful to influence responding under the current experimental conditions. Conversely, it is also possible that effort simply does not influence the efficacy of parameters of reinforcement for some children. However, because only two values of

effort were evaluated, it is unclear if increasing the schedule requirement would have shifted responding toward a different parameter of reinforcement (as compared to the parameter identified under a dense schedule). Taken together, future researchers may consider evaluating more than two values of reinforcer and response parameters when conducting a competing parameters assessment. For example, future researchers may consider evaluating three values of quality (HQ, MQ, LQ), magnitude (1 piece of food, 5 pieces of food, 10 pieces of food), and immediacy (delivery of reinforcers immediately, one hour, and 5 hours after session). In addition, future researchers may consider using a progressive ratio schedule of reinforcement to determine whether dense and lean schedules of reinforcement differentially affect the reinforcing efficacy of various parameters of reinforcement as an efficient means to identify the effect of effort on response allocation.

Although the current series of experiments extended previous research in several important ways, there are a few limitations worth noting. First, the day care from which all subjects were selected was located in a small, liberal college town. As such, several of the subjects in the current experiment are children of highly educated professors, graduate students, or undergraduate students. Because a correlation between higher education and healthier eating habits (National Center for Health Statistics, 2011) has been reported, it is possible that the results of these preference assessments may not actually be representative of all young children's food preferences.

As stated previously, one potential explanation for the failure to replicate the effects of effort on Mitch's response allocation under the initial dense schedule assessment phase may have been due to the changing response requirements. Specifically, Mitch's response allocation shifted from immediacy to quality only after exposure to the lean schedule of reinforcement. One

possible way to evaluate whether exposure to lean schedules affected Mitch's responding may have consisted of increasing the response requirement even further then decreasing the response requirement. Therefore, future researchers conducting the CPA may consider reversing back to a dense schedule of reinforcement following exposure to a lean schedule in order to determine whether exposure to lean schedules of reinforcement influences subjects' response allocation under dense schedules of reinforcement.

Although validating the CPA results was outside of the scope of the current series of experiments, the lack of validation of the CPA results may pose a limitation to the current investigation. For example, without an evaluation of an intervention based on the results of the CPA, it is unclear if the CPA accurately identified the most-influential parameter of reinforcement for each child. However, this limitation should be tempered with the fact that both Thomason (2007) and Neef et al. (2001b) developed effective intervention strategies based on the results of the CPA. That is, these researchers established the CPA as a useful tool to identify the parameter of reinforcement that most influences individual's choices. Nonetheless, future researchers may consider developing and evaluating interventions based on the results of the CPA.

In conclusion, the series of preference assessments conducted in Experiment 1 confirmed indirect reports that some children prefer less-healthy to healthier foods, are unwilling to try some foods, and that some children's less-preferred foods tend to consist of vegetables and fruits. However, future researchers may consider replicated these preference assessment with a more representative sample of young children. Finally, the competing parameters assessment conducted in Experiment 2 extended previous researcher by evaluating the relative influence of various parameters of reinforcement and responding on the *food choices* made by *young typically*

developing children. The results of the competing parameters assessment indicated that both quality and immediacy of reinforcement were influential parameters of reinforcement for two and three children, respectively; however, magnitude of reinforcement was not found to influence the food choices made by any of the children. Further, the effects of effort were only partially replicated with one (Ivy) subject. Therefore, future research is needed to (a) evaluate the relative influence of a larger number of different values of each response and reinforcer parameter. Finally, future researchers may consider validating the results of the competing parameters assessment.

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Table 1

Foods included in each food group of preference assessments

Food group	Foods
Grain	Whole wheat bread, Saltine Crackers™, fat-free vanilla wafers, cheerios, Wonder Bread™, Club Crackers™, vanilla wafers, Captain Crunch™
Protein	Ground turkey, turkey bacon, grilled chicken, 1% cheese, ground beef, bacon, chicken nuggets, whole cheese
Snack	Pretzels™, plain popcorn, Baked Doritos™ or Baked Lays™, raisins, chocolate pretzels, buttered popcorn, Doritos™ or Lays™ , chocolate raisins
Fruit	Plum or peach, pineapple, orange, pear, canned plum or canned peach, canned pineapple, canned orange, canned pear, canned peach
Vegetable	Steamed broccoli; steamed cauliflower; steamed green beans; yams broccoli, butter, and cheese; cauliflower, butter, and cheese; green beans, butter, and cheese; Tater Tots™

Table 2

Nutrition facts for each item included in the preference assessments

Food Group	Food	Serving Size	Calorie	Total Fat	Sodium	Total Carbs	Dietary Fiber	Sugar	Protein
Grain	Wheat Bread	1 oz	70	1g	149 mg	13 g	2 g	6 g	3 g
	White Bread	1 oz	120	1 g	306 mg	23 g	1 g	2 g	3 g
	Saltine Crackers	1 oz	38	12 g	94 mg	6 g	<1 g	0 g	<1 g
	Club Crackers	1 oz	142	6 g	253 mg	18 g	2 g	2 g	2 g
	Nilla Wafer	1 oz	130	5 g	110 mg	20 g	0 g	10 g	1 g
	Fat-Free Nilla Wafer	1 oz	120	2 g	110 mg	24 g	0 g	12 g	1 g
	Cheerio	1 oz	100	2 g	140 mg	20 g	3 g	1 g	3 g
	Capt'n Crunch	1 oz	116	2 g	210 mg	24 g	1 g	13 g	1 g
Protein	Turkey Bacon	1 oz	71	6 g	344 mg	<1 g	0 g	0 g	3 g
	Bacon	1 oz	157	11 g	655 mg	<1 g	0 g	<1 g	4 g
	Baked Chicken	1 oz	33	<1 g	19 mg	0 g	0 g	0 g	7 g
	Chicken Nugget	1 oz	80	5 g	153 mg	4 g	<1 g	0 g	4 g
	1% Cheese	1 oz	29	1 g	101 mg	<1 g	0 g	1 g	4 g
	Whole Cheese	1 oz	110	9 g	180 mg	0 g	0 g	0 g	7 g
	Ground Turkey	1 oz	30	<1 g	14 mg	0 g	0 g	0 g	7 g
	Ground Beef	1 oz	77	5 g	26 mg	0 g	0 g	0 g	8 g
Snack	Pretzel	1 oz	108	1 g	485 mg	22 g	1 g	0 g	3 g
	Choc. Pretzel	1 oz	130	5 g	161 mg	20 g	0 g	12 g	2 g
	Raisin	1 oz	62	<1 g	2 mg	16 g	<1 g	12 g	<1 g
	Choc. Raisin	1 oz	95	4 g	8 mg	16 g	<1 g	4 g	1 g
	Plain Popcorn	1 oz	4	0 g	0 mg	<1 g	<1 g	0 g	<1 g
	Butter Popcorn	1 oz	12	<1 g	25 mg	2 g	<1 g	0 g	<1 g
	Lays	1 oz	160	10 g	170 mg	15 g	1 g	1 g	2 g
	Baked Lays	1 oz	120	2 g	150 mg	26 g	2 g	2 g	2 g
	Dorito	1 oz	140	8 g	210 mg	16 g	1 g	0 g	2 g
	Baked Dorito	1 oz	120	4 g	230 mg	2 g	1 g	2 g	3 g

Table 2 (Continued)

Food Group	Food	Serving Size	Calorie	Total Fat	Sodium	Total Carbs	Dietary Fiber	Sugar	Protein
Fruit	Pear	1 oz	12	0 g	<1 mg	3 g	<1 g	2 g	<1 g
	Canned Pear	1 oz	18	0 g	2 mg	5 g	<1 g	4 g	0 g
	Pineapple	1 oz	9	0 g	<1 mg	3 g	<1 g	2 g	<1 g
	Canned Pineapple	1 oz	14	0 g	<1 mg	4 g	<1 g	3 g	<1 g
	Peach	1 oz	12	0 g	0 mg	3 g	<1 g	f3 g	<1 g
	Canned Peach	1 oz	17	0 g	2 mg	5 g	<1 g	5 g	<1 g
	Orange	1 oz	10	0 g	<1 mg	3 g	<1 g	2 g	<1 g
	Canned Orange	1 oz	19	0 g	2 mg	5 g	<1 g	5 g	<1 g
	Plum	1 oz	10	0 g	0 mg	2 g	<1 g	2 g	<1 g
	Canned Plum	1 oz	20	0 g	6 mg	5 g	<1 g	5 g	<1 g
Veg.	Cauliflower	1 oz	2	0 g	2 mg	<1 g	<1 g	<1 g	<1 g
	Cauliflower w/ Cheese	1 oz	13	1 g	95 mg	2 g	<1 g	<1 g	<1 g
	Yam	1 oz	20	0 g	1 mg	5 g	<1 g	<1 g	<1 g
	Tater Tots	1 oz	50	3 g	125 mg	7 g	1 g	0 g	1 g
	Broccoli	1 oz	4	0 g	4 mg	<1 g	<1 g	<1 g	<1 g
	Broccoli w/ Cheese	1 oz	15	<1 g	68 mg	2 g	<1 g	<1 g	<1 g
	Green Bean	1 oz	8	0 g	0 mg	2 g	<1 g	<1 g	<1 g
	Green Bean w/ Cheese	1 oz	28	1 g	23 mg	1 g	<1 g	<1 g	1 g

Child: _____ Date: _____
Evaluator: _____ Primary/Reliability

Items:

1.
2.
3.
4.
5.
6.
7.
8.

Trials:

1 x 2	1 x 3	1 x 4	1 x 5	1 x 6	1 x 7	1 x 8
2 x 3	2 x 4	2 x 5	2 x 6	2 x 7	2 x 8	
3 x 4	3 x 5	3 x 6	3 x 7	3 x 8		
4 x 5	4 x 6	4 x 7	4 x 8			
5 x 6	5 x 7	5 x 8				
6 x 7	6 x 8					
7 x 8						

Directions: within a given trial, circle the number associated with the item selected and record if the child: accepted (A), consumed (C), expelled the food (E), or did not make a selection (NS).

Figure 1. Eight-item paired-choice preference assessment procedure data sheet. Each food item was assigned a number (top panel). Within each trial (bottom panel), the data collector was instructed to (a) circle the number associated with he item selected and (b) record if the child accepted the food, consumed the food, expelled the food, or did not make a selection.

Table 3

The percentage of trials in which healthier and less-healthy foods were consumed and the Healthy Eating Index scores for each food group during the within-food group PA.

Subject	Percentage of Consumption														
	Grain			Protein			Snack			Protein			Grain		
	H	L.H	H	L.H	H	L.H	H	L.H	H.E. Index	H.	L.H.	H.E. Index	H	L.H.	H.E. Index
Benny	25.0	75.0	25.0	75.0	25.0	75.0	18.8	81.3	-63.0	43.8	56.3	-12.5	12.5	87.5	-75.0
Bernard	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	0.0	37.5	43.8	-6.3	6.3	25.0	-18.7
Bianca	62.5	37.5	62.5	37.5	62.5	37.5	18.8	81.3	-63.0	31.3	0.0	31.1	0.0	25.0	-25.0
Brea	43.8	56.3	43.8	56.3	43.8	56.3	43.8	56.3	-12.5	75.0	25.0	50.0	75.0	25.0	50.0
Carrie	56.3	43.8	56.3	43.8	56.3	43.8	12.5	87.5	-75.0	62.5	37.5	25.0	12.5	87.5	-75.0
Cece	50.0	43.8	50.0	43.8	50.0	43.8	25.0	75.0	-50.0	43.8	56.3	-12.5	56.3	18.8	37.5
Cristy	56.3	43.8	56.3	43.8	56.3	43.8	37.5	62.5	-25.0	43.8	25.0	18.8	12.5	25.0	-12.5
Danny	37.5	62.5	37.5	62.5	37.5	62.5	50.0	37.5	12.5	50.0	18.8	31.2	37.5	62.5	-25.0
Eddy	56.3	37.5	56.3	37.5	56.3	37.5	43.8	37.5	6.3	62.5	37.5	25.0	62.5	37.5	25.0
Ellen	43.8	56.3	43.8	56.3	43.8	56.3	43.8	56.3	-12.5	25.0	75.0	-50.0	50.0	43.8	6.2
Eunice	37.5	62.5	37.5	62.5	37.5	62.5	56.3	43.8	12.5	50.0	50.0	0.0	37.5	62.5	-25.0
Harry	18.8	81.3	18.8	81.3	18.8	81.3	56.3	43.8	12.5	56.3	43.8	12.5	6.3	25.0	-18.7
Ivy	56.3	43.8	56.3	43.8	56.3	43.8	37.5	62.5	-25.0	6.3	56.3	-50.0	6.3	31.3	-25.0
Jackie	37.5	62.5	37.5	62.5	37.5	62.5	37.5	62.5	-25.0	31.3	68.8	-37.5	31.3	68.8	-37.5
Laurie	25.0	75.0	25.0	75.0	25.0	75.0	43.8	56.3	-12.5	50.0	50.0	0.0	0.0	0.0	0.0
Lily	43.8	56.3	43.8	56.3	43.8	56.3	50.0	50.0	0.0	62.5	12.5	50.0	6.3	25.0	-18.7
Marie	37.5	62.5	37.5	62.5	37.5	62.5	31.3	68.8	-37.5	50.0	50.0	0.0	31.3	68.8	-37.5
Mitch	56.3	43.8	56.3	43.8	56.3	43.8	50.0	50.0	0.0	25.0	68.8	-43.8	18.8	0.0	18.8
Tristan	43.8	43.8	43.8	43.8	43.8	43.8	37.5	62.5	-25.0	12.5	43.8	-31.3	0.0	25.0	-25.0
Tyler	25.0	68.8	25.0	68.8	25.0	68.8	25.0	68.8	-43.8	50.0	18.8	31.2	12.5	50.0	-37.5
Xander	37.5	43.8	37.5	43.8	37.5	43.8	25.0	62.5	-37.5	6.3	50.0	-43.7	0.0	25.0	-25.0

Note. H = healthier foods; L. H. = less-healthy foods; H.E. Index = healthy eating index, defined as the difference in the percentage of consumption of healthier foods and less-healthy foods. Higher scores on the Healthy Eating Index represent healthier eating habits.

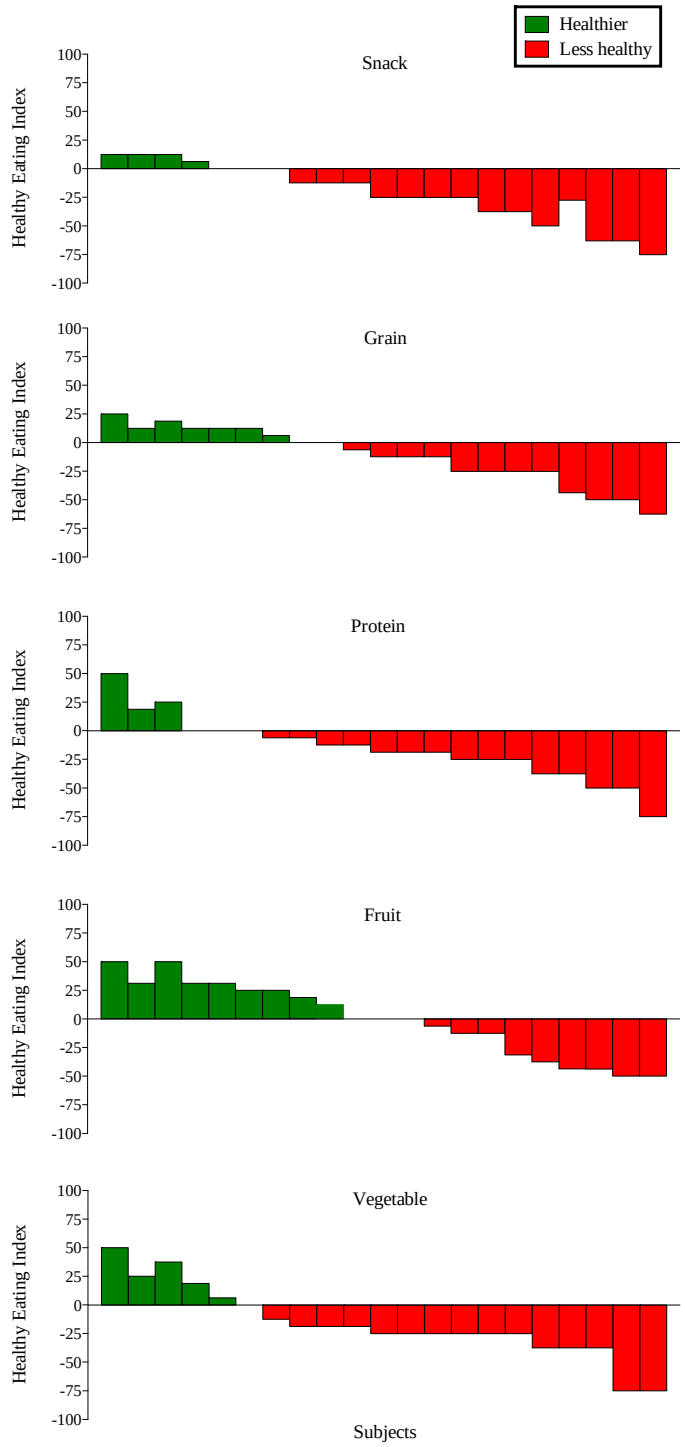


Figure 2. Healthy Eating Indices summarizing the preferences for healthier and less-healthy foods within each food group during the within-food group preference assessments. Bars (green) above the x axis denote a preference for healthier foods and bars (red) below the x axis denote a preference for less-healthy foods.

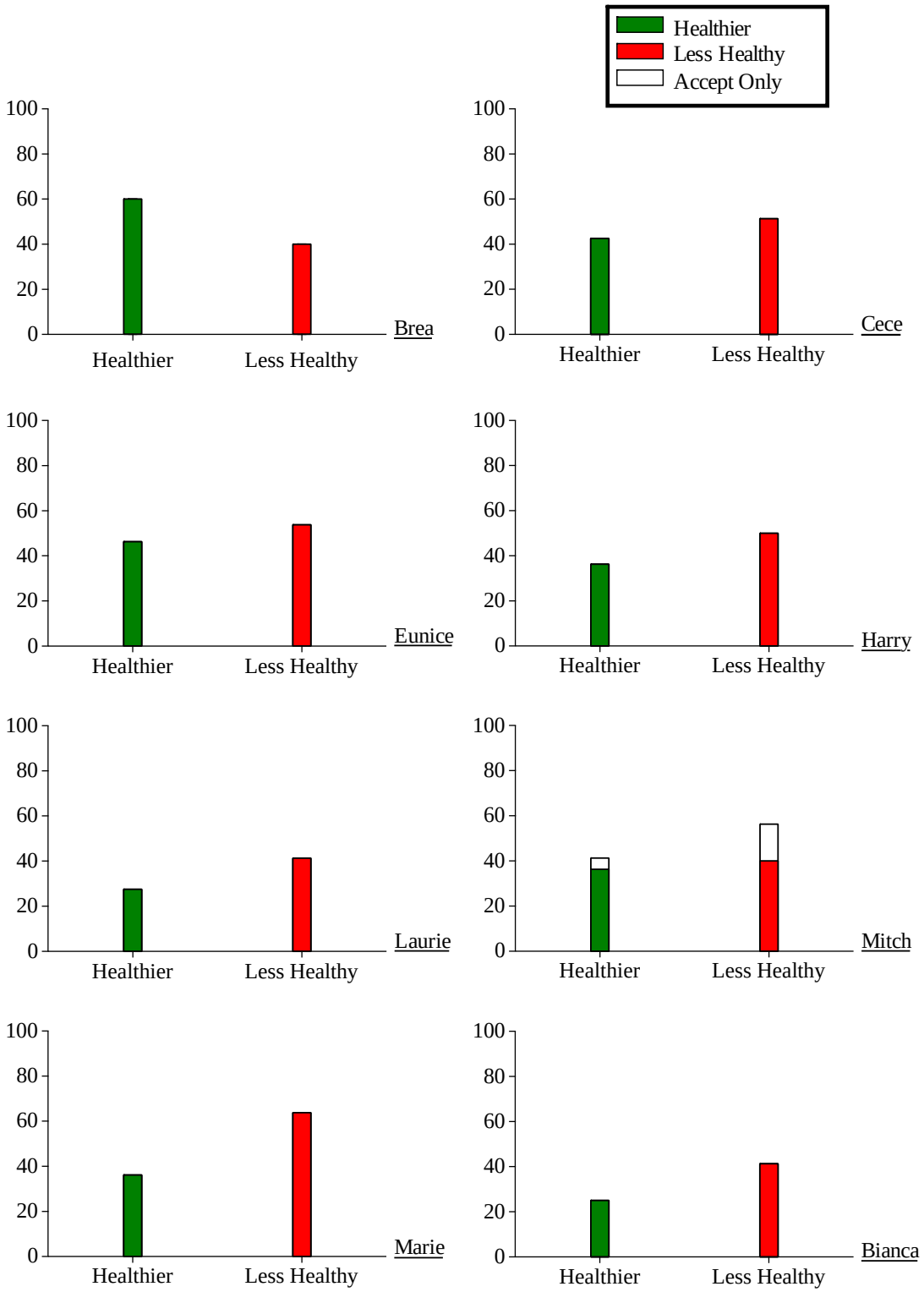


Figure 3. The overall percentage of trials in which healthier and less-healthy foods were consumed during the within-food group preference assessments.

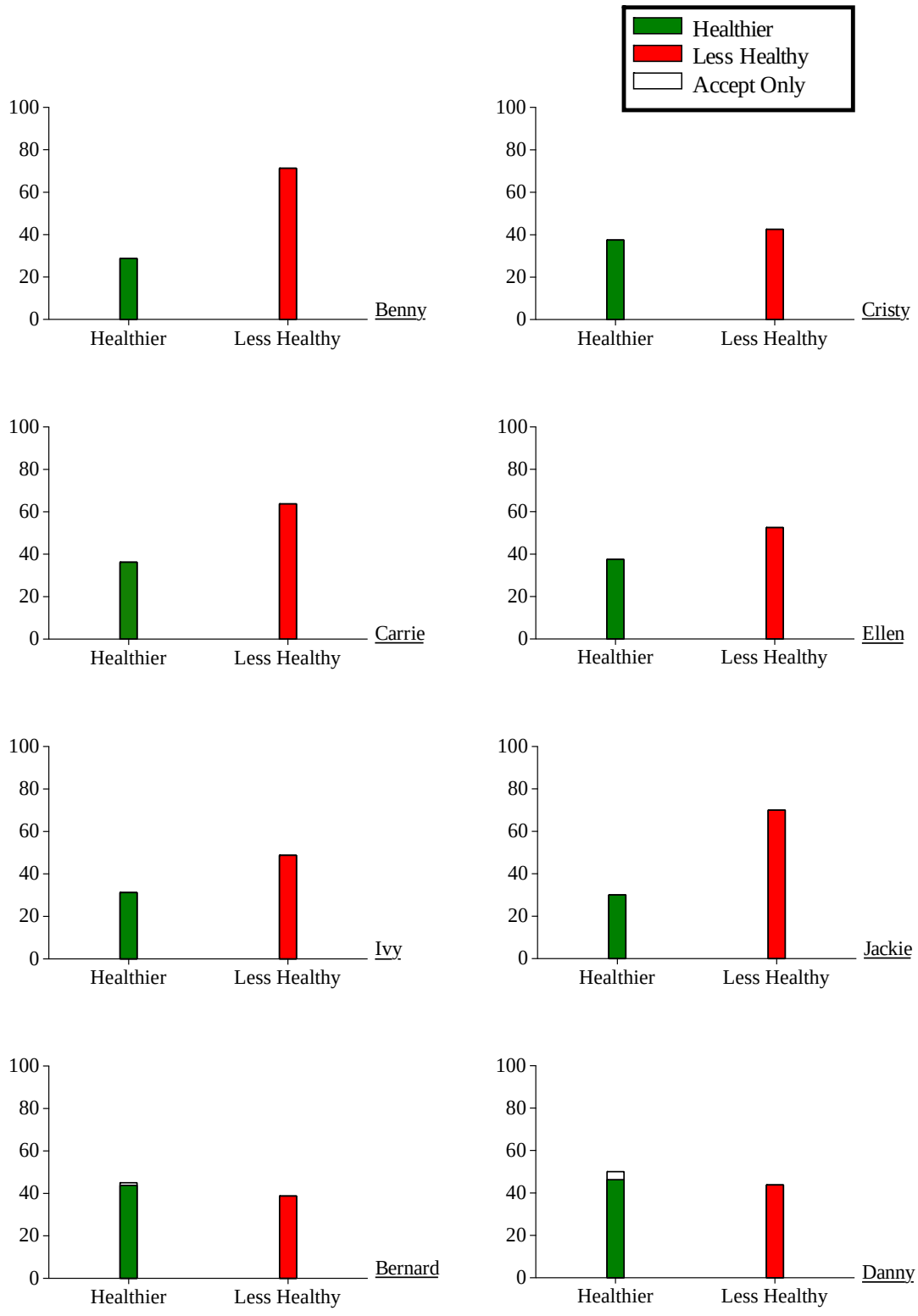


Figure 4. The overall percentage of trials in which healthier and less-healthy foods were consumed during the within-food group preference assessments.

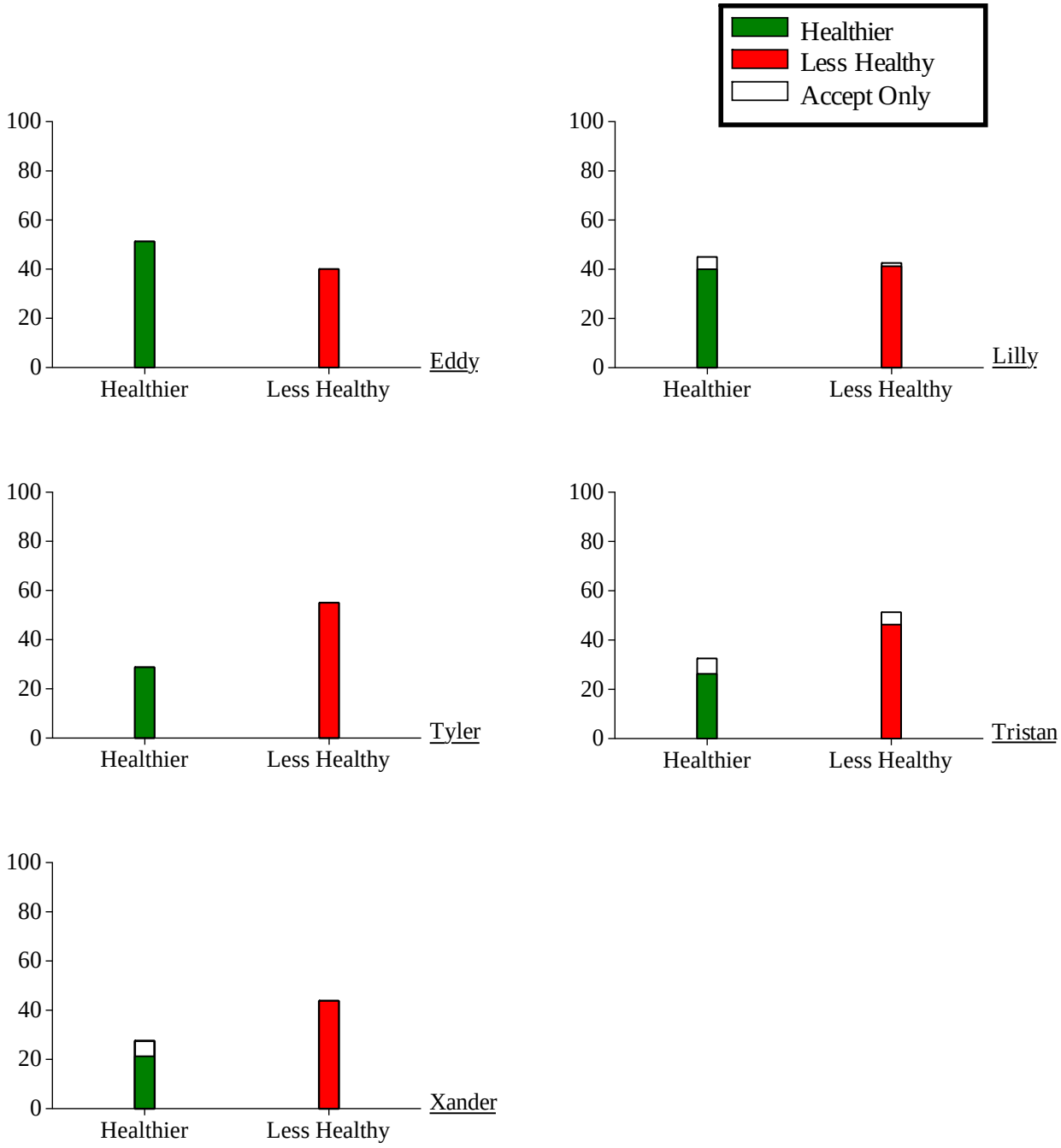


Figure 5. The overall percentage of trials in which healthier and less-healthy foods were consumed during the within-food group preference assessments.

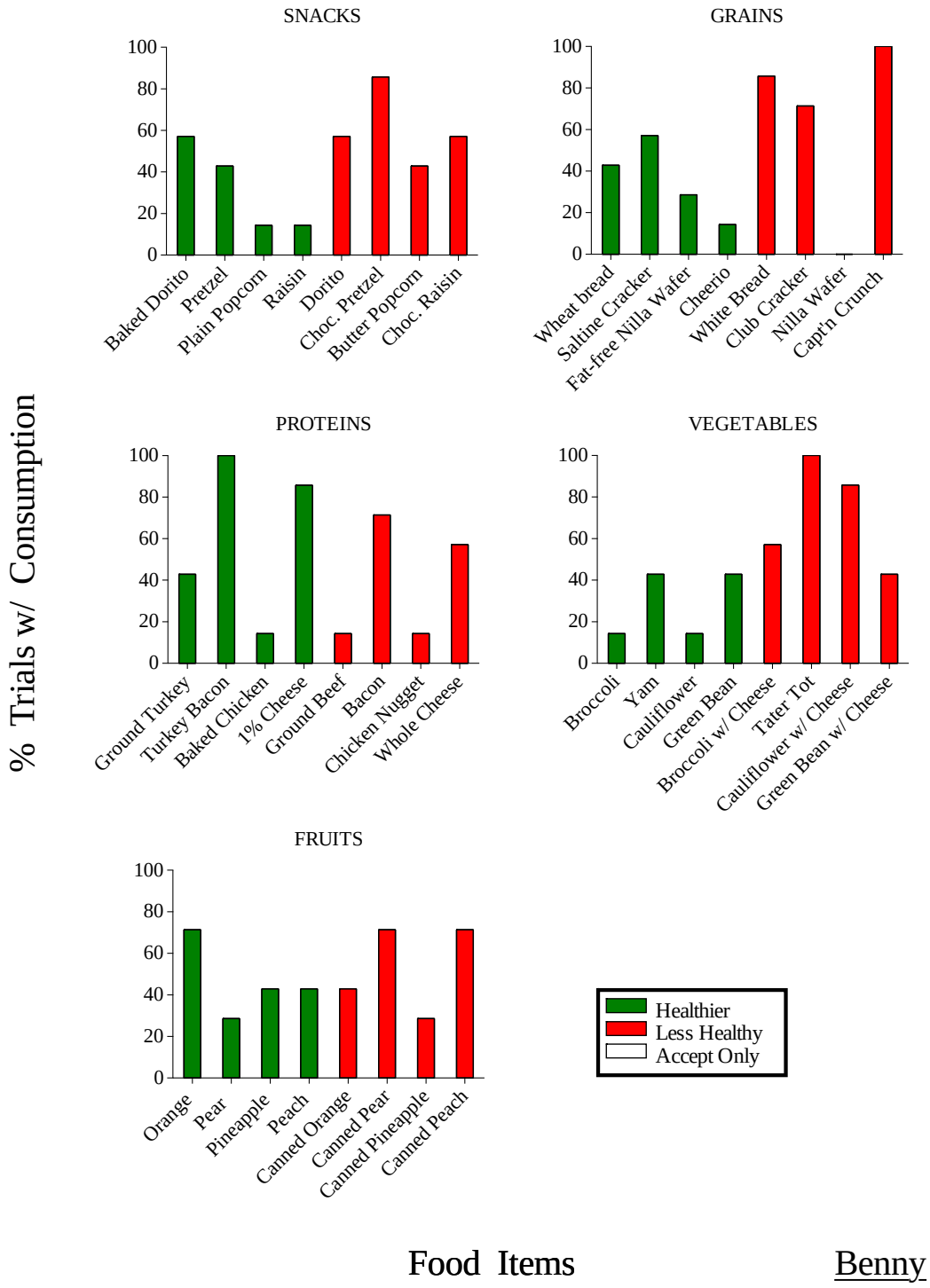


Figure 6. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

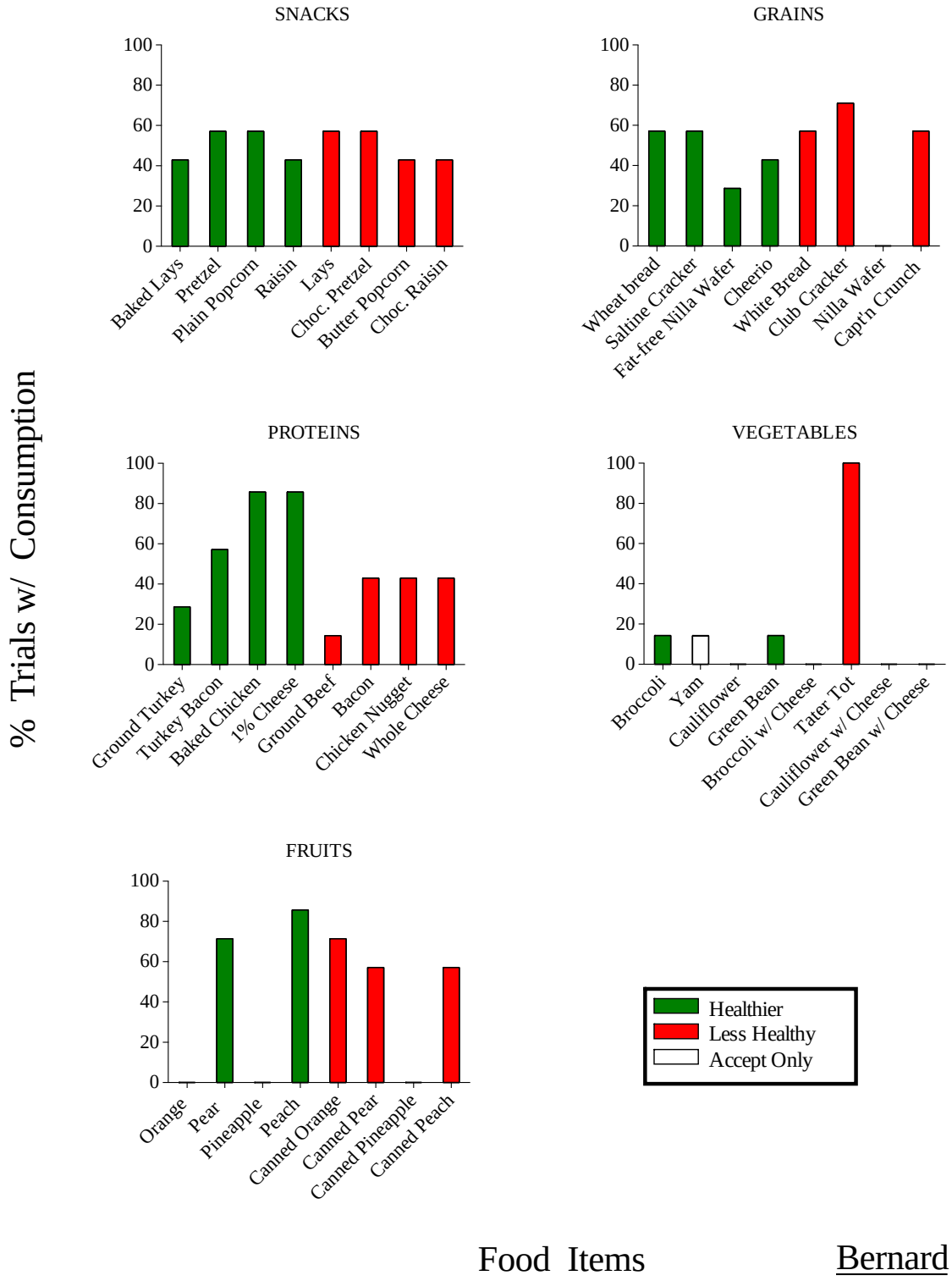


Figure 7. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

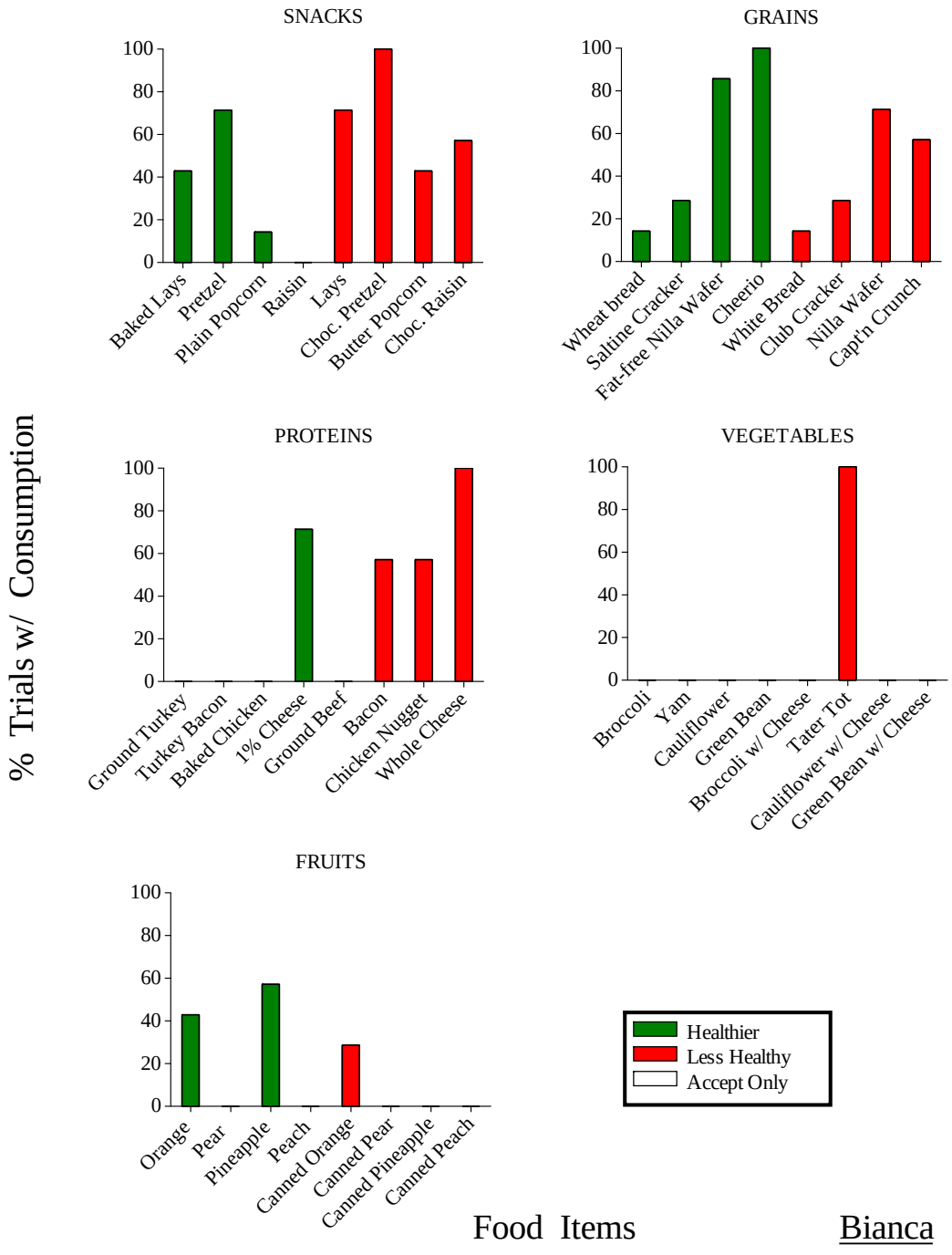


Figure 8. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

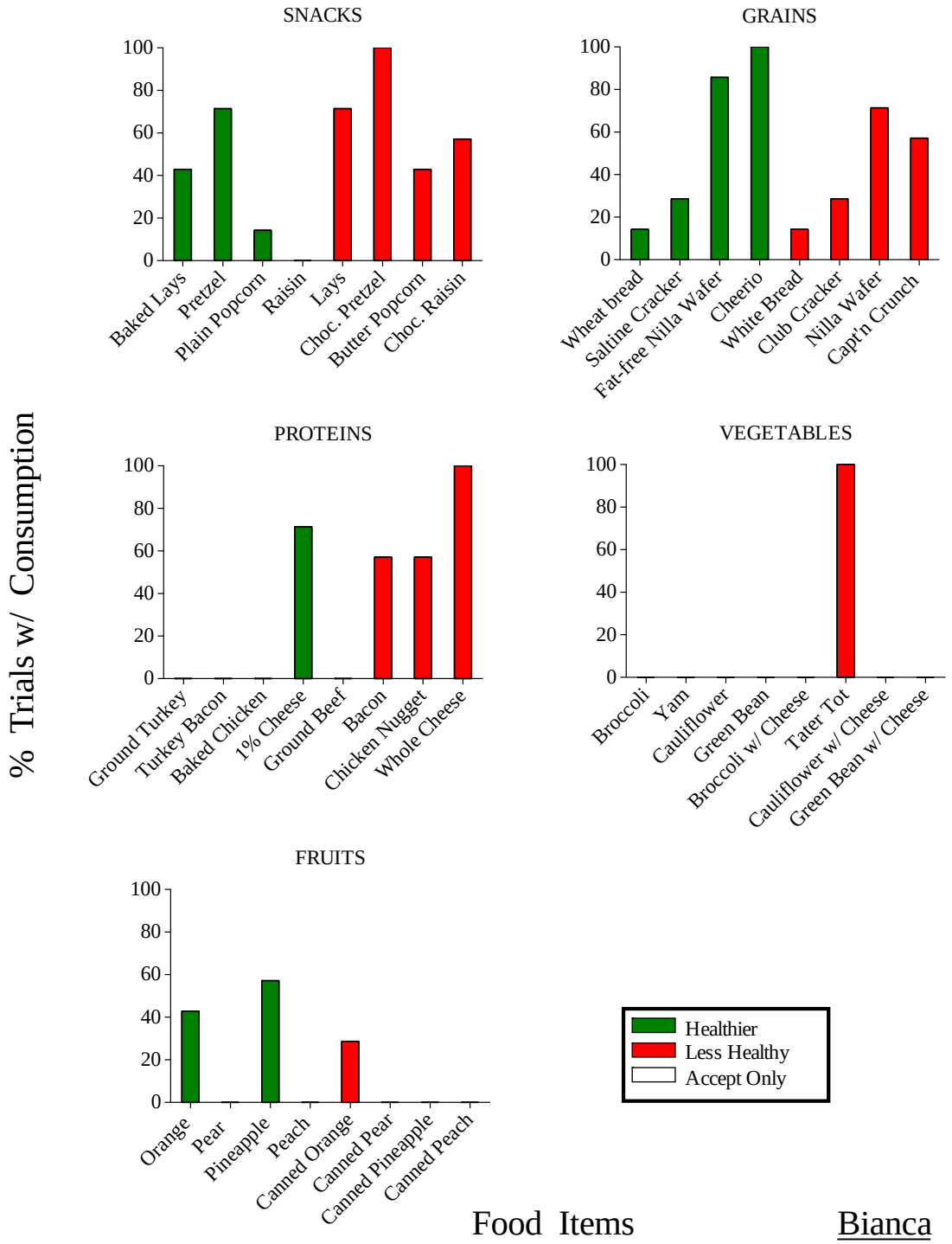


Figure 9. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

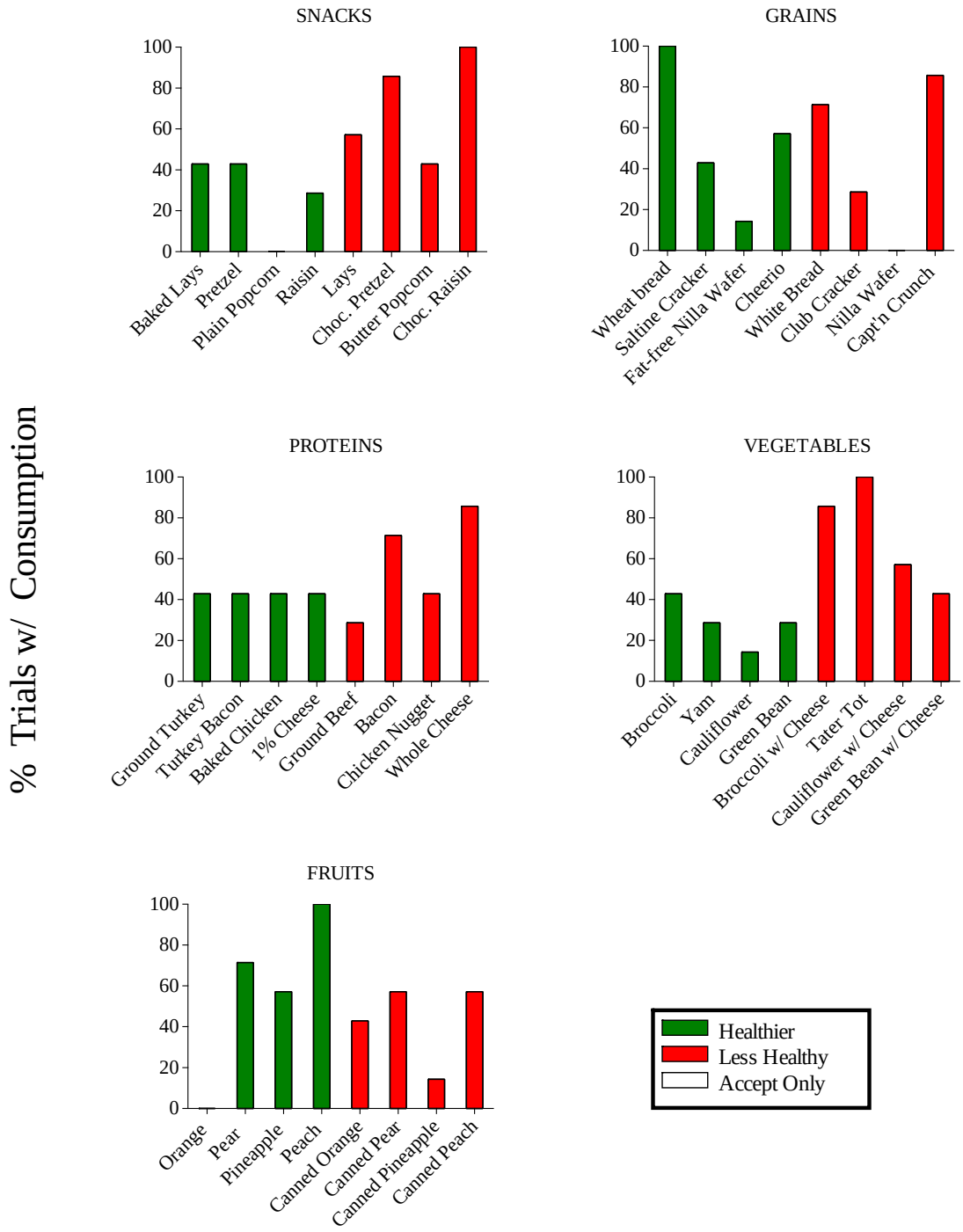


Figure 10. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

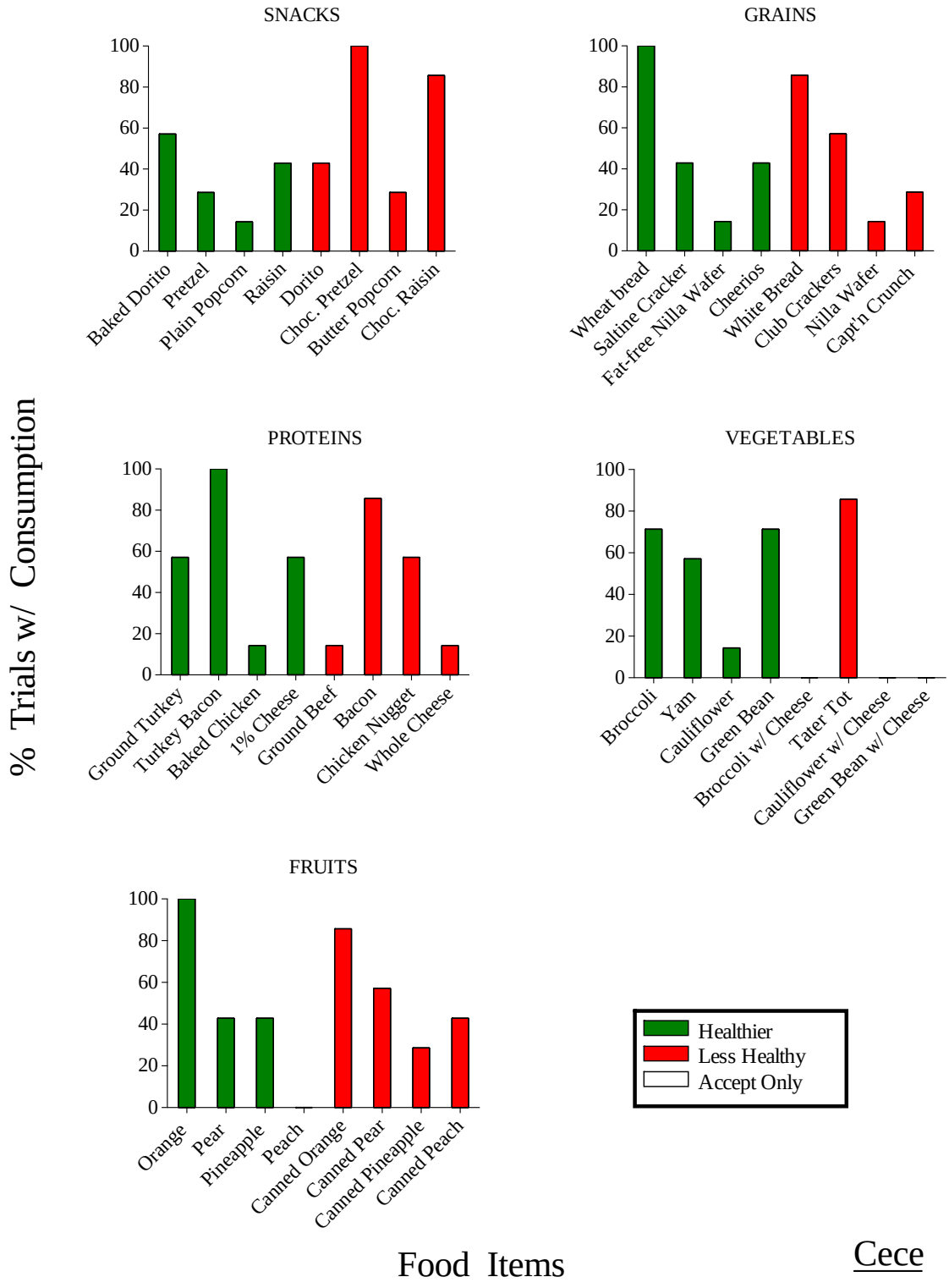


Figure 11. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

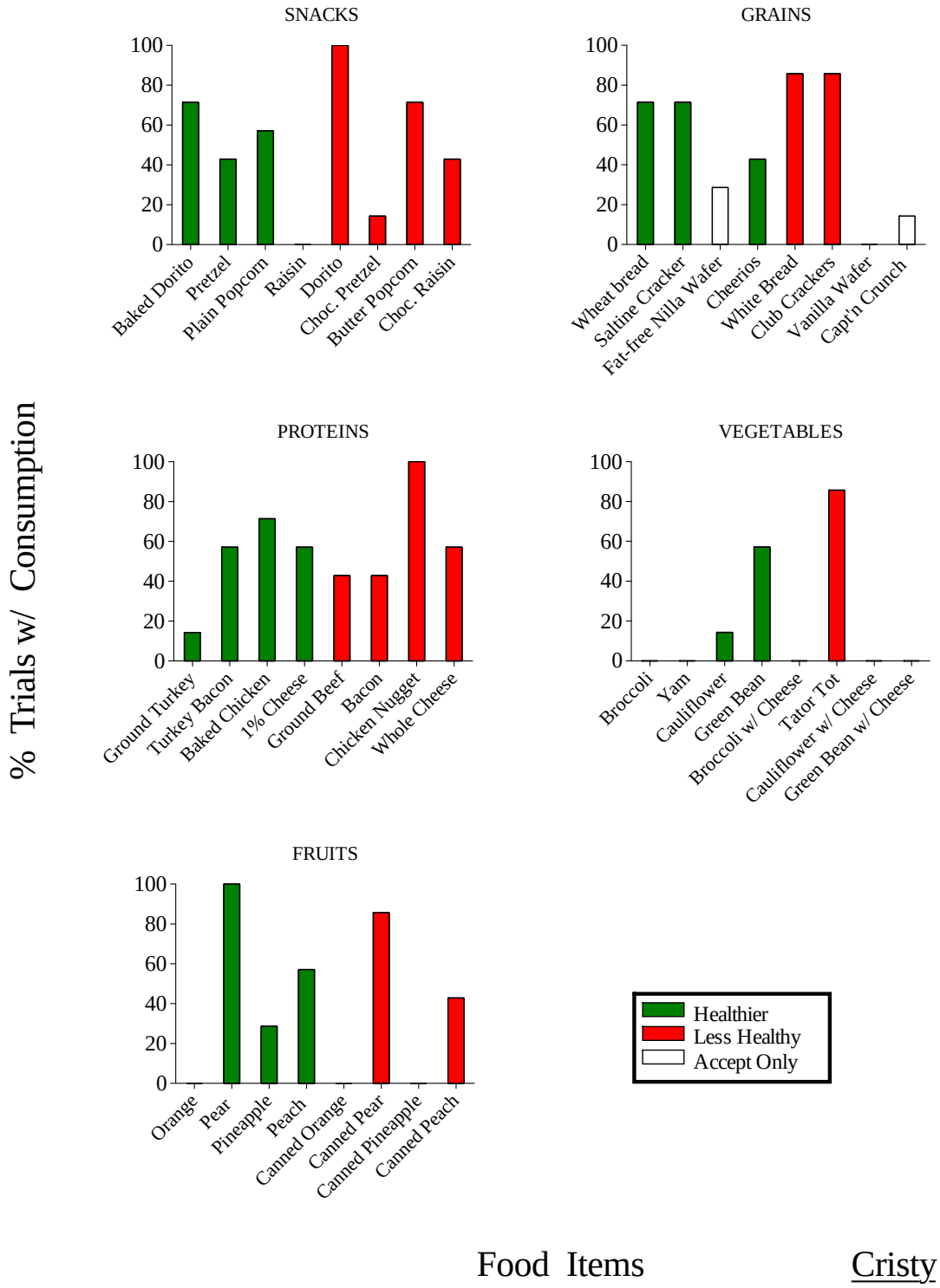


Figure 12. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

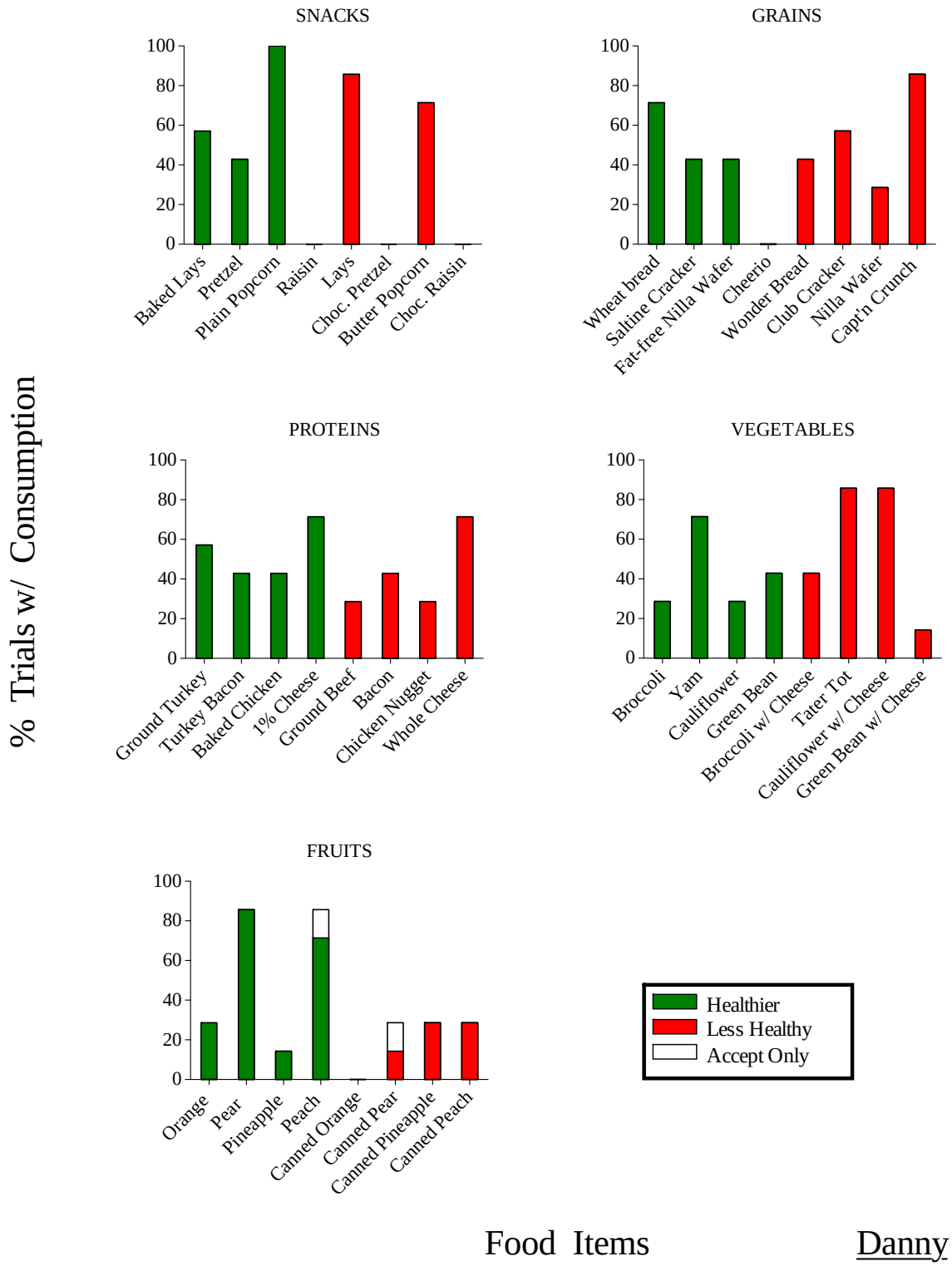


Figure 13. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

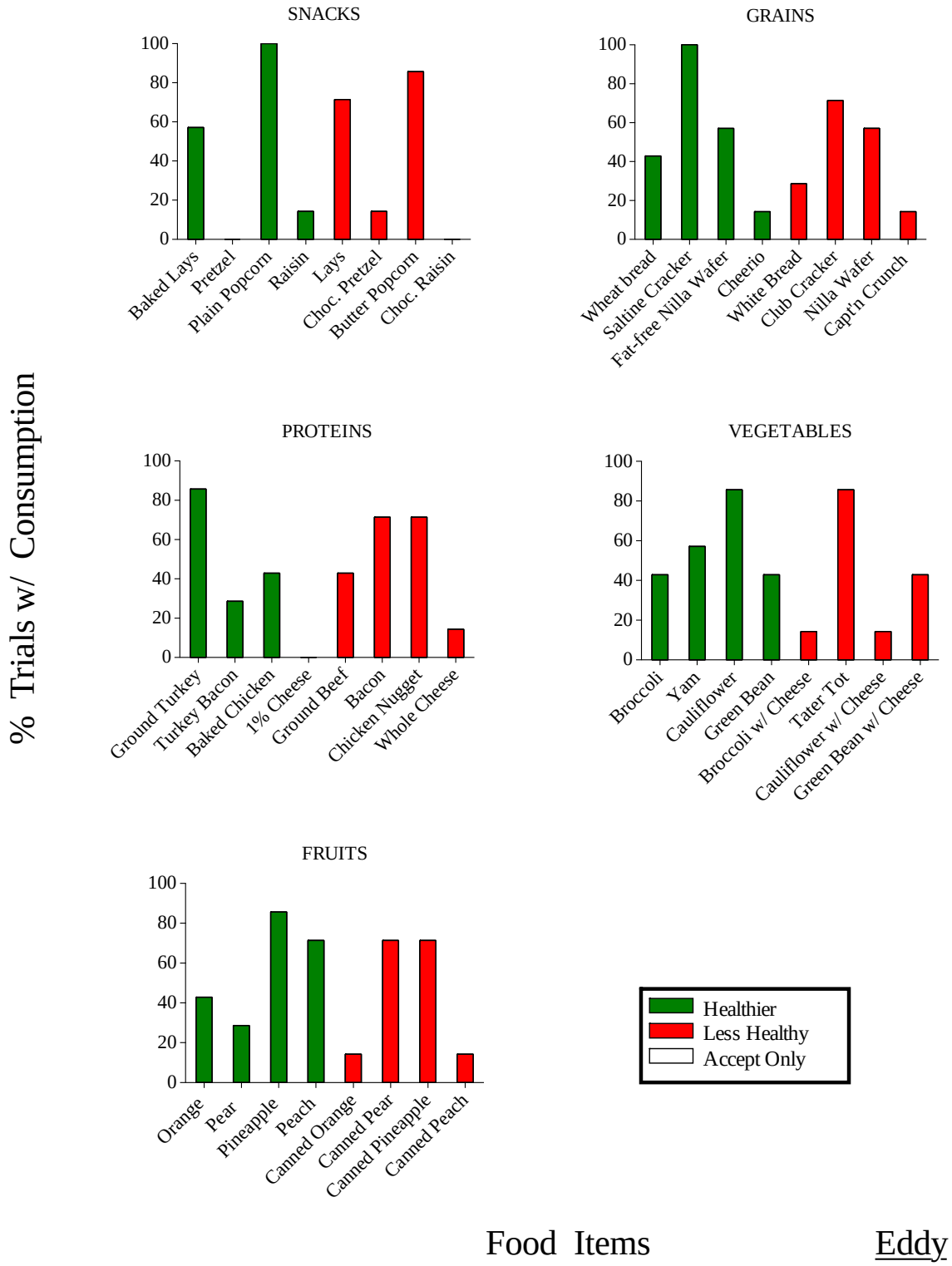


Figure 14. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

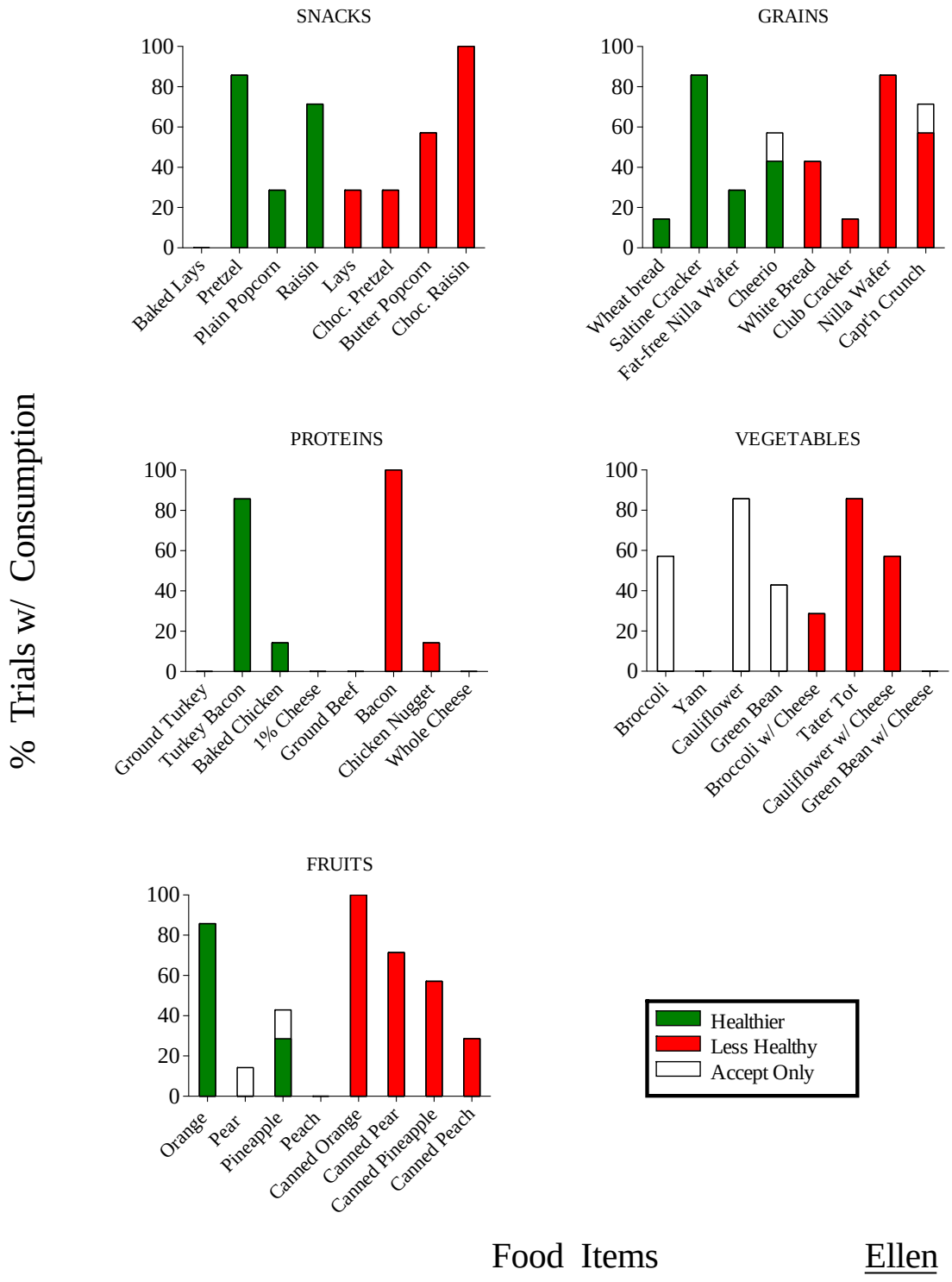


Figure 15. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

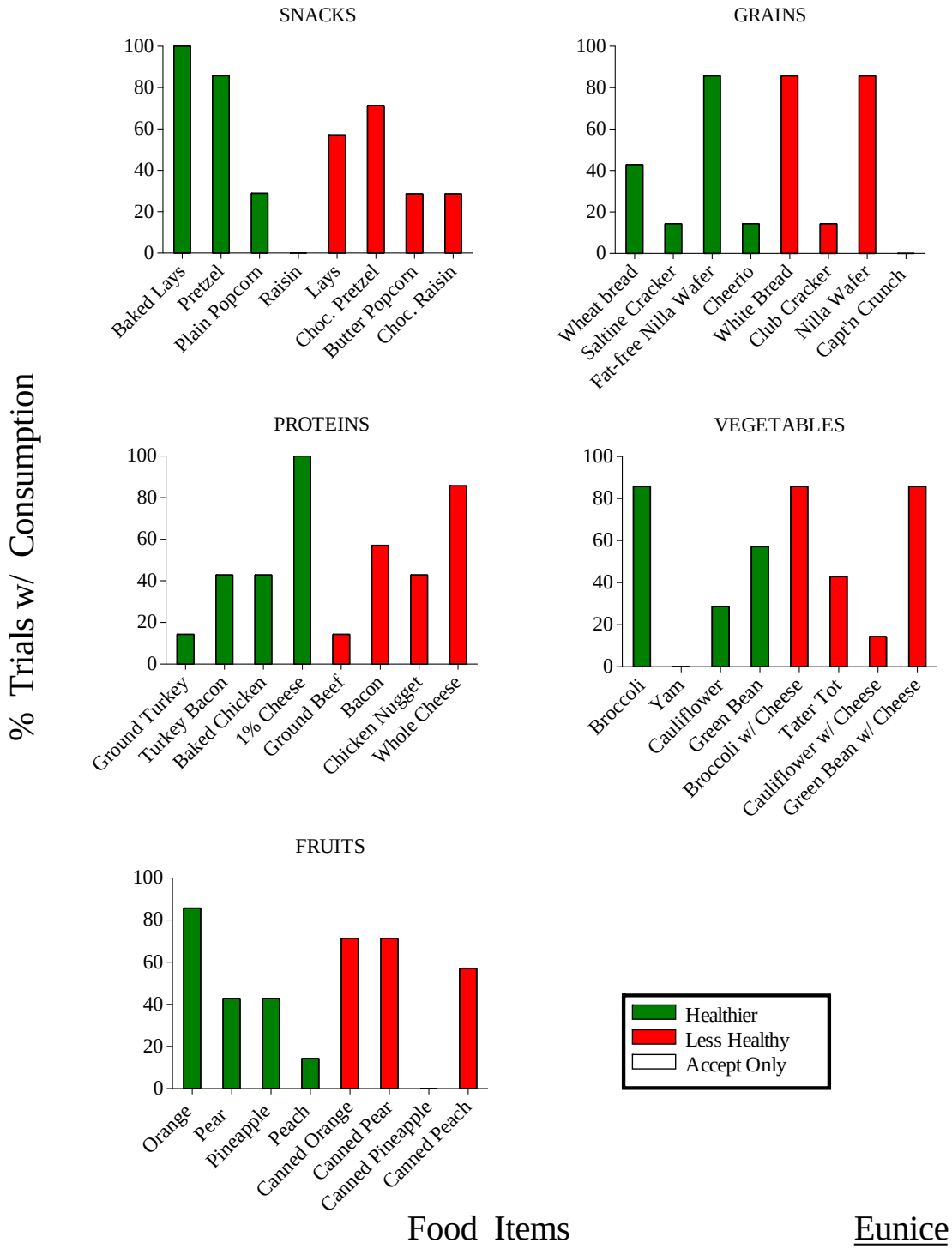


Figure 16. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

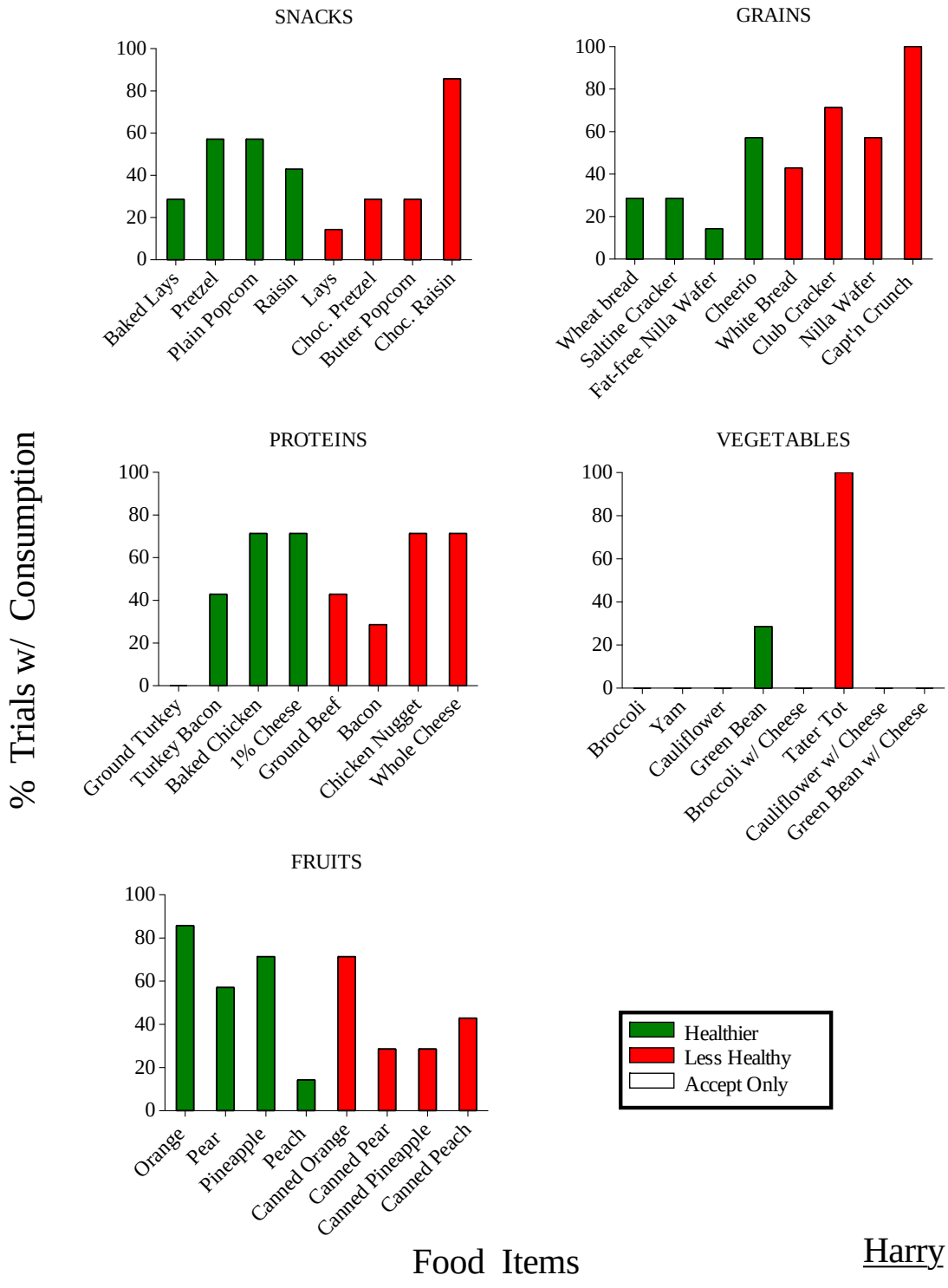


Figure 17. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

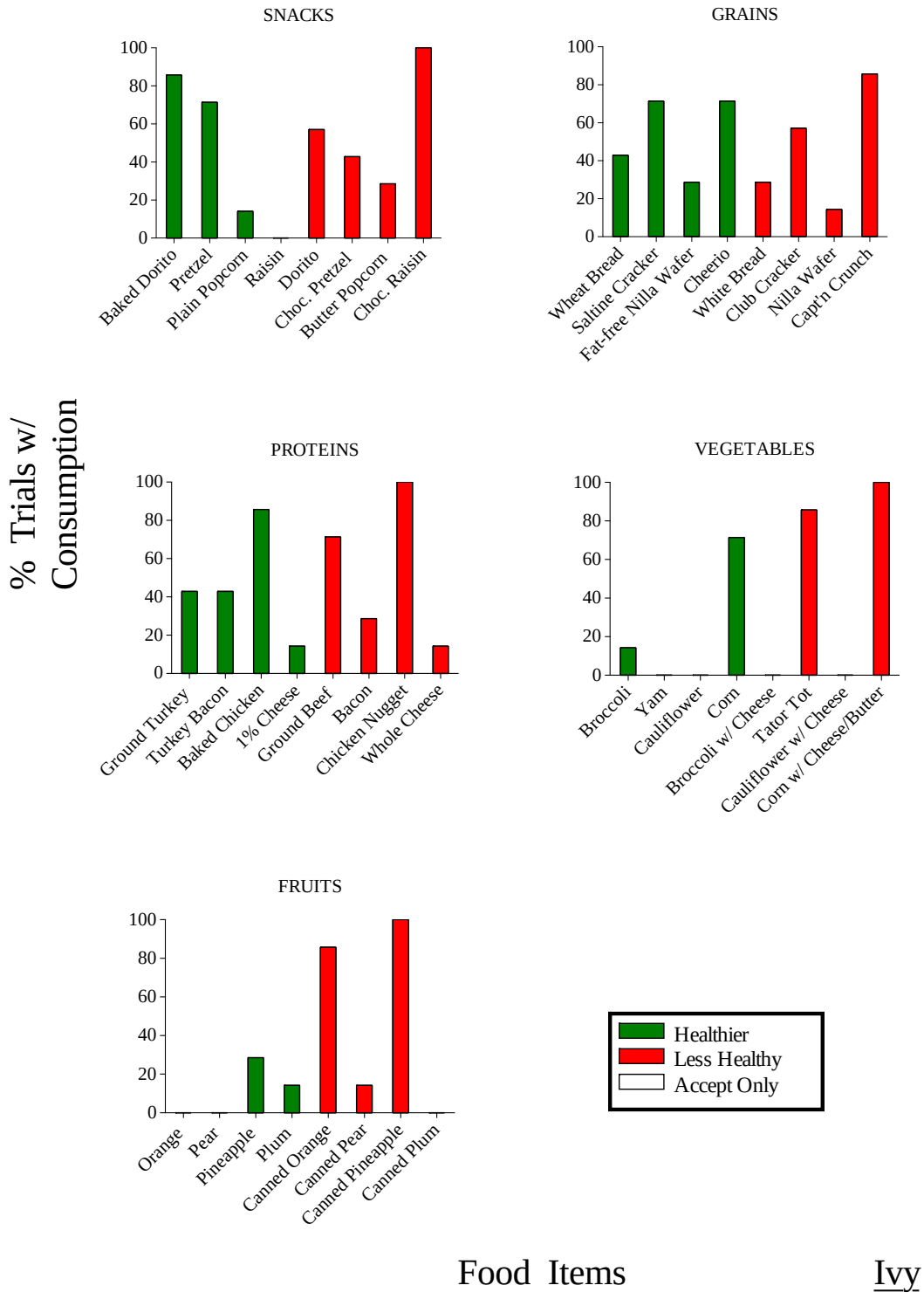


Figure 18. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

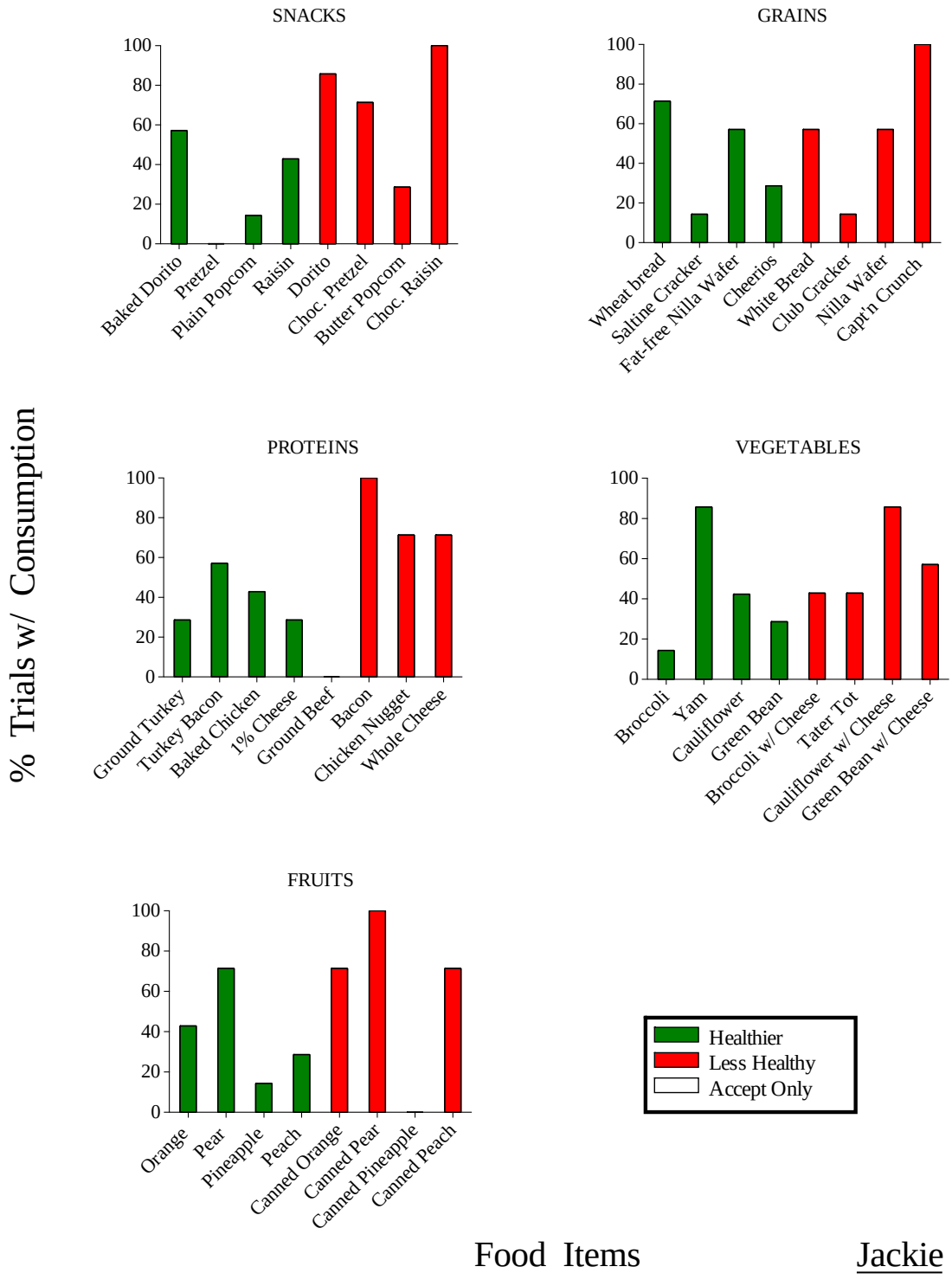


Figure 19. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

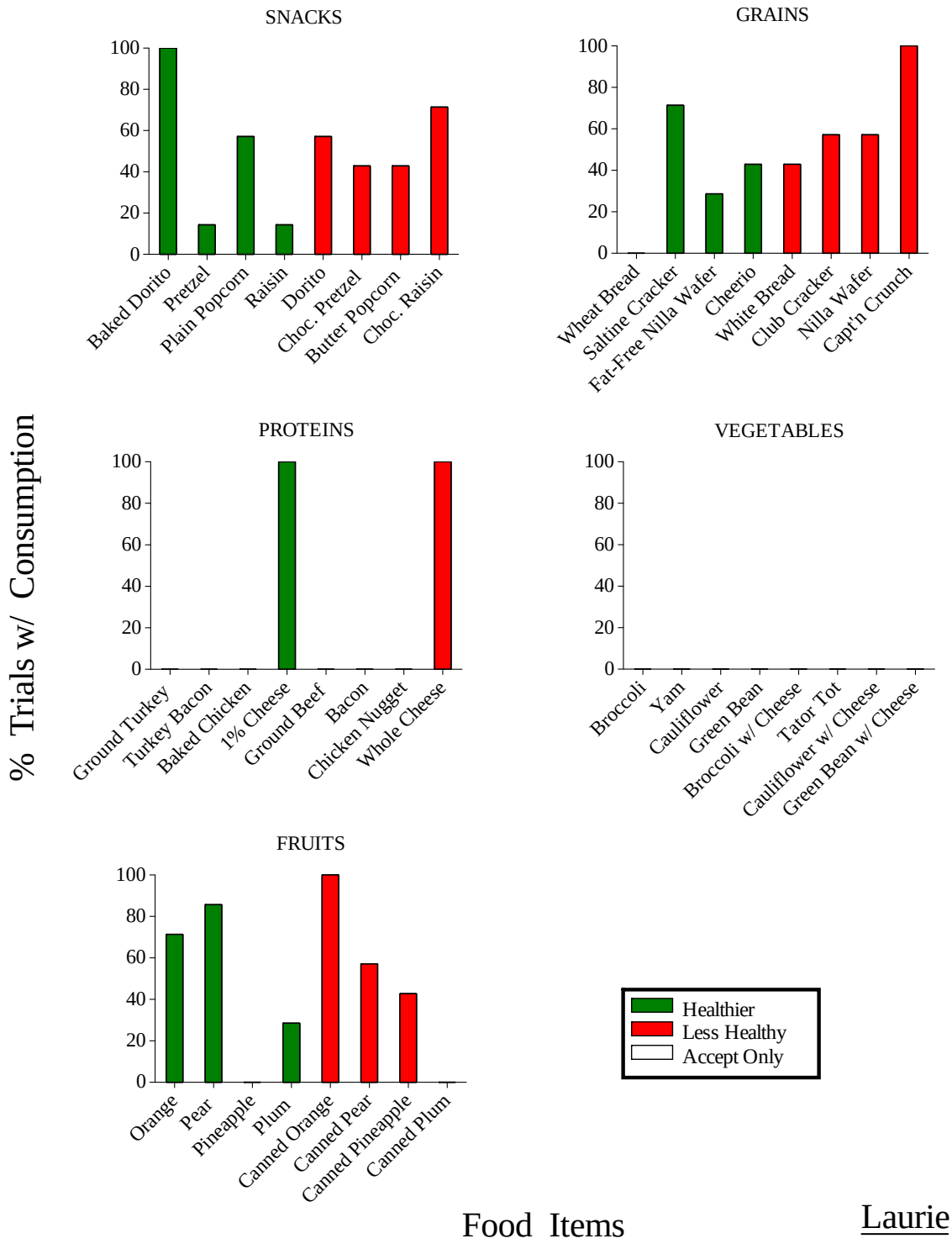


Figure 20. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

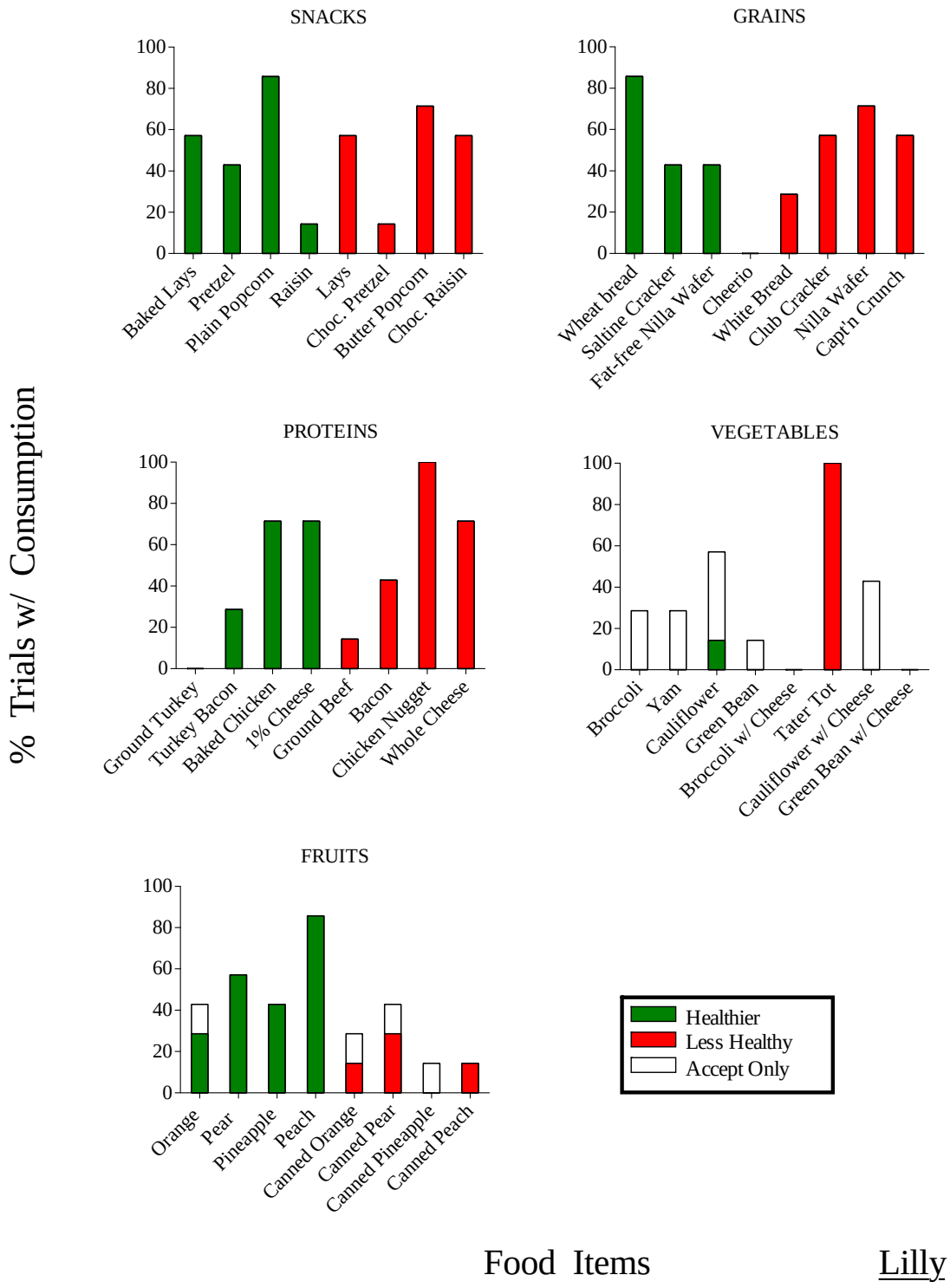


Figure 21. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

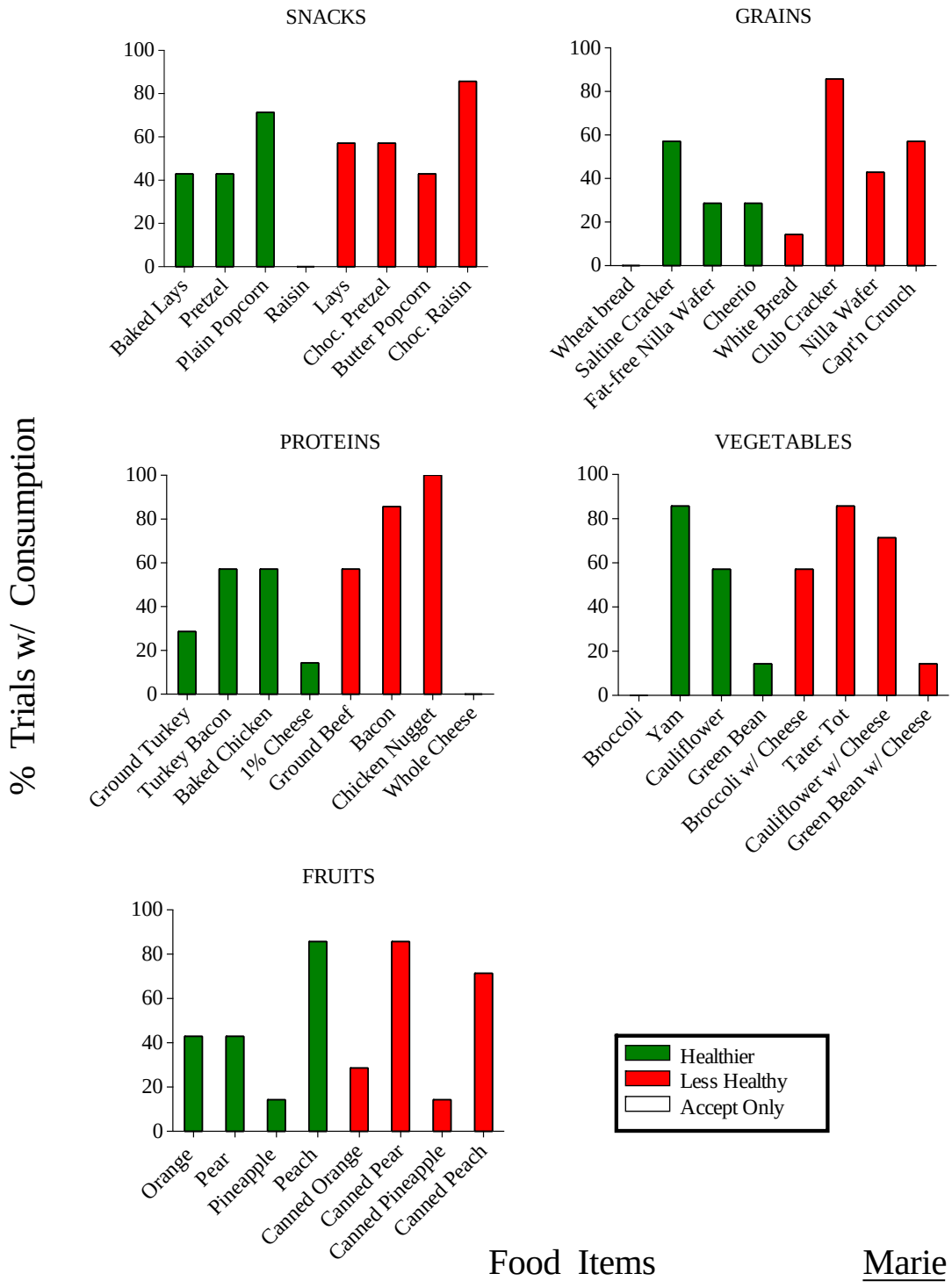


Figure 22. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

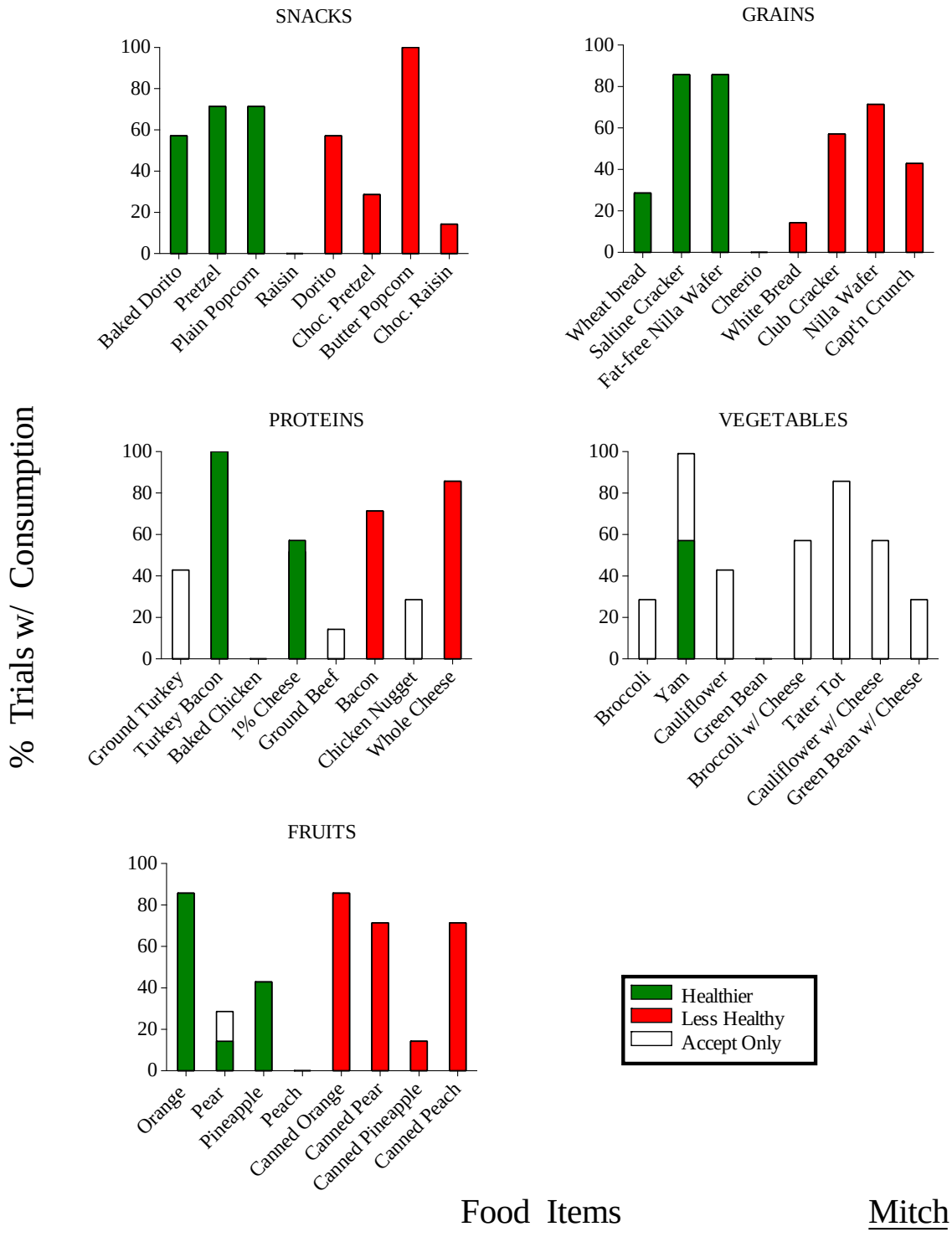


Figure 23. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

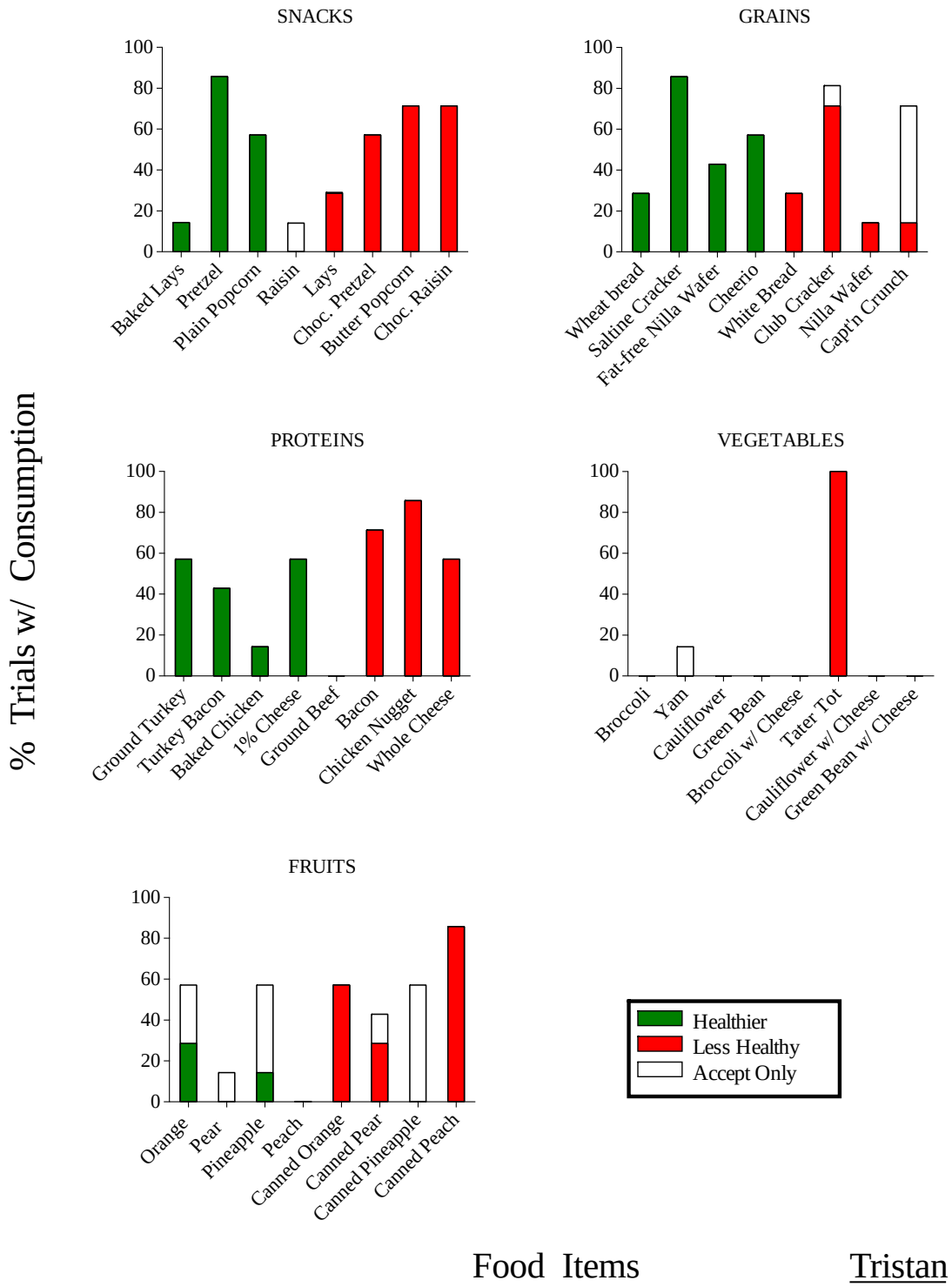


Figure 24. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

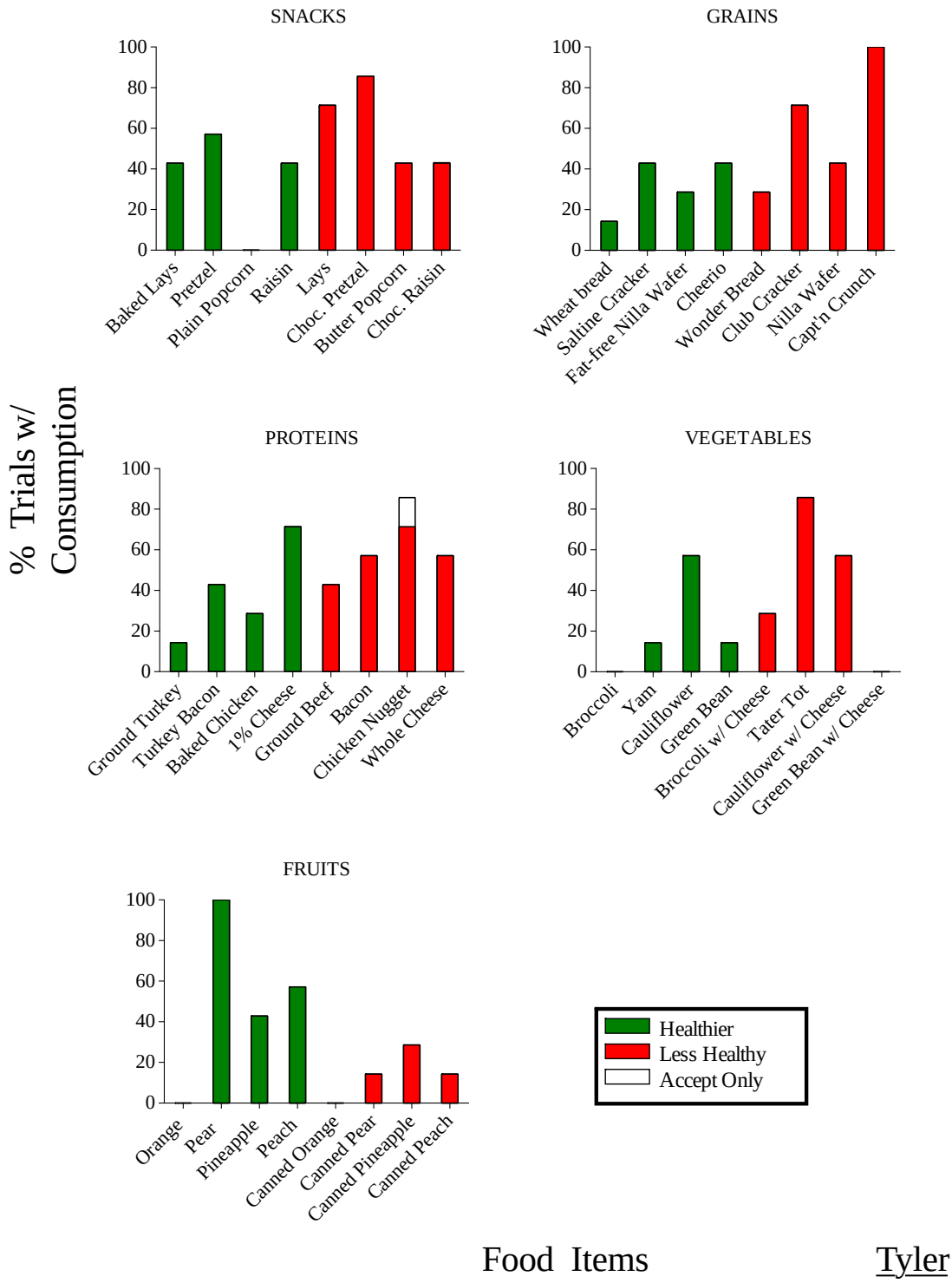


Figure 25. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

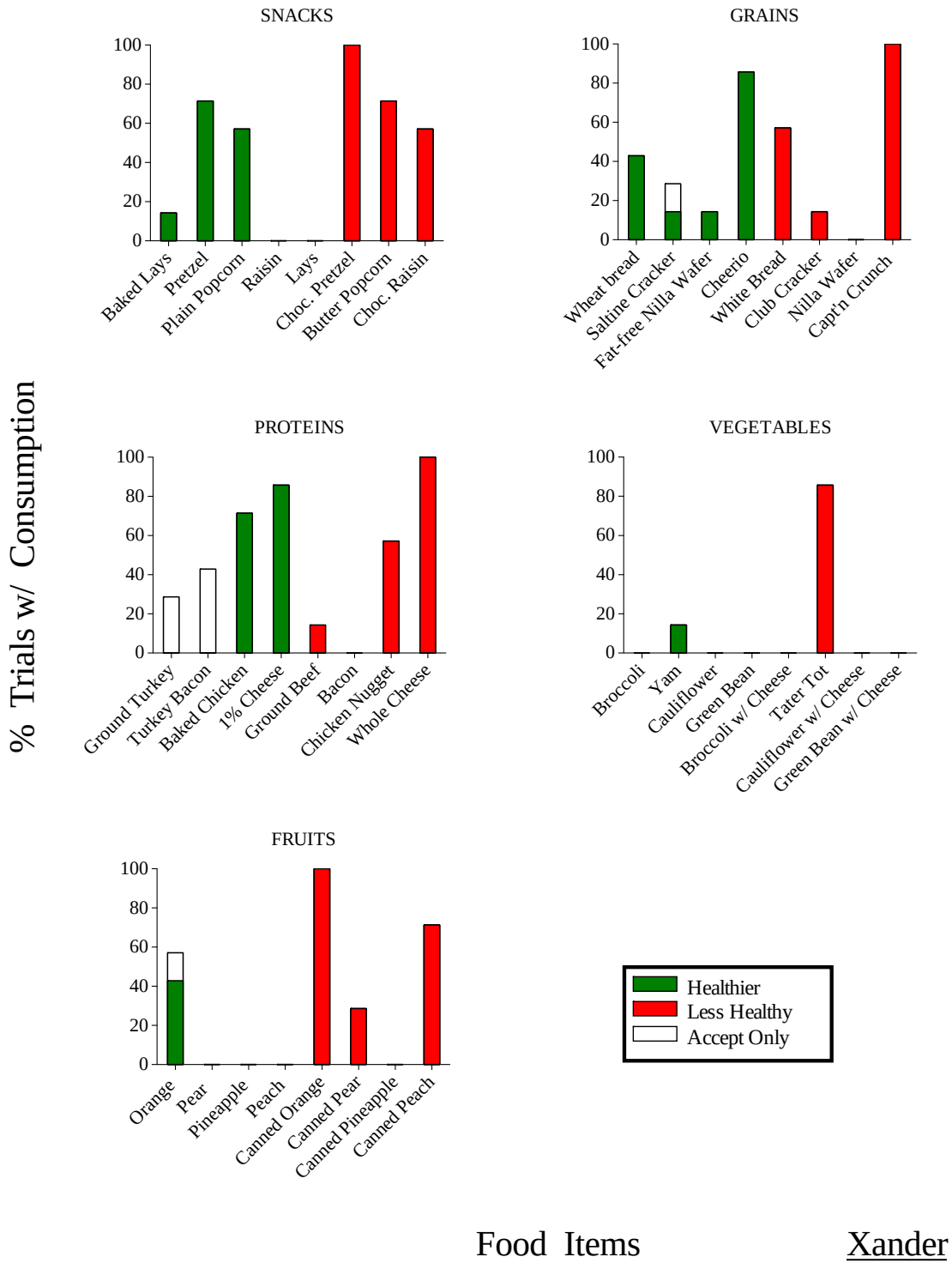


Figure 26. The percentage of trials with consumption of each item for each food group during the within-food group paired-choice preference assessment conducted in Phase 2. The green bars denote healthier items and the red bars denote less-healthy items.

Table 4

Overall results of the within-food group preference assessments and Healthy Eating Index scores collapsed across all food groups during the within-food group preference assessments

Subject	Percentage of Consumption		Healthy Eating Index
	Healthier	Less Healthy	
Benny	28.8	71.3	-42.5
Bernard	43.8	38.8	5.0
Bianca	25.0	41.3	-16.3
Brea	60.0	40.0	20.0
Carrie	36.3	63.8	-27.5
Cece	42.5	51.3	-8.8
Cristy	37.5	42.5	-5.0
Danny	46.3	43.8	2.5
Eddy	51.3	40.0	11.3
Ellen	37.5	52.5	-15.0
Eunice	46.3	53.8	-7.5
Harry	36.3	50.0	-13.7
Ivy	31.3	48.8	-17.5
Jackie	30.0	70.0	-40.0
Laurie	27.5	41.3	-13.8
Lily	40.0	41.3	-1.3
Marie	36.2	63.8	-27.6
Mitch	36.3	40.0	3.7
Tristan	26.3	46.3	-20.0
Tyler	28.8	55.5	-26.7
Xander	21.3	43.8	-22.5

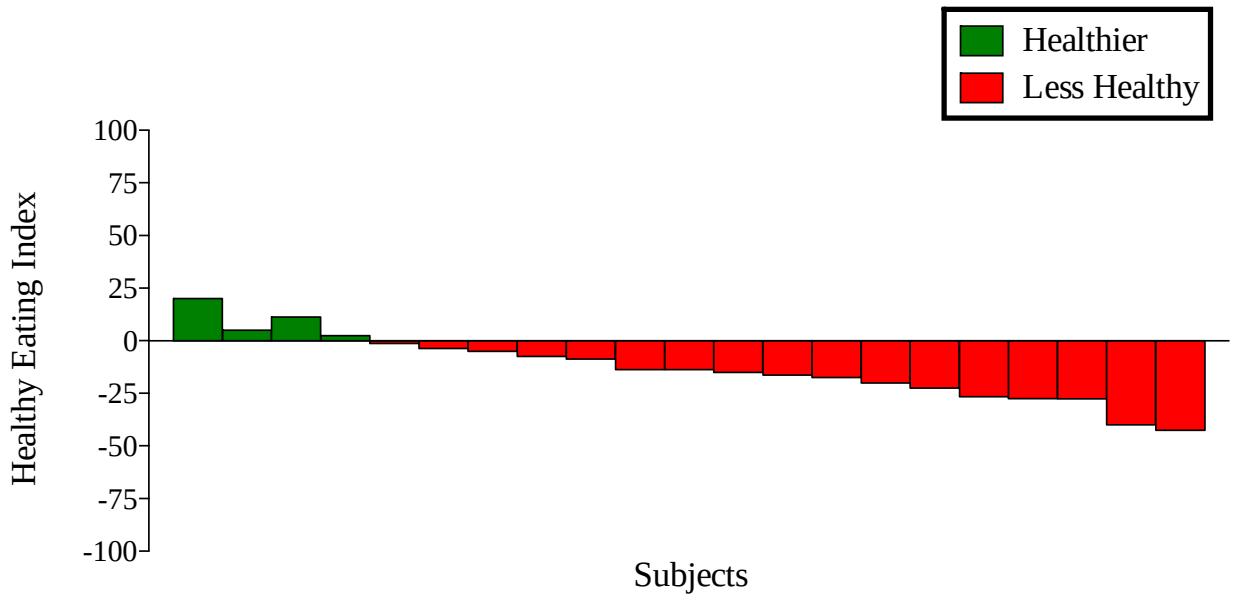


Figure 27. Overall Healthy Eating Index scores collapsed across all food groups during the within-food group preferences assessments. Bars (green) above the x axis denote a preference for healthier foods and bars (red) below the x axis denote a preference for less-healthy foods.

Table 5

Number of healthier v. less-healthy trials with no choice during the within-food group preference assessments

Subject	Grain	Protein	Snack	Fruit	Vegetable
Benny	0	0	0	0	0
Bernard	0	0	0	3	10
Bianca	0	4	0	11	12
Brea	0	0	0	0	0
Carrie	0	0	0	0	0
Cece	1	0	0	0	4
Christy	0	1	0	5	10
Eunice	0	0	0	0	0
Ivy	0	0	0	6	10
Jackie	0	0	0	0	0
Laurie	0	9	0	0	16
Mitch	0	0	0	0	0
Xander	3	0	2	6	12
Eddy	0	3	3	0	0
Tyler	1	0	1	5	6
Danny	0	1	2	3	0
Lily	0	0	0	3	7
Tristan	0	1	0	0	12
Ellen	0	7	0	0	1
Marie	0	0	0	0	0
Harry	0	0	0	0	11
Total Trials	5	26	8	33	111

Table 6

Results of the between-food group preference assessments

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Benny	Grain	Capt'n Crunch	57.1	3	2
		Club Cracker	57.1	3	
		White Bread	50.0	4	
	Protein	1% Cheese	57.1	5	3
		Bacon	35.7	6	
		Turkey Bacon	28.6	7	
	Snack	Chocolate Raisin	78.0	1	1
		Chocolate Pretzel	71.4	2	
		Doritos	71.4	2	
	Fruit	Orange	42.0	5	5
		Canned Peach	42.0	5	
		Canned Orange	28.6	7	
	Vegetable	Tater tot	50.0	4	4
		Cauliflower w/ Cheese	42.0	5	
		Broccoli w/ Cheese	28.6	7	
Bernard	Grain	White Bread	50.0	5	4
		Club Cracker	35.7	6	
		Capt'n Crunch	28.6	7	
	Protein	1% Cheese	78.6	2	2
		Turkey Bacon	50.0	5	
		Baked Chicken	50.0	5	
	Snack	Chocolate Pretzel	92.9	1	1
		Lays	64.3	3	
		Pretzel	64.3	3	
	Fruit	Canned Orange	57.1	4	3
		Peach	50.0	5	
		Canned Peach	21.4	8	
	Vegetable	Tater tot	78.6	2	5
		Yam	28.6	7	
		Green Bean	0.0	9	
Bianca	Grain	Nilla Wafer	42.9	6	3
		Cheerio	42.9	6	
		Fat-free Nilla Wafer	35.7	7	
	Protein	Chicken Nugget	85.7	2	2
		Whole Cheese	71.4	4	
		1% Cheese	64.3	5	
	Snack	Pretzel	92.9	1	1
		Chocolate Pretzel	78.6	3	
		Lays	64.3	5	
	Fruit	Pineapple	28.6	8	5
		Orange	21.4	9	
		Canned Orange	21.4	9	
	Vegetable	Tater Tot	92.9	1	4
		Yam	0.0	10	
		Cauliflower w/ Cheese	0.0	10	

Table 6 (Continued)

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Brea	Grain	Capt'n Crunch	71.4	4	2
		Saltine Cracker	57.1	5	
		White Bread	50.0	6	
	Protein	1% Cheese	38.0	7	4
		Bacon	38.0	7	
		Turkey Bacon	14.3	10	
	Snack	Chocolate Pretzel	100.0	1	1
		Chocolate Raisin	85.7	2	
		Pretzel	78.6	3	
	Fruit	Pear	38.0	7	4
		Orange	38.0	7	
		Canned Pear	14.3	10	
	Vegetable	Tater Tot	78.6	3	3
		Broccoli	28.6	8	
		Cauliflower	21.4	9	
Carrie	Grain	Capt'n Crunch	78.6	3	4
		White Bread	28.6	9	
		Wheat Bread	21.4	10	
	Protein	Whole Cheese	71.4	4	3
		Chicken Nugget	64.3	5	
		Bacon	35.7	8	
	Snack	Chocolate Raisin	85.7	2	2
		Chocolate Pretzel	50.0	6	
		Lays	42.9	7	
	Fruit	Pineapple	92.9	1	1
		Peach	64.3	5	
		Pear	28.6	9	
	Vegetable	Tater Tot	50.0	6	5
		Cauliflower w/ Cheese	21.4	10	
		Broccoli w/ Cheese	14.3	11	
Cece	Grain	Wheat Bread	78.0	2	3
		White Bread	64.3	3	
		Club Cracker	7.0	8	
	Protein	Turkey Bacon	64.3	3	2
		Chicken Nugget	64.3	3	
		Bacon	57.1	4	
	Snack	Chocolate Pretzel	92.0	1	1
		Chocolate Raisin	92.0	1	
		Baked Dorito	78.0	2	
	Fruit	Canned Pear	14.3	7	5
		Orange	7.0	8	
		Canned Orange	0.0	9	
	Vegetable	Tater Tot	57.1	4	4
		Yam	35.0	5	
		Broccoli	21.4	6	

Table 6 (Continued)

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Cristy	Grain	White Bread	64.3	5	3
		Whole Wheat Bread	57.1	6	
		Club Cracker	42.9	7	
	Protein	Chicken Nugget	100.0	1	1
		Baked Chicken	85.7	2	
		Whole Cheese	78.6	3	
	Snack	Dorito	78.6	3	2
		Baked Dorito	71.4	4	
		Butter Popcorn	35.7	8	
	Fruit	Pear	57.1	6	4
		Canned Pear	21.4	9	
		Peach	0.0	11	
	Vegetable	Tater Tot	57.1	6	5
		Green Bean	21.4	9	
		Cauliflower	0.0	11	
Danny	Grain	Club Cracker	85.7	1	1
		Capt'n Crunch	78.6	2	
		Wheat Bread	42.9	5	
	Protein	Chicken Nugget	64.7	4	4
		Ground Turkey	35.7	6	
		Bacon	35.7	6	
	Snack	Plain Popcorn	57.1	3	4
		Butter Popcorn	50.0	4	
		Lays	35.7	6	
	Fruit	Pear	42.9	5	5
		Peach	14.3	7	
		Canned Pineapple	0.0	8	
	Vegetable	Yam	57.1	3	3
		Tater Tot	50.0	4	
		Cauliflower w/ Cheese	42.9	5	
Eddy	Grain	Saltine Cracker	57.1	5	3
		Club Cracker	57.1	5	
		Nilla Wafer	35.7	6	
	Protein	Chicken Nugget	64.3	4	4
		Bacon	35.7	6	
		Ground Turkey	35.7	6	
	Snack	Plain Popcorn	85.7	1	1
		Lays	85.7	1	
		Butter Popcorn	64.3	4	
	Fruit	Peach	35.7	6	5
		Canned Pineapple	21.4	7	
		Canned Pear	14.3	8	
	Vegetable	Yam	78.6	2	2
		Tater Tot	71.4	3	
		Cauliflower	14.3	8	

Table 6 (Continued)

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Eunice	Grain	Fat-free Nilla Wafers	42.9	7	4
		White Bread	28.6	9	
		Nilla Wafers	7.0	11	
	Protein	1% Cheese	64.3	4	3
		Whole Cheese	64.3	4	
		Bacon	35.7	8	
	Snack	Chocolate Pretzel	100.0	1	1
		Pretzel	85.7	3	
		Lays	64.3	4	
	Fruit	Canned Pear	92.9	2	2
		Canned Orange	57.1	5	
		Orange	50.0	6	
	Vegetable	Broccoli	28.6	9	5
		Broccoli w/ Cheese	21.4	10	
		Green Bean w/ Cheese	7.0	11	
Ellen	Grain	Capt'n Crunch	78.6	3	3
		Nilla Wafer	64.3	5	
		Saltine Cracker	50.0	3	
	Protein	Turkey Bacon	85.7	2	1
		Bacon	78.6	3	
		Chicken Nugget	50.0	6	
	Snack	Chocolate Raisin	100.0	1	2
		Pretzel	71.4	4	
		Raisin	35.7	8	
	Fruit	Canned Orange	42.9	7	4
		Orange	28.6	9	
		Canned Pear	7.0	11	
	Vegetable	Tater Tot	28.6	9	5
		Cauliflower w/ Cheese	14.3	14	
		Cauliflower	0.0	5	
Harry	Grain	Capt'n Crunch	78.6	3	3
		Cheerios	50.0	6	
		Club Cracker	21.4	9	
	Protein	Whole Cheese	92.9	1	1
		1% Cheese	71.4	4	
		Baked Chicken	71.4	4	
	Snack	Chocolate Raisin	85.7	2	2
		Plain Popcorn	64.3	5	
		Pretzel	50.0	6	
	Fruit	Canned Orange	35.7	7	4
		Orange	35.7	7	
		Pineapple	28.6	8	
	Vegetable	Tater Tot	50.0	6	5
		Green Bean	7.0	10	
		Yam	7.0	10	

Table 6 (Continued)

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Ivy	Grain	Saltine Cracker	35.7	8	5
		Capt'n Crunch	28.6	9	
		Cheerios	7.0	11	
	Protein	Baked Chicken	85.7	1	1
		Chicken Nugget	64.3	4	
		Ground Beef	50.0	6	
	Snack	Chocolate Raisin	78.6	2	3
		Baked Dorito	57.1	5	
		Pretzel	42.9	7	
	Fruit	Canned Pineapple	71.4	3	1
		Pineapple	64.3	4	
		Canned Orange	64.3	4	
	Vegetable	Green Bean w/ Cheese	50.0	6	4
		Tater Tot	28.6	9	
		Green Bean	14.3	10	
Jackie	Grain	Capt'n Crunch	85.0	2	4
		White Bread	14.3	11	
		Nilla Wafer	7.0	12	
	Protein	Chicken Nugget	78.0	3	2
		Turkey Bacon	71.4	4	
		Whole Cheese	64.3	5	
	Snack	Chocolate Raisin	100.0	1	1
		Chocolate Pretzel	85.0	2	
		Dorito	50.0	7	
	Fruit	Canned Pear	21.4	10	5
		Canned Peach	21.4	10	
		Canned Orange	21.4	10	
	Vegetable	Yam	57.1	6	3
		Cauliflower w/ Cheese	42.0	8	
		Green Bean w/ Cheese	28.0	9	
Laurie	Grain	Capt'n Crunch	71.4	3	3
		Saltine Cracker	35.0	5	
		Club Cracker	35.0	5	
	Protein	Whole Cheese	85.7	1	2
		!% Cheese	78.0	4	
		Bacon	0.0	13	
	Snack	Baked Doritos	85.7	1	1
		Chocolate Raisins	85.7	1	
		Plain Popcorn	42.0	8	
	Fruit	Canned Oranges	74.0	5	4
		Pear	35.0	9	
		Oranges	14.3	12	
	Vegetable	Tater Tot	64.3	13	5
		Green Bean	0.0	12	
		Cauliflower	0.0	5	

Table 6 (Continued)

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Lily	Grain	Club Cracker	92.9	2	2
		Capt'n Crunch	71.4	4	
		Wheat Bread	28.6	7	
	Protein	Whole Cheese	71.4	4	3
		Chicken Nugget	28.6	7	
		Baked Chicken	28.6	7	
	Snack	Chocolate Raisin	100.0	1	1
		Butter Popcorn	78.6	3	
		Plain Popcorn	64.3	5	
	Fruit	Peach	14.3	8	5
		Pear	14.3	8	
		Pineapple	0.0	9	
	Vegetable	Tater Tot	57.1	6	4
		Cauliflower	0.0	9	
		Yam	0.0	9	
Marie	Grain	Capt'n Crunch	50.0	6	3
		Saltine Cracker	42.9	7	
		Club Cracker	28.6	9	
	Protein	Chicken Nugget	78.6	2	1
		Bacon	71.4	3	
		Baked Chicken	50.0	6	
	Snack	Chocolate Raisin	92.9	1	1
		Plain Popcorn	57.1	5	
		Lays	50.0	6	
	Fruit	Pear	64.3	4	2
		Canned Pear	35.7	8	
		Peach	28.6	9	
	Vegetable	Tater Tot	64.3	4	4
		Yam	35.7	8	
		Cauliflower w/ Cheese	0.0	10	
Mitch	Grain	Fat-free Nilla Wafer	78.6	2	1
		Nilla Wafer	71.4	3	
		Saltine Cracker	71.4	3	
	Protein	Bacon	85.7	1	2
		Turkey Bacon	71.4	3	
		Whole Cheese	50.0	5	
	Snack	Pretzel	78.6	2	3
		Butter Popcorn	58.0	4	
		Plain Popcorn	42.9	6	
	Fruit	Canned Orange	57.1	4	4
		Orange	35.7	7	
		Canned Peach	35.7	7	
	Vegetable	Yam	14.3	8	5
		Tater Tot	0.0	9	
		Broccoli w/ Cheese	0.0	9	

Table 6 (Continued)

Subject	Category	Food	Percent Consumed	Rank	Category Rank
Tristan	Grain	Club Cracker	64.3	4	2
		Cheerios	50.0	5	
		Saltine Cracker	42.9	6	
	Protein	Whole Cheese	78.6	3	3
		Chicken Nugget	64.3	4	
		Bacon	0.0	10	
	Snack	Chocolate Raisin	92.9	1	1
		Pretzel	85.7	2	
		Butter Popcorn	78.6	3	
	Fruit	Canned Orange	35.7	7	4
		Canned Peach	28.6	8	
		Orange	7.0	9	
	Vegetable	Tater Tot	35.7	6	5
		Yam	0.0	10	
		Cauliflower	0.0	10	
Tyler	Grain	Capt'n Crunch	78.6	2	2
		Cheerios	57.1	5	
		Club Cracker	35.7	5	
	Protein	Whole Cheese	78.6	2	3
		1% Cheese	64.3	4	
		Chicken Nugget	14.3	8	
	Snack	Chocolate Pretzel	100.0	1	1
		Pretzel	78.6	2	
		Lays	71.4	3	
	Fruit	Pear	14.3	7	5
		Peach	0.0	9	
		Pineapple	0.0	9	
	Vegetable	Tater Tot	57.1	5	4
		Cauliflower	14.3	7	
		Cauliflower w/ Cheese	0.0	9	
Xander	Grain	Capt'n Crunch	21.4	7	5
		While Bread	7.0	8	
		Cheerios	0.0	9	
	Protein	1% Cheese	64.3	5	2
		Whole Cheese	57.1	4	
		Baked Chicken	35.0	6	
	Snack	Chocolate Pretzel	92.0	1	1
		Pretzel	92.0	1	
		Butter Popcorn	71.4	2	
	Fruit	Canned Orange	64.3	3	3
		Orange	50.0	5	
		Canned Peach	21.4	7	
	Vegetable	Tater Tot	35.0	6	4
		Yam	0.0	9	
		Cauliflower w/ Cheese	0.0	9	

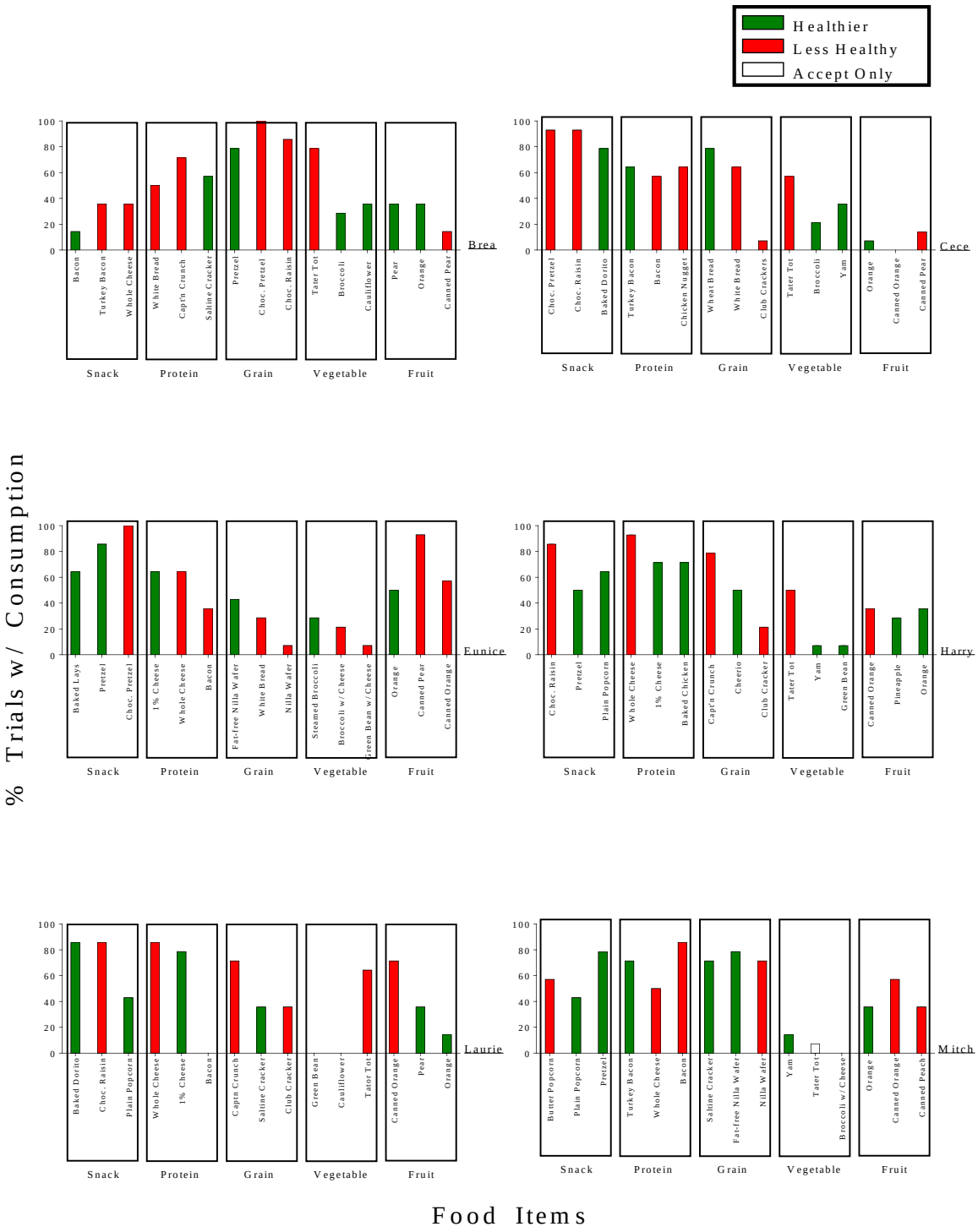


Figure 28. The percentage of trials with consumption of each item during the between-food group preference assessment. The green bars denote healthier items and the red bars denote less-healthy items.

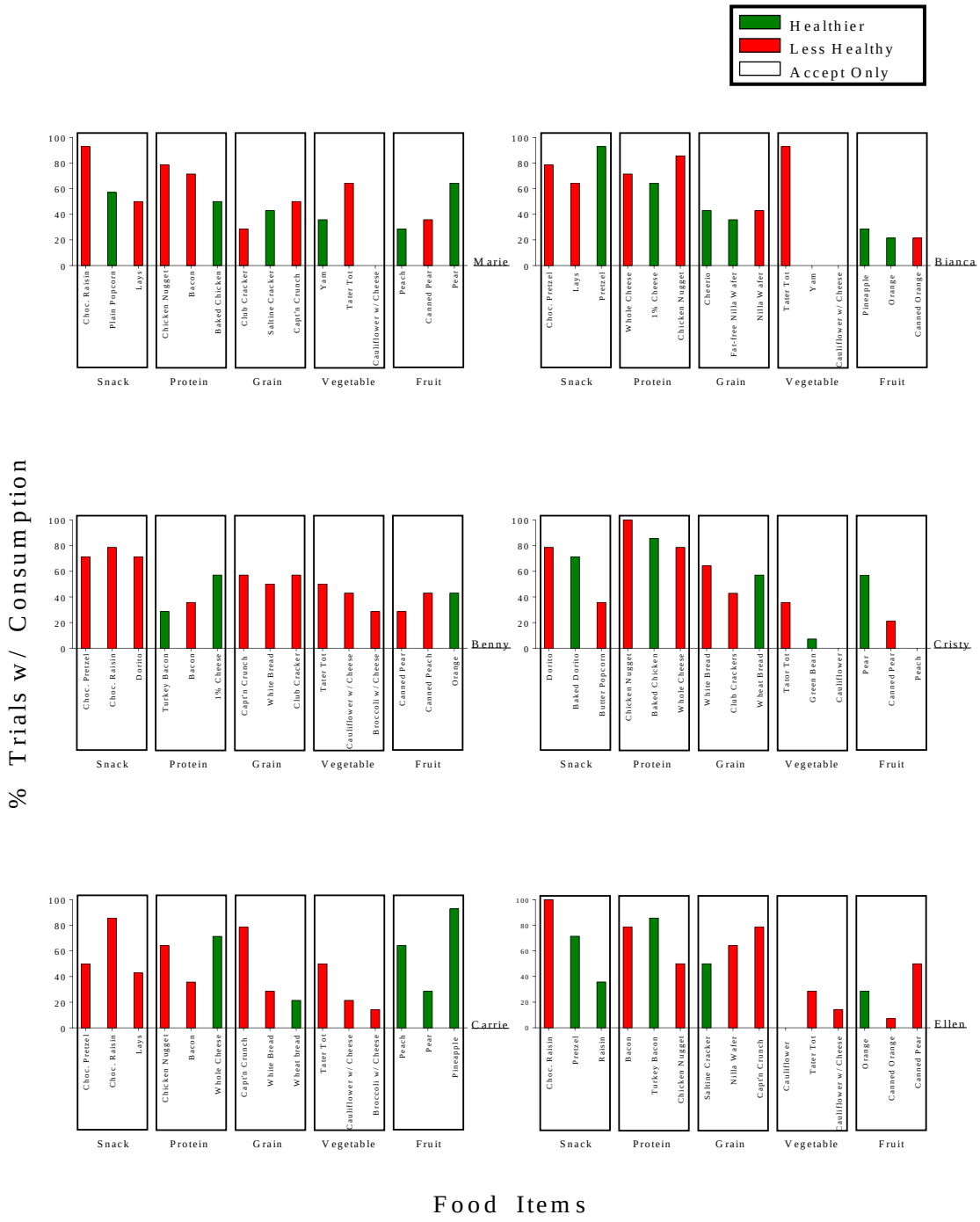


Figure 29. The percentage of trials with consumption of each item during the between-food group preference assessment. The green bars denote healthier items and the red bars denote less-healthy items.

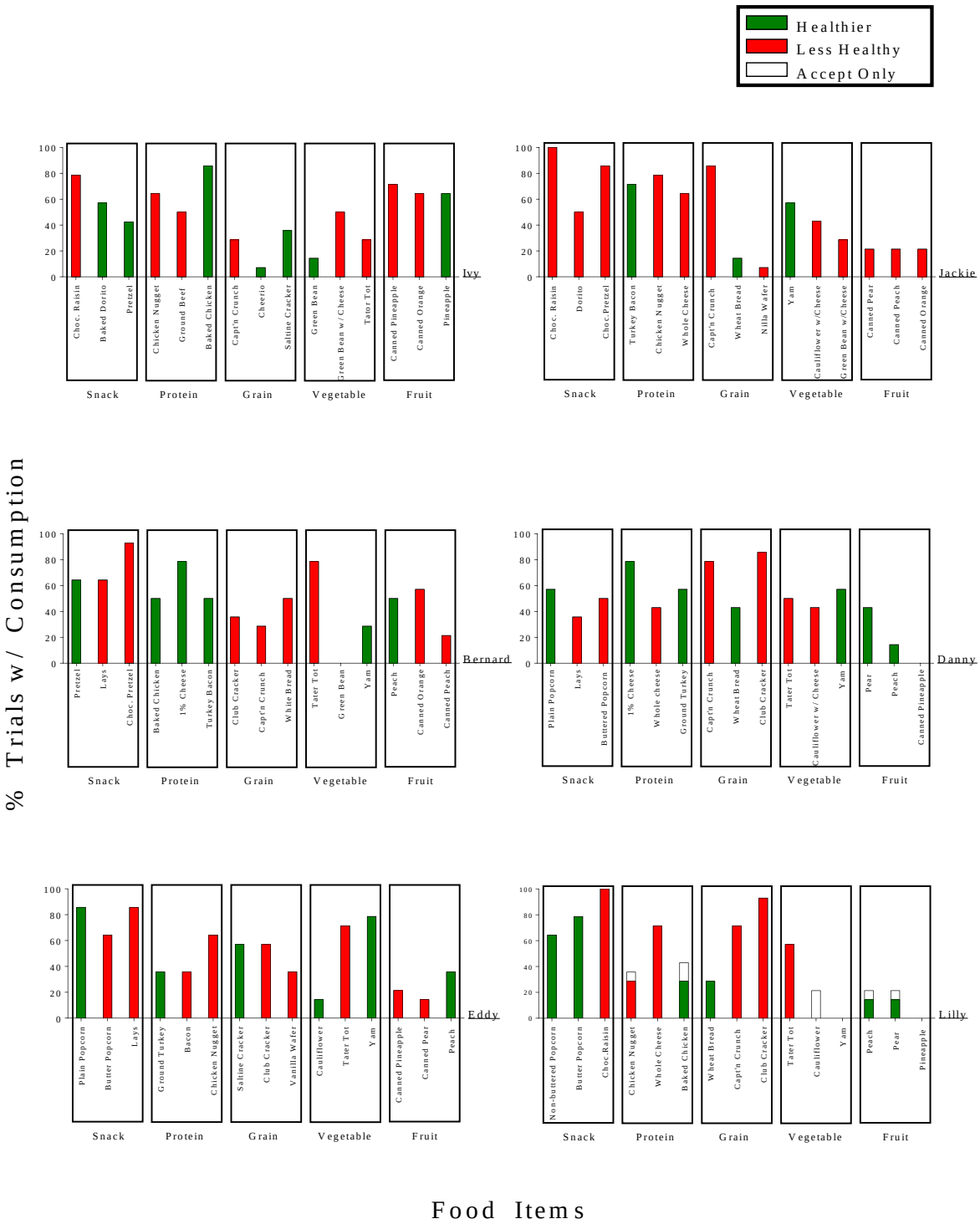
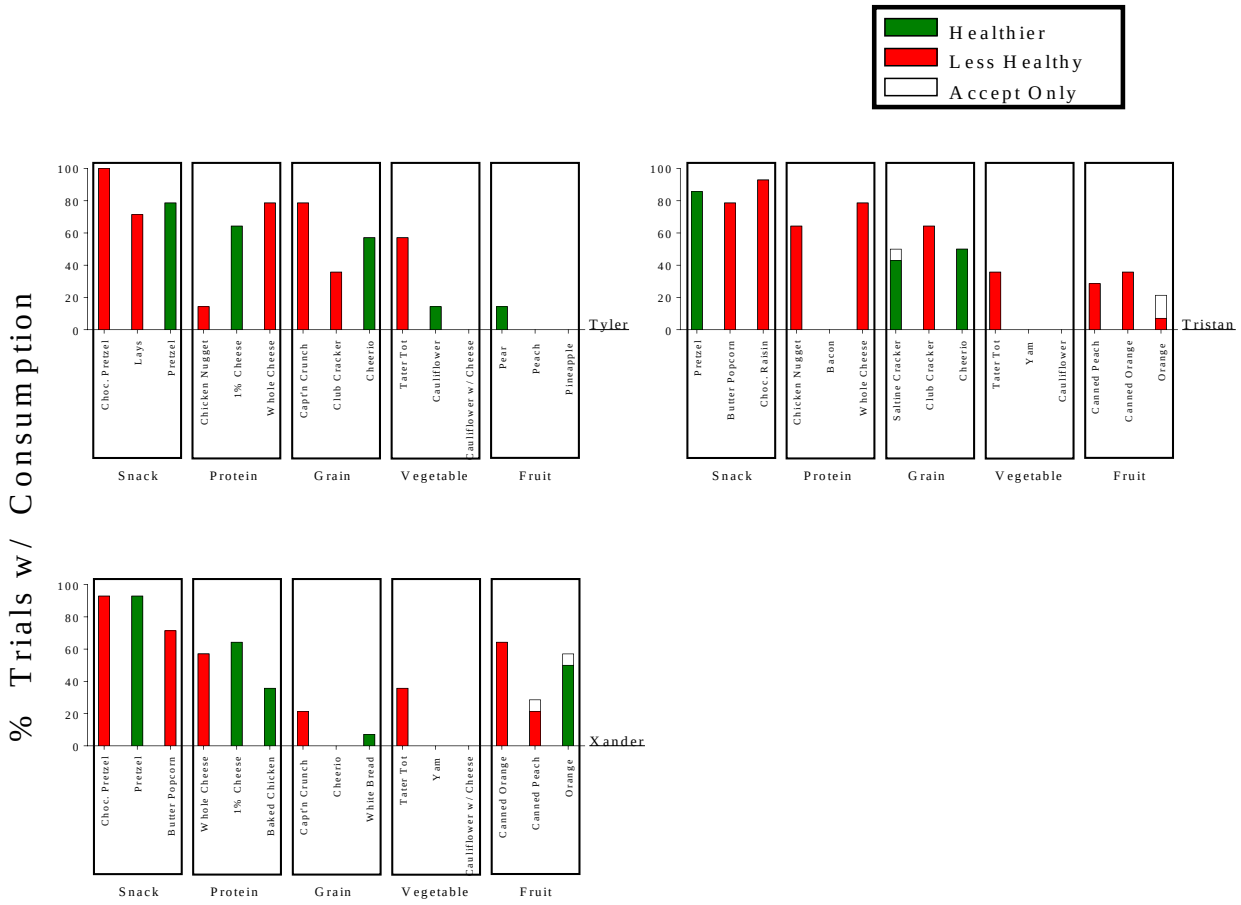


Figure 30. The percentage of trials with consumption of each item during the between-food group preference assessment. The green bars denote healthier items and the red bars denote less-healthy items.



Food Items

Figure 31. The percentage of trials with consumption of each item during the between-food group preference assessment. The green bars denote healthier items and the red bars denote less-healthy items.

Table 7

Summary of preferences for healthier and less-healthy foods and the Healthy Eating Index scores collapsed across all food groups during the between-food group preference assessments

Subject	Percentage of Consumption		Healthy Eating Index
	Healthier	Less Healthy	
Benny	50.0	50.0	0.0
Bernard	42.8	57.1	-14.3
Bianca	35.1	63.2	-28.1
Brea	26.8	73.2	-46.4
Carrie	52.3	47.7	4.6
Cece	38.0	62.0	-24.0
Cristy	35.7	64.3	-28.6
Danny	50.0	48.2	1.8
Eddy	51.9	48.1	3.8
Ellen	44.4	55.6	-11.2
Eunice	57.4	42.6	14.8
Harry	33.3	66.7	-33.4
Ivy	42.9	57.1	-14.2
Jackie	47.2	52.8	-5.6
Laurie	28.6	66.1	-37.5
Lily	7.1	87.5	-80.4
Marie	44.4	55.6	-11.2
Mitch	43.6	56.4	-12.8
Tristan	27.8	63.0	-35.2
Tyler	28.1	59.6	-31.5
Xander	37.0	40.7	1-3.7

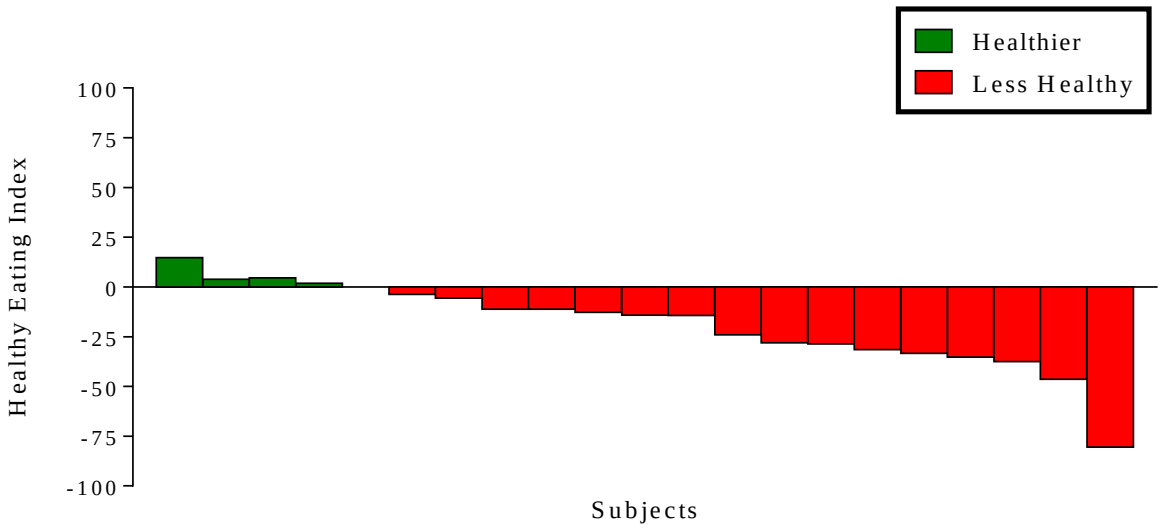


Figure 32. Healthy eating indices summarizing the preferences for healthier and less-healthy foods collapsed across each food group during the between-food group preference assessments. Bars (green) above the x axis denote a preference for healthier foods and bars (red) below the x axis denote a preference for less-healthy foods.

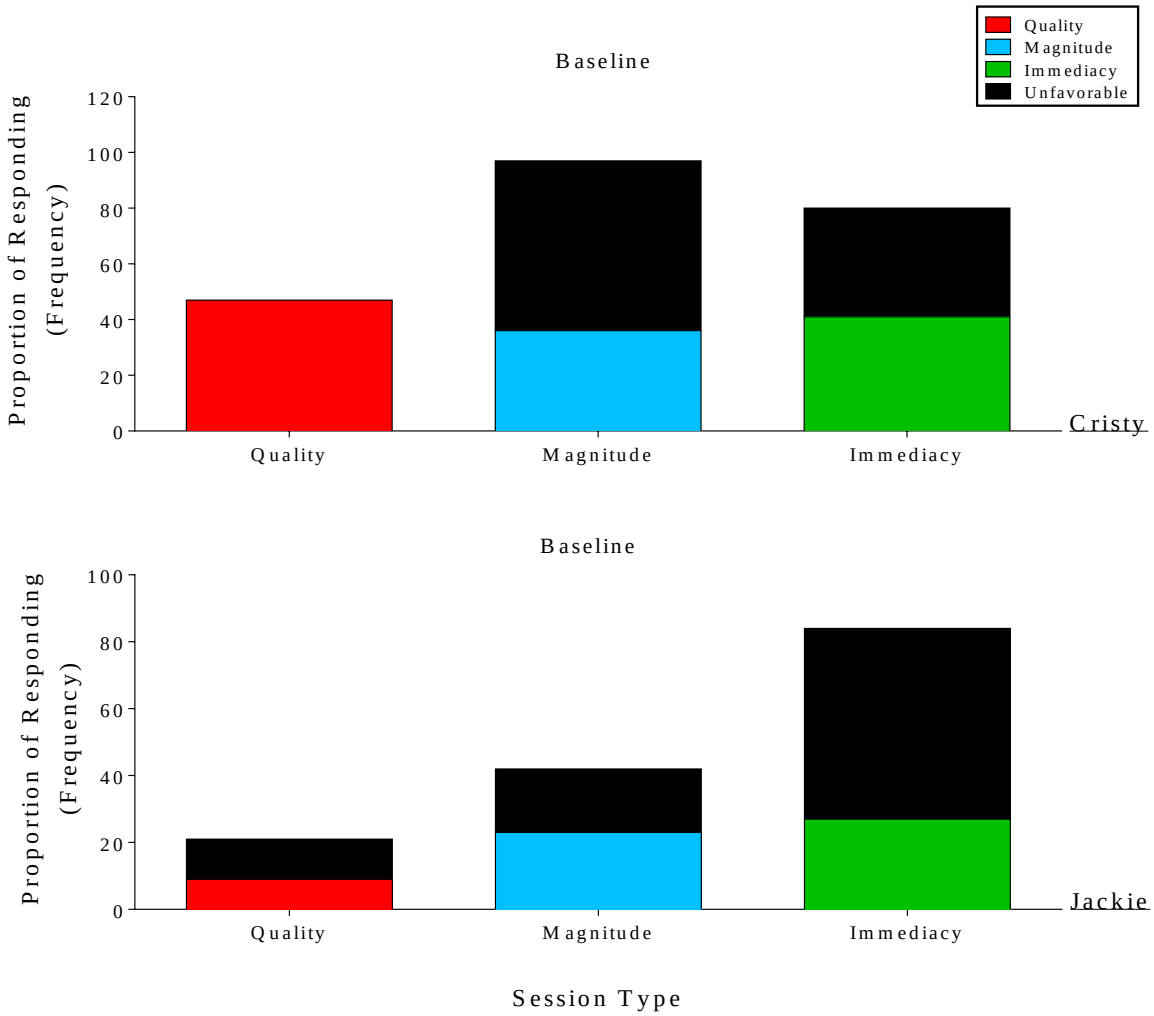


Figure 33. The total proportion of responding (frequency) during the baseline and assessment phases of the competing parameters assessment during Experiment 2. Sessions are scaled to the x axis and the proportion of responding is scaled to the y axis.

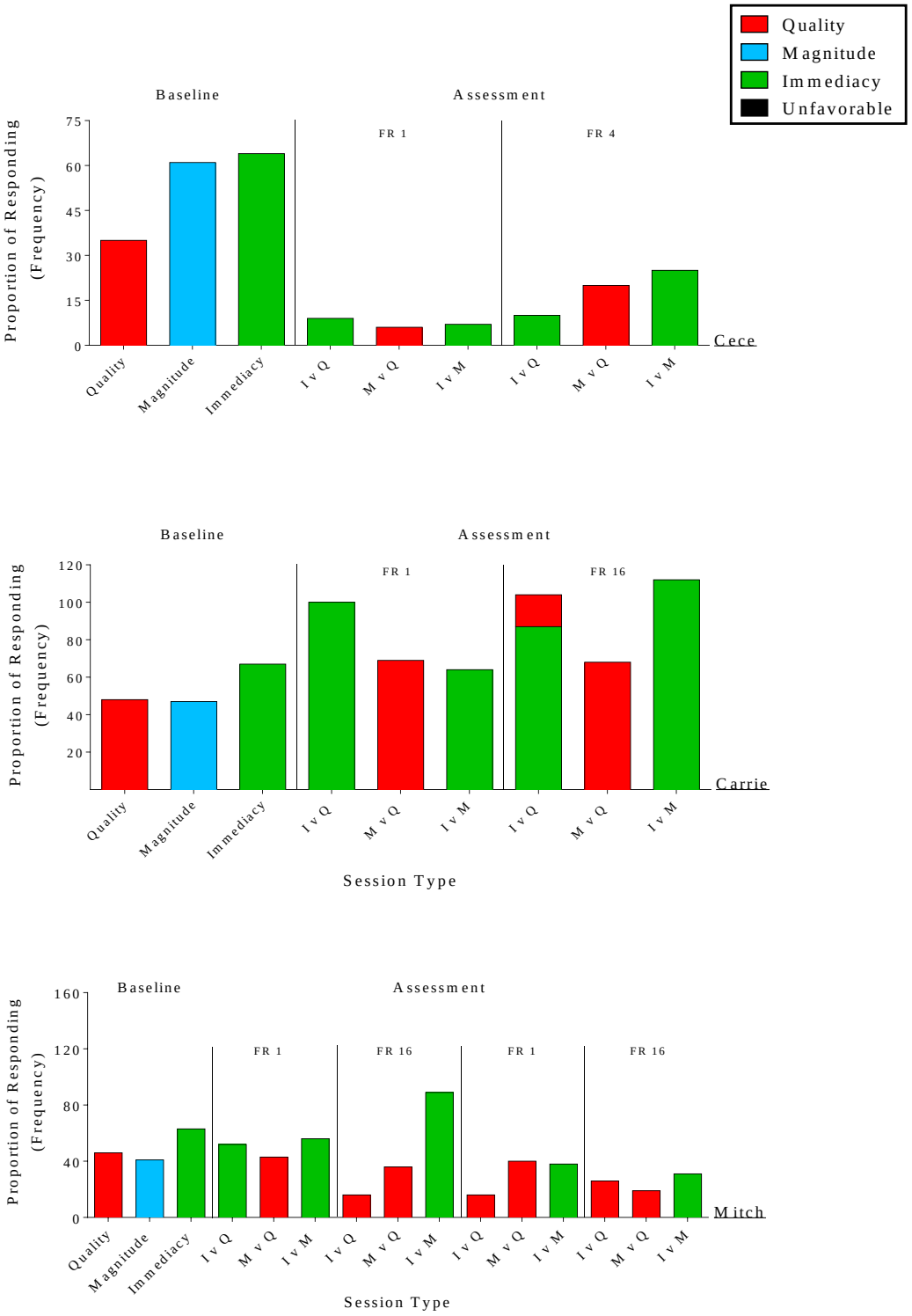


Figure 34. The total proportion of responding (frequency) during the baseline and assessment phases of the competing parameters assessment during Experiment 2. Sessions are scaled to the x axis and the proportion of responding is scaled to the y axis.

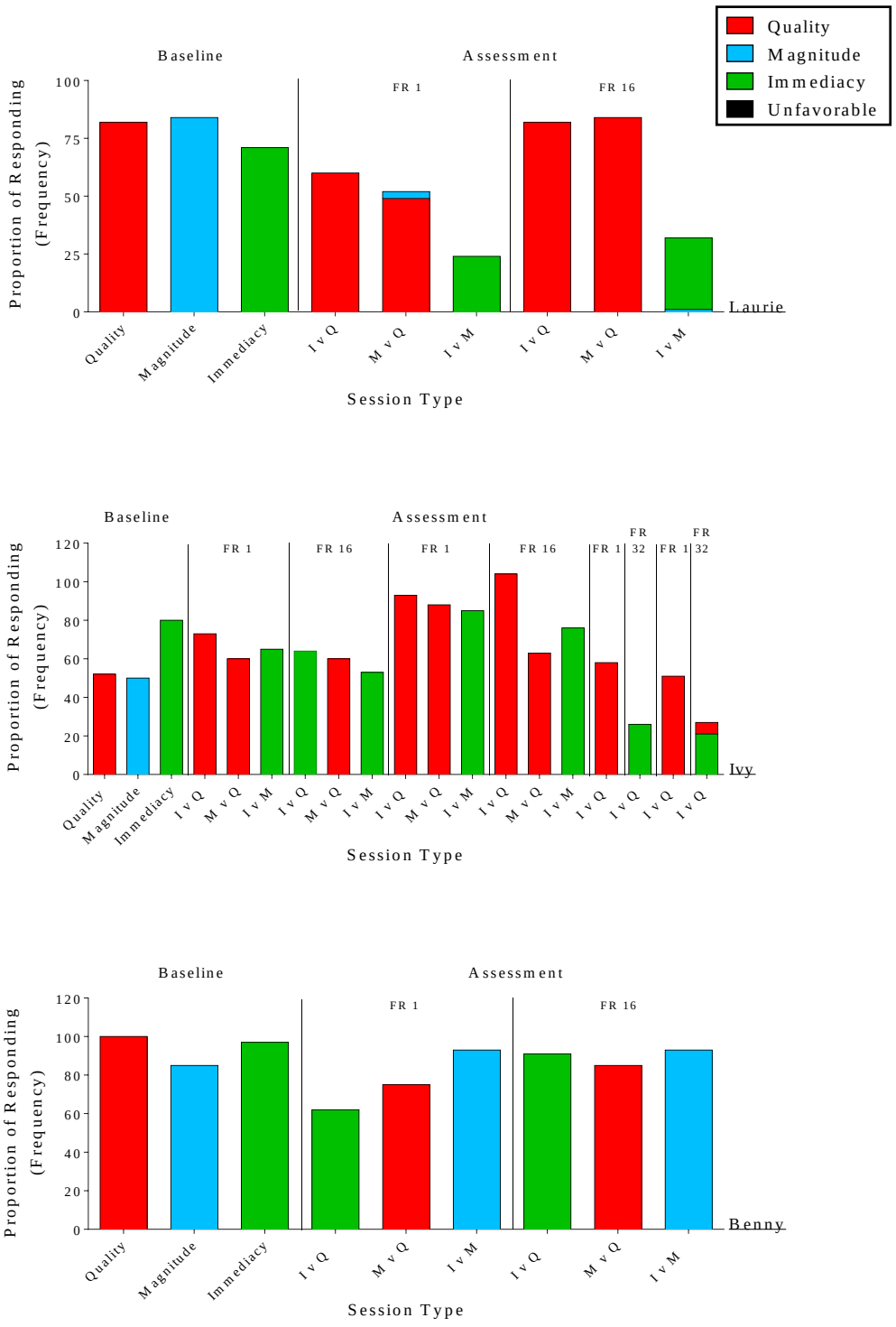


Figure 35. The total proportion of responding (frequency) during the baseline and assessment phases of the competing parameters assessment during Experiment 2. Sessions are scaled to the x axis and the proportion of responding is scaled to the y axis.