Healthy Eating: Approaching the Selection, Preparation, and Consumption of Healthy Food as Choice Behavior

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Abstract

Healthy eating has important well-being and financial implications for our society. As such, it is critical that the field of behavior science and behavior analysis conduct more research in this area so that effective interventions may be developed. One barrier to addressing healthy eating may be conceptual. Far from being a single response, eating is comprised of a series of choice responses. These selection, preparation and consumption responses form a temporally delayed behavioral chain. When designing interventions to address healthy eating, therefore, one must not only consider the specific target response, but alternative response options, and the effect of changing one response on other choices in the chain. The purpose of this article is to refine the analysis of healthy eating behavior, provide examples of research conducted in this area, and discuss how these interventions may influence this chain of responses. It is hoped that by doing so, additional research will be conducted and disseminated so that individuals, organizations, and policy makers can implement more effective interventions for healthy eating.

Keywords Healthy eating · Food · Choice behavior · Consumer behavior · Consumption

Multiple articles have been published in the field of behavior analysis calling for researchers and practitioners to explore new areas of application due to a high social need, for employment opportunities, or to expand the reach of our science (Critchfield & Kollins, 2001; Normand & Kohn, 2013; Bostow, 2011). One example of this is with respect to healthy eating. Healthy eating is related to multiple social health issues, such as obesity, diabetes, and other medical conditions. The Centers for Disease Control and Prevention recently reported that over one-third of U.S. adults (39.8%) and approximately 18.5% of youth 2–19 years of age were considered obese (Hales, Carroll, Fryar,

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& Ogden, 2017). Childhood obesity is related to higher risks of cardiovascular disease, metabolic disorders, pulmonary problems, skeletal diseases, and psychosocial problems (Daniels, 2006). In addition to obesity, over 30.3 million people (approximately 9.4% of the population) in the United States currently have diabetes (Centers for Disease Control, 2017). As such, it is clear that these health conditions, and in particular the behaviors that directly influence them, should be of primary importance to the behavior science and behavior analysis communities.

Addressing obesity and its related behaviors is not new to behavior analysis. For example, Wooley, Wooley, and Dyrenforth (1979) published an article in the *Journal of Applied Behavior Analysis (JABA)* discussing behavioral treatments for this issue. For healthy eating in particular, many studies were published in *JABA* in the 1980s and early 1990s (e.g., Dubbert, Johnson, Schlundt, & Montague, 1984; Mayer, Heins, Vogel, Morrison, Lankester, et al., 1986; Wagner & Winett, 1988; Stark, Collins, Osnes, & Stokes, 1986; Stock & Milan, 1993; Winett, Kramer, Walker, Malone, & Lane, 1988; Winett, Moore, Wagner, Hite, Leahy, et al., 1991). Since then there has been a great deal of research conducted within the field of behavior analysis and in related fields of study.

However, this research is limited due to an imprecise definition and conceptualization of healthy eating. Healthy eating in many cases is described topographically. For example, the 2015–2020 Dietary Guidelines for Americans issued by the U.S. Department of Health and Human Services and the U.S. Department of Agriculture (2015) recommend that individuals focus on variety, nutrient density, and caloric amount or quantity across and within the food groups that reduces the risk of chronic disease and maintains a healthy weight. They also recommend that individuals reduce added sugars, saturated fats, and sodium intake. However, there are a multitude of diets and dietary recommendations that contradict this definition, which may have adverse effects on healthy eating (Nagler, 2014). Although this is problematic, the goal of this article is not to specify or judge what items have a nutritional advantage over another. Of greater concern for the behavioral community is that "healthy eating" is an imprecise term used to refer to several different types of responses interchangeably, such as purchasing behavior and consumption. In many cases, healthy eating is also researched and analyzed as a discrete response independent of other response options. Eating (including healthy eating) can be more precisely conceptualized as a series of choice responses that form a temporally delayed to behavioral chain. This article will more closely examine the choice points that form this behavioral chain, environmental factors and response characteristics that affect these different choice points, and how a better understanding of this chain of choice responses and their respective treatments may assist researchers and practitioners in improving healthy eating decisions.

Healthy Eating as a Choice Behavior

Eating can be conceptualized as a series of choice responses. Approaching healthy eating as a choice response is critical because people are typically not presented with just one option when eating (Rasmussen, Robertson, & Rodriguez, 2016). For example, when in a store or restaurant, an individual makes a purchase among many options, or when consuming they may eat all, some, or none of their portion. A choice response

"refers to the manner in which individuals allocate their time or responding among available response options" (Fisher & Mazur, 1997, p. 387). In particular, choice responding, or how an individual allocates time, "depends on the reinforcing value of the alternatives and constraints on the alternatives" (Epstein, Leedy, Temple, & Faith, 2007, p. 885). When deciding what to make for dinner an individual is likely to choose the meal that tastes better to him or her, but only if factors such as effort to prepare and caloric content are equal.

With respect to eating, and healthy eating in particular, a choice among available options will be a function of response requirements as well as environmental factors. Response requirements may include the effort to obtain the food, monetary price of the food, and delay to consumption. The response cost (i.e., effort to obtain the food, monetary price) can result in different shifts in responding. In behavioral economics, demand curves illustrate how consumption of a commodity (such as food) decreases as cost increases (see discussions by Rasmussen, Reilly, & Hillman, 2010b; Rasmussen et al., 2016; Epstein et al., 2007). Increases in cost can also result in a different choice: an individual will choose a less-preferred food over a preferred food if less effort is required to obtain it (Lappalainen & Epstein, 1990). For example, a person may choose to eat a healthier snack available in the home (e.g., carrot sticks) if eating an unhealthy, more preferred snack (e.g., potato chips) requires driving to the store. Financial cost will also influence responding, and how individuals choose to allocate their available funds among different response options is subject to the relative rates of reinforcement and punishment available (Foxall, 2010). If carrot sticks have a higher monetary cost relative to potato chips or an equal cost but the potato chips taste better (e.g., more reinforcing to consume) then the potato chips may be selected. Similar shifts in responding can be seen when delay to consumption is introduced. Delay discounting procedures are utilized in behavioral economics to assess how the subjective value of a reward decreases as the delay to its receipt increases (e.g., Robertson & Rasmussen, 2018). Even relatively short delays (e.g., 25 sec) have been shown to influence selection of a healthy versus unhealthy food option in vending machines (Appelhans, French, Olinger, Bogucki, Janssen, et al., 2018). In the previous example, the time it takes to drive to the store will delay consumption, thereby decreasing the value of the unhealthy food and shifting responding to the alternative with the shorter delay (i.e., the carrot sticks).

Environmental factors that affect choice include motivating operations, the presence of particular antecedent stimuli, and the consequences of a given response. For healthy eating in particular, there are properties of food as a reinforcer that will influence how behavior is allocated, such as macronutrient content, palatability, caloric content, food variety, etc. (see Epstein et al., 2007, for a review). Epstein et al. also discuss how recent history with respect to deprivation and satiation of a specific food, or food in general, also influences responding. Deprivation and satiation are both categorized as motivating operations. According to Michael (1993) a motivating operation "is an environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of that part of the organism's repertoire relevant to those events as consequences" (p. 192). Deprivation (i.e., time since food consumption) momentarily increases the effectiveness of food as a reinforcer but also evokes any behavior followed by food reinforcement in the past. As one consumes food, the

reinforcing value of food decreases and food seeking behaviors abate, which is called satiation (Laraway, Snyckerski, Michael, & Poling, 2003; Michael, 1982, 1993; Tapper, 2005). This is distinct from the discriminative properties of a stimulus that signal the availability of reinforcement given a particular response. As such, the presence or absence of particular discriminative stimuli may increase or decrease the probability of a response. If unhealthy and healthy food options are arranged in a buffet, the sight and smell of the foods may function as discriminative stimuli that signal the availability of reinforcement or not based on an individual's history of responding.

Eating, however, is comprised of more than one choice response. In particular, there are a number of behavioral choice points that have been contacted prior to consumption. Figure 1 illustrates an example of these various choice points between an unhealthy option and a healthier one. This series of choice points forms a behavioral chain. A behavioral chain is "a complex behavior consisting of two or more component behaviors that occur together in a sequence. For each component behavior, there is a discriminative stimulus and response" (Miltenberger, 2016, p. 528). For healthy eating, this series of responses includes the selection, preparation, and consumption of food—all with corresponding discriminative stimuli. For example, when an individual sees and purchases carrots at a store, this carrot is now available for preparation (peeling, chopping, and cooking) and the cooked carrot for consumption. When people discuss eating (and healthy eating) in more colloquial terms, it's conversed about as if it was a single response, versus a series of choice responses, occurring in a temporally delayed behavioral chain. As a chain of responses, the response requirements and environmental factors that affect each link in the chain must be considered. In addition, the outcome

Fig. 1 Example of choice points for selection, preparation and consumption responses

of each choice response affects subsequent choice responses in the chain. For example, once the choice to purchase at a vending machine is made, versus a cafeteria or restaurant, the food options are now limited. Most relevant to the current conversation, the number of healthy food items is now restricted. Once an individual responds in an unhealthy manner (e.g., chooses to eat at a fast food restaurant), interventions targeted at subsequent choice responses may have less of an overall effect on health outcomes. In addition, if researchers target only one response in the chain (e.g., selection) without addressing other responses, consumption may not occur or maintain. For example, if an intervention provides coupons to encourage vegetable purchases by low income families, but no training is provided on how to cook the vegetables, the effort to prepare and poor taste of the vegetables may decrease consumption and/or result in selection of an unhealthy alternative. As such, preparation of the food would also need to be addressed.

However, this conceptualization also implies that there are numerous points at which one can influence healthy eating, and that interventions need not address all of the responses simultaneously. If eating is conceptualized as a series of choice responses, interventions can be designed that address individual choice points to increase the probability of healthier decisions. Indeed, when reviewing the healthy eating literature there are trends with respect to the types of interventions that address selection versus preparation versus consumption. For example, although consequence interventions are primarily utilized for consumption, antecedent interventions such as prompts primarily target selection. The factors that influence the types of interventions that have been tested may include logistical issues rather than relative effectiveness, such as the financial cost and difficulty of providing tangible reinforcers for healthy purchases in a grocery store. There are, however, other multicomponent interventions that attempt to address all choice points simultaneously. These interventions commonly utilize both antecedent and consequence interventions. Examples of this might include educational strategies paired with goal setting, feedback, and reinforcement.

Selection, Preparation, and Consumption Responses

Eating includes a series of selection, preparation, and consumption responses. Selection of food involves both where an individual chooses to obtain food and what food is chosen. Topographically it may include buying an item at a vending machine or grocery store, picking what to eat on a menu, or picking up and placing items on a tray in a cafeteria (e.g., in a school). With respect to healthy eating, people may select generally healthy (e.g., grocery store) or unhealthy (e.g., fast food restaurant) locations and subsequent selection of what to eat may then be limited. However, an individual may still select something healthy from a fast food restaurant (e.g., salad) or something unhealthy from a grocery store (e.g., chips).

Preparation includes any behaviors a person engages in to move from selection to consumption. The degree of preparation can vary greatly, ranging from minimal, such as unwrapping a candy bar from a vending machine, to several hours of peeling, chopping, and cooking in an individual's kitchen. Preparation of food can be healthy or unhealthy, similar to selection. For example, baking a fish versus frying the fish in unhealthy oils.

Consumption involves actually eating the food selected, specifically at the appropriate serving size. Although an individual may buy items from a store or place items on a tray, it doesn't necessarily follow that they will consume all, or even part, of the food item. An individual may also overconsume and eat more of a particular food than would be considered healthy.

Eating, as a temporally delayed behavioral chain, may include a single or multiple selection, preparation, and consumption response(s). For example, an individual may purchase potatoes at a store (selection response), but then he or she must wash, chop, and cook the potatoes (preparation responses) before consumption. Alternatively, a person may "eat," but not engage in all types of responses in the chain. For example, an individual will be asked to consume a food that they neither selected nor prepared, such as a child eating dinner in the home. Regardless, there is a great deal of literature focused on adjusting response requirements and/or environmental factors to influence healthy eating at each of these choice points. The research studies discussed in subsequent sections have been summarized in Tables 1, 2, and 3 and represent a sample of possible interventions drawn from both behavioral (e.g., *JABA*) and nonbehavioral journals (e.g., *Public Health Nutrition*). Although the interventions reviewed here are organized according to their effect on a particular response requirement or environmental factor, it is important to note that several of these interventions will influence responding in multiple ways. For example, feedback is discussed in the consequence section, but feedback may also serve as an antecedent intervention (Daniels, 1994).

Response Requirements: Response Effort, Delay to Reinforcement, and Monetary Cost

There are multiple response requirements to consider when evaluating whether an individual will engage in a healthy or an unhealthy response. These requirements include the effort to obtain the food, delay to consumption, and the financial cost of healthy versus unhealthy food items.

Response Effort and Delay to Reinforcement

Response effort is defined as "the amount of force, exertion, or time involved in executing a response" (Miltenberger, 2016, p. 535). Behavioral economics research suggests that as response effort increases an individual will consume less (Rasmussen, Lawyer, & Reilly, 2010a) or switch from preferred to less-preferred foods (Lappalainen & Epstein, 1990). The implication for healthy eating is that if the healthy option requires more effort, all other factors being equal, an individual may consume less healthy food or choose unhealthy options instead.

With an increase in effort there may also be an increase in delay to consumption. Delay to a specific response, such as consumption, does not necessarily include additional effort, however. For example, in purchasing carrots from a store and preparing them for consumption, both delay and response effort are involved. When purchasing from a fast food restaurant, there is only a delay in the time from when the burger is ordered to when it is delivered for consumption. The influence of response effort on allocation of responding then is clearly illustrated when individuals eat fast food rather than choose to cook a meal.

Table 1 Studies evaluating the effects of changing response requirements on healthy food choice

Authors	Year	Population & Setting	Manipulation	Target Response	Outcome
1 Appelhans et al.	2018	Adults at a large academic medical center	Compared the addition of a 25-sec delay to regular snacks, \$0.25 tax to healthy snacks, \$0.25 discount to healthy snacks, and combinations of delay with tax or discount	Selection	The delay and discount had a small, comparable effect on increasing healthy snack selection (40.1% increased to 42.5% and 43%). The strongest effects were seen with the tax (53.7%) and tax plus delay (50.2%).
2 Condrasky, Griffin, Catalano, & Clark	2010	Parents	Interaction with a chef and nutrition educator, hands-on cooking activities, nutrition education lessons, and meal planning guidance	Preparation Consumption	Self-reported food preparation skills and healthy food consumption increased
3 Hyland, Stacy, Adamson, & Moynihan	2006	12–13-year-olds in low-income areas	Taught how to cook with a variety of ingredients that were low cost and easy to replicate at home	Preparation Consumption	Improvements in food preparation skills and limited increase in healthy food consumption (both self-reported)
4 Kneringer & Page	1999	Staff in two group homes for individuals with developmental disabilities	Training and weekly feedback (verbal and graphic), monthly supervisor feedback during follow-up	Preparation	Healthy menu development (28% to 81%), healthy menu (59% to 98%), appropriate portion size (29% to 90%); maintained at six-month follow-up
5 Johnson & Cuvo	1981	Individuals with intellectual disabilities	Taught how to cook using pictorial recipes, prompts, and positive consequences	Preparation	Increases and maintenance in all three targeted cooking skills
6 Block, Chandra, McManus, & Willett	2010	Beverage cart and cafeteria in a hospital	Price increase on soft drinks vs. health message	Selection	Price change decreased soft drink purchase by 26%
7 Hernan, Harrison, Abdelmonem, & Jenks	2008	Women enrolled in WIC	Provided a bimonthly subsidy for purchasing fruits and vegetables over a six-month period	Selection Consumption	Statistically significant increase in self-reported consumption (didn't measure selection) of fruits and vegetables in experimental group versus control group. Results maintained at six-month follow-up.

Studies are organized as they appear in the document. As such, some of the studies presented above include multiple components which could also be included in Table 2 and/or 3 but are only presented in this table, similar to the discussion in the document.

Table 2 Studies evaluating the effects of antecedent interventions on healthy food choice

		2014	Grocery store	Effect of positioning healthy food items at checkout	Selection	Sales of target items increased by over 300%
1	Sigurdsson, Larsen, & Gunnarsson			Addition of POP prompt with health information		No additional change in sales
2	Rozin et al.	2011	Cafeteria	Moving items closer or further from consumer	Selection	Items on the edge of the salad bar or near the front are more likely to be selected
3	Wansink & Hanks	2013	Breakfast buffet at a conference	Served healthy foods first in the buffet line	Selection	75% of diners selected the first food they saw, and first three foods comprised 66% of foods taken
4	Luiselli, Ricciardi, & Gilligan	2005	1 child diagnosed with ASD	Gradually increased the amount of milk in a preferred beverage	Consumption	Increased consumption to 100% milk concentration
5	Tiger & Hanley	2006	1 child	Mixed chocolate syrup into milk and gradually reduced chocolate, implemented by preschool teachers	Consumption	Increased milk consumption at school which was also maintained at home
6	Hausman, Borrero, Fisher, & Kalng	2014	9 university students	Used equivalence-based instruction (comparing food portions w/ measurement aids (e.g., measuring cups) or common items (deck of playing cards)	Consumption	Improved accuracy in estimating portion size
7	Trucil, Vladescu, Reeve, DeBar, & Schnell	2015	3 university students	Used equivalence-based instruction (comparing food portions w/ measurement aids (e.g., measuring cups) or common items (deck of playing cards)	Consumption	Improved accuracy in estimating portion size with varying portion sizes and when food in original packaging
8	Papies & Veling	2013	Restaurant	Effect of posted calorie information and a motivational statement	Selection	Self-reported current or past dieters selected lower calorie option, no effect on other customers
9	Dubbert, Johnson, Schlundt, & Montague	1984	Cafeteria	Item labels and large posters to identify low calorie items	Selection	Purchasing changed for vegetables and salads, but not entrees
10	Mayer et al.	1986	Cafeteria	Posters at beginning of food line, smaller signs by entrees, fliers on tables; general + three specific entree recommendations	Selection	Immediate increase in low fat entree purchase (20% to 37%), not a full reversal (27%), slight increase when reintroduced (34%)
11	Wagner & Winett	1988	2 fast food restaurants	Banner, posters and table tents reading "Be Fit & Healthy: Eat a low-fat SALAD as your meal or add a side salad"	Selection	Results were mixed and highly variable, slight increase of 13.5% in salad sales overall

Table 2 (continued)

12	Thomdike, Sonnenberg, Riis, Barracough, & Levy	2012	Customers in a hospital cafeteria	Traffic light intervention: healthy foods marked green, semi-healthy yellow, and unhealthy red Rearranged so green foods at eye level and closer, red above/below eye level and further away	Selection	Decreased sale of all red items by 9.2%, but notably regular soda decreased by 23% Further decrease in red items of 4.9% and of soda by 5.9%.
13	Sonnenberg et al.	2013	Customers in a hospital cafeteria	Traffic light intervention	Selection	Not statistically significant, but green purchases increased and red purchases decreased for group who self-identified as always eating healthy or that health was important
14	Hamlin, McNeill, & Moore	2014	College students on a university campus	Front-of-pack labeling	Selection	Increased overall purchasing but didn't have differential impact on healthy vs. unhealthy purchases
15	Rafacz, Scramstad, Nerestant, & Johnson	2016	Fast food restaurant on college campus	POP prompt stating "make the healthy choice" and indicating healthy vs. unhealthy changes	Preparation	Decreased addition of unhealthy dressing, increased healthy dressing and vegetables to sandwiches
16	Levin & Carr	2001	Children diagnosed with Autism Spectrum Disorder	Restricted access to highly preferred food items prior to meals, provided contingent on consumption of non-preferred foods	Consumption	Increased consumption of non-preferred to age-appropriate serving size
17	Temple et al.	2006	children	Assessed effect of presenting new food stimulus versus same food stimulus	Consumption	Change to new food stimulus increased salivation and motivated responding (access to points for food)
18	Myers Ernst & Epstein	2002	male undergraduate students	Assessed effect of same food versus a variety of food	Consumption	Food variety increased food consumption
19	Temple, Giacomelli, Roennnich, & Epstein	2008	children	Assessed effect of same food versus a variety of food	Consumption	Food variety increased motivated responding (access to points for food)

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Table 3 Studies evaluating the effects of consequence interventions on healthy food choice

1	Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri	2010	Fourth and fifth grade students	Repeated taste exposure to four vegetables	Consumption (preference)	Increases in liking for three out of the four vegetables
2	Anzman-Frasca, Savage, Marini, Fisher, & Birch	2012	Children	Paired a vegetable with dip during taste exposure training	Consumption (preference)	No additive effect: preference shifted by fourth exposure with or without dip; some maintenance at one month
3	Hausner, Olsen, & Moller	2012	2-3 year olds	Taste exposure to artichoke puree alone or with sucrose added	Consumption	Increased intake by the fifth exposure for puree alone and to puree + sucrose by tenth exposure
4	Solberg, Hanley, Layer, & Ingvarsson	2007	3-5 year olds	Taste exposure of less preferred food with condiments and reinforcers	Consumption (preference)	No increase in preference once condiments and reinforcers removed
5	Cooke et al.	2011	4-6 year olds	12 daily taste exposures plus tangible and social reinforcers	Consumption (preference)	All conditions increased consumption and preference, three-month follow-up reinforcement condition maintained while exposure alone did not
6	Riordan, Iwata, Finney, Wohl, & Stanley	1984	Children	Preferred foods provided contingent on consuming non-preferred foods for three of the four participants	Consumption	Consumption increased across food categories (variety of foods consumed increased), effects maintained at follow-up
7	Madsen, Madsen, & Thompson	1974	Children, rural Head Start Program	Delivered sugar-coated cereal, candies and praise contingent on eating novel breakfast foods	Consumption	Increased novel foods (not necessarily healthy)
8	Loewenstein, Price, & Volpp	2016	40 elementary schools, 8000 children	Token system implemented for either 3 weeks or 5 weeks to increase consumption of fruits and vegetables	Consumption	Students consuming at least one fruit or vegetable increased from 39.9% to 76.4% (three-week exposure) and 37.6% to 79.5% (5-week exposure) with some limited maintenance at 1 and 2-month follow-up
9	Lowe, Home, Bowdery, & Egerton	2004	Children in 3 schools	Food Dudes: narratives and video peer models who battle junk food villains w/ individual and group-level social and tangible reinforcers for consumption	Selection Consumption	An increase from 48% during baseline to 71% during intervention of snack-time fruit and 38% to 68% of snack-time vegetables on average across three schools

Table 3 (continued)

10	Morrill, Madden, Wengreen, Fargo, & Aguilar	2016	Children in school setting	Same as Lowe et al. (2004)	Selection Consumption	Found that tangible reinforcers were more effective than social reinforcers
11	Stark, Collins, Osnes, & Stokes	1986	Preschool children in school setting, generalization to home	Traffic light diet training, stickers contingent on green food selection, and taught to solicit (cue) praise from adult	Selection	Education and reinforcement initially increased healthy food selection, but the “cue” was required for generalization to the home environment
12	Cassey, Washio, & Hantula	2016	Two teams of preschoolers with ASD in classroom setting	Version of the “Good Behavior Game”—individual feedback, praise, and for the winning team, a small prize each session (e.g., stickers, small toy)	Selection Consumption	Students increased from zero rates of consumption to an average of 13.8 bites during the intervention
13	Jones, Madden, & Wengreen	2014a	252 children in an elementary school	Builds on Food Dudes, and uses gamification such that the heroes move through a game scenario contingent on the school meeting consumption goals.	Selection Consumption	38.7% increase in fruit consumption and a 33.3% increase in vegetable consumption
14	Jones, Madden, Wengreen, Aguilar, & Desjardins	2014b	Children in school setting	Similar to Jones, Madden, & Wengreen	Selection Consumption	Replicated findings of Jones et al. (2014a)
15	Normand & Osborne	2010	Four college students at university dining options	Provided individualized feedback on calorie and fat content of purchases	Selection	Feedback decreased fat and calorie purchases for 3 out of 4 participants
16	Mahon, Neufeld, Mani, & Christophersen	1984	Four adult burn patients in a hospital	Informational feedback on level of kilocalories and protein in food, recommended amounts, and their actual intake	Consumption	Levels increased to prescribed levels for protein and kilocalories increased with patients meeting prescribed levels 35% of days (relative to zero during baseline)
17	Stock & Milan	1993	Three individuals in an independent living facility	Used feedback and social reinforcement	Selection Consumption	Improved low-cholesterol food selection and consumption. Selections increased from 28.2% at baseline to 65.2%.

Table 3 (continued)

18	Winett, Kramer, Walker, Malone, & Lane	1988	Supermarket	Educational materials, models and feedback	Selection	Increased purchase of complex carbohydrates by 5.4%, reduced fat purchasing by 6.7%, and decreased cost to the consumer by 26.4%
19	Winett et al.	1991	Supermarket	Automated system that provided videos and tracked consumers' purchases through an in-store kiosk	Selection	Replicated findings of Winett et al. (1988)
20	Loro, Fisher, & Levenkron	1979	Adults in weight-reduction treatment	The first intervention involved situational and stimulus control of external cues for eating, the second specified quantity and quality of eating behavior, and the third emphasized using graphs to monitor weight loss and other individualized self-control strategies.	Weight outcome: no direct measure	All three treatments resulted in statistically significant reduction in weight, but self-control more successful at follow-up
21	Hendrickson & Rasmussen	2013, 2016	Adults and adolescents	50-minute mindful-eating training	Selection	Increased self-controlled choices for food (lower impulsivity)
22	Sites et al.	2015	Overweight or obese employees in work setting	Utilized a combination of preordering, incentives (lunch vouchers), point-of-purchase health information, and mindful eating	Selection	Statistically significant decrease in fat and calorie purchasing compared to baseline, even when the vouchers were discontinued
23	Epstein et al.	2001, 2008	Families	Multicomponent intervention with: traffic light intervention, education and multiple behavioral interventions (e.g., stimulus control, reinforcement)	Consumption	Reinforcing increased consumption of green foods (e.g., fruits and vegetables) displaced red foods (e.g., high in fat or sugar) and resulted in greater weight loss than reinforcing a reduction in red foods alone

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Increased response effort may take multiple forms for healthy eating, including distance an individual must travel to obtain food and effort to prepare the food itself. Travel distance is most relevant for selection, as opposed to preparation or consumption responses. As previously mentioned, selection of food involves both where an individual chooses to obtain food and what food is chosen. When selecting a purchasing location, response effort involved in traveling to and from the location may influence responding. For example, if a grocery store with many healthy options is further away than one with fewer healthy options, individuals may choose the latter. Indeed, proximity to grocery stores has been found to be related to increases in the probability that adults will consume four or more servings of fruits and vegetables per day (Robinson, Dominguez, Teklehaimanot, Lee, Brown, et al., 2013). Interventions may need to be designed to either 1) remove some of the aversive qualities of the travel distance (e.g., provide gas money) or 2) incentivize traveling further (e.g., coupons or gift cards to healthier options). Individuals in food deserts must travel some distance to access healthy food options (American Nutrition Association, 2011). In order to increase healthy food selection for individuals in some areas, addressing food availability is necessary prior to other behavioral interventions.

Another way of decreasing effort for healthy eating is to eliminate some of the responses in the chain, or to decrease the effort involved in any given response. Altering response effort, therefore, is most applicable to the preparation response. For example, response effort may be manipulated by providing prepackaged healthy snack options in vending machines or grocery stores (see discussion by Epstein et al., 2007). Some examples may include vegetables that are already cut-up or healthy snack options for school lunches that are individually packaged.

Delay to consumption and the effort involved in food preparation in the home may also result in increases in food consumption outside of the home or the purchase of food that can be quickly and easily prepared. Indeed, interventions that commonly address in-home preparation may influence responding by reducing delay and response effort, for example, a cooking class or easy-to-follow recipes. Although studies on cooking, etc. do not explicitly evaluate reductions in response effort or delay, it could be assumed that instructing someone on food preparation may decrease the number of mistakes, steps, or time it takes to prepare a food item. These interventions may also improve the appearance and taste of healthy food, which may increase or maintain their consumption and satiety, over less palatable foods. For example, direct instruction may include how to properly season food, and the amount of seasoning (e.g., oregano) on food has been shown to change consumption levels (e.g., Yeomans, 1996; see further discussion by Sorensen, Moller, Flint, Martens, & Raben, 2003).

There are several examples of such interventions in the research literature. For example, hands-on cooking activities have been self-reported by participants to positively influence food preparation skills and healthy food consumption (e.g., Condrasky, Griffin, Catalano, & Clark, 2010; Hyland, Stacy, Adamson, & Moynihan, 2006). Training and feedback have also been shown to increase healthy menu development, correct meal preparation, and portion size estimates (Kneringer & Page, 1999). In addition, teaching cooking can be successfully used with individuals with intellectual disabilities (Johnson & Cuvo, 1981). Behavioral skills training (BST) is one training strategy that has been demonstrated to be effective in improving a number of behaviors (e.g., Johnson, Miltenberger, Egemo-Helm, Jostad, Flessner, et al., 2005) and could be applied to meal preparation as well. Cooking

instruction, like nutrition education, is frequently utilized in multicomponent interventions, and a more evidence-based approach to training, such as BST, could prove beneficial. As such, the research does indicate that directly teaching preparation skills can improve several responses related to healthy eating, but additional research utilizing BST is warranted and direct measures of the effects of this training on preparation, as well as selection and consumption, is needed.

Monetary Cost: Consumer Behavior and Price

Like travel distance, monetary cost is most relevant for the selection response(s), but may not always apply. For example, a selection response at a store or restaurant will have a financial cost that will influence behavioral allocation, whereas the selection response by a child at a school cafeteria will not. Consumer behavior analysis employs a behavioral economic approach to the complexities of consumer choice, including how financial cost relates to the selection response in purchasing environments.

According to Foxall (2010), consumer behavior illustrates how the matching law (Herrnstein, Rachlin, & Laibson, 1997) can be applied to purchasing behavior. An individual has a predetermined amount of money to allocate among different responses and how they allocate this money will be based on relative rates of reinforcement and punishment. In particular, consumer behavior is under the relative influence of utilitarian reinforcement and punishment and informational reinforcement and punishment. Although Foxall argues that food purchasing is primarily subject to utilitarian consequences, which are the functional outcomes of behavior, food purchasing may also be influenced by informational (socially mediated) consequences as well. Whether a consumer chooses to purchase a healthy or unhealthy item may be heavily influenced by the relative price (utilitarian punishment) of each. However, although price can have negative effects for the consumer (in terms of cost), it can also have positive effects by signaling better quality (informational reinforcement) (Sigurdsson, Foxall, & Saevarsson, 2010).

This is particularly relevant given that the research in this area typically involves increasing the price of unhealthy alternatives (e.g., Block, Chandra, McManus, & Willett, 2010; Appelhans et al., 2018), or decreasing the price of healthy foods (e.g., subsidies; e.g., Herman, Harrison, Abdelmonem, & Jenks, 2008). Both interventions have proven successful, which seems to indicate that adjusting price is a viable option, though price may be challenging to manipulate. Alternatively, future research could evaluate if prompts that identify healthy alternatives to unhealthy foods that are comparable in price may be effective in increasing their selection. For example, placing a sign by the snack section of a grocery store advertising whole fruit as a comparably priced alternative to potato chips. However, the viability of this may also be limited because research suggests that healthy food is more expensive per calorie than unhealthy food (Drewnowski, 2010).

Environmental Factors: Antecedent and Consequence Interventions

In addition to response requirements, environmental factors including motivating operations, discriminative stimuli, and consequences will also influence responding.

There are many interventions that have targeted one or several of these factors in an attempt to influence healthy food selection, preparation, and consumption. As previously mentioned, most antecedent interventions typically target food selection and most consequence interventions target consumption or selection and consumption. Multi-component interventions will combine several interventions in an attempt to change one or all of the different eating responses.

Antecedent Interventions

Discriminative Stimuli: Altering the Discriminative Stimulus and Discrimination Training A discriminative stimulus is a stimulus that has been correlated with the increased availability of reinforcement contingent on responses of some type (Michael, 1982). Altering the saliency of these discriminative stimuli can serve to increase healthy food selection and consumption. One example of this is manipulating the location of healthy food items for selection. Moving healthy food items to the checkout line in a grocery store has been shown to significantly increase purchasing (Sigurdsson et al., 2014). Placement of food items closer or further from consumers in cafeteria lines also has an effect, with items on the edge or near the front more likely to be purchased (e.g., Rozin, Scott, Dingley, Urbanek, Jiang, et al., 2011; Wansink & Hanks, 2013). As such, simply changing proximity to healthier options (i.e., increasing the saliency of the discriminative stimulus) will increase the probability of consumers selecting healthier options over unhealthy options. Alternatively, one can also decrease the saliency of a stimulus that does not signal reinforcement. For example, the sight or smell of a vegetable may be aversive (i.e., not signal reinforcement) whereas the site and smell of apple pie will signal the availability of reinforcement. One intervention to address appearance, smell, and taste is to mask these characteristics of the healthy item by blending it with a preferred food (e.g., Luiselli, Ricciardi, & Gilligan, 2005; Tiger & Hanley, 2006). The nonpreferred food is typically faded back in increasingly larger quantities. Consuming these larger and larger quantities is then reinforced, such that the appearance and smell of the food then becomes a discriminative stimulus that signals reinforcement.

Interventions also target portion-size discrimination, that is, training individuals to identify what a healthy portion of food should be. If individuals are presented with larger and larger portion sizes and have been reinforced in the past for eating the full amount (Orrell-Valente, Hill, Brechwald, Dodge, Pettit, et al., 2007), they may over-consume calories. As portion sizes continue to grow (Young & Nestle, 2003), the ability to discriminate a reasonable portion size is critical. Multiple studies have been conducted demonstrating that portion-size estimation can be improved through equivalence-based instruction (Hausman, Borrero, Fisher, & Kahng, 2014; Trucil, Vladescu, Reeve, DeBar, & Schnell, 2015). In essence, equivalence-based instruction teaches individuals to respond to physically dissimilar stimuli as if they were the same, such as comparing food portions with measurement aids (e.g., measuring cups) or common items (e.g., deck of playing cards). This training has proven successful with varying portion sizes and when food is presented in its original packaging. However, more research needs to be conducted on how this training maintains over time and generalizes to the natural environment with other stimuli (e.g., plate size or social conditions) (Trucil et al., 2015).

Marketing, Health Education, and Point-of-Purchase Prompts In addition to directly manipulating discrimination or presence of the discriminative stimulus, prompts may be utilized as an antecedent intervention to increase healthy food selection. Advertising of food items may occur at a time and distance from selection and consumption (e.g., internet or television ads) or in close proximity (e.g., packaging). The overall goal of marketing foods is presumably to increase selection (i.e., purchasing). As suggested by one article on marketing and advertising of healthy foods in particular, however, the industry has made the mistake of primarily advertising the health characteristics of the food items (Bublitz & Peracchio, 2015). Other food products are marketed by appealing to sensory characteristics, such as smell or taste, or by pairing items with other stimuli such as sexy individuals or cartoon characters. Indeed, a study by Smeets and Barnes-Holmes (2003) demonstrated that by pairing the same soda with a preferred and nonpreferred picture, the children developed a preference for the soda paired with the preferred picture.

The primary issue with marketing health characteristics, such as low calories or low fat, is that it assumes the individual is motivated to respond to these stimuli. This is a similar issue for health education interventions designed to increase healthy selection, preparation, and consumption, for the sake of improving health outcomes rather than improving sales. For example, one study found that posting caloric information only effected selection by current or past dieters (Papies & Veling, 2013). As such, health information may only influence those who are already motivated to reduce calories, fat, sugar, etc. Content of the message, such as highlighting the lack of an unhealthy ingredient versus the addition of healthy ingredients, has also been found to influence responding (see review by Van't Riet, 2012). As such, future research needs to further examine what type of content is likely to influence what type of consumer, such as a dieter, but also a parent, child, or someone concerned about appearance versus health. One of the primary issues may be that researchers assume these interventions will have a motivational effect when they are more likely to operate as discriminative stimuli for those individuals who have a particular reinforcement history. For example, if someone has a history of being reinforced for purchasing low calorie food, then the health information may serve as a discriminative stimulus or prompt. In order for these interventions to increase the reinforcing value of purchasing a particular item (i.e., function as a motivating operation) than adjusting the content or pairing them with appealing images may be more successful (Fagerstrom, 2010; Fagerstrom, Foxall, & Arntzen, 2010; see also a discussion of conditioned motivating operations by Tapper, 2005).

Regardless, as a point-of-purchase prompt, health information is particularly problematic due to conflicting health information, complexity of the information, and issues with saliency (Van't Riet, 2012; Escaron, Meinen, Nitzke, & Martinez-Donate, 2013; Harnack & French, 2008; Kiszko, Martinez, Abrams, & Elbel, 2014; Liberato, Bailie, & Brimblecombe, 2014). Changing health guidelines (U.S. Department of Health & Human Services & U.S. Department of Agriculture, 2015) and the complexity of information conveyed may overwhelm consumers. Consumers have reported that they find product health information too complicated (Kristal, Levy, Patterson, Li, & White, 1998) and one review argued that many consumers have a limited understanding of that information (Cowburn & Stockley, 2005). Several studies, however, have utilized relatively simple posters and table tents that encourage consumers to select specific

healthier options (e.g., Dubbert et al., 1984; Mayer et al., 1986; Wagner & Winett, 1988). A more simplified traffic light intervention that indicates healthy (green), semi-healthy (yellow), and unhealthy (red) labeling of food products has also been used across multiple settings with some degree of effectiveness (e.g., Thorndike, Sonnenberg, Riis, Barraclough, & Levy, 2012; Sonnenberg, Gelsomin, Levy, Riis, Barraclough, et al., 2013). The health information also needs to be close to the point of purchase and salient enough that shoppers notice it—such as front-of-pack labeling (e.g., Hamlin, McNeill, & Moore, 2014).

There has been a great deal of research on providing health information at the point of purchase, but more is needed. In addition to making health and nutritional information more salient and simpler, future studies should examine what prompt components (word choice, placement, visual stimuli) have the greatest impact on selection behavior. This applies to other marketing/advertising stimuli as well. In addition, multiple reviews of the research literature found that much of the research was not empirical, lacked sufficient experimental control (e.g., no control group; Liberato et al., 2014; Van't Riet, 2012), and primarily relied on self-reported intention to buy or the effects on actual purchasing behavior were mixed (Larson & Story, 2009). Because these are important considerations for applied behavior analysis (Baer, Wolf, & Risley, 1968), it follows that behavior analysts may be poised to make an important contribution in this area. Much of the research is also in closed consumer settings and extrapolating these findings to an open consumer market may be problematic (DiClemente & Hantula, 2003). Finally, most of this research involves the selection response and additional research should be conducted on utilizing prompts for preparation and consumption. For example, prompting the addition of healthy dressings and vegetables to sandwiches in a fast food restaurant (Rafacz, Scramstad, Nerestant, & Johnson, 2016).

Motivating Operations: Priming, Deprivation, and Satiation Interventions In addition to altering discriminative stimuli and adding prompts, having consumers taste a product may serve to increase responding. There is some indication in the literature that providing a taste or small amount of a food may prime an increase in motivated responding (de Wit, 1996) even in people that are satiated (Cornell, Rodin, & Weingarten, 1989). Although these studies on priming relate specifically to consumption, if the taste of a healthy item is reinforcing, then a person may be more likely to purchase the food item, where health information alone may be insufficient to evoke a response. Use of tasting to increase purchasing is frequently utilized in a variety of settings (e.g., Steinberg & Yalch, 1978) and may increase healthy food selection as well.

Deprivation and satiation will also function as motivating operations that influence the reinforcing value of consuming a healthy versus an unhealthy food item (Tapper, 2005). Deprivation of a particular food or the act of consuming a food may have multiple effects on the reinforcing value of that food as a reinforcer. In particular, one must consider the food-specific effects due to food deprivation versus the more general effects of response deprivation (Epstein et al., 2007). For example, depriving someone of the opportunity to consume food may increase the reinforcing value of consuming overall, but restricting access to a particular food may increase only the value of that food item. A study by Levin and Carr (2001) restricted access to highly preferred food items prior to meals and then provided preferred foods contingent on consumption of nonpreferred foods with children diagnosed with Autism Spectrum Disorder (ASD).

This method increased consumption gradually to an age-appropriate serving size of the target nonpreferred food. This suggests that restricting access to a specific food may increase its reinforcing value such that its contingent delivery increases consumption of a nonpreferred food. It is interesting that the authors found that deprivation of the highly preferred food alone or providing the preferred food contingently with no deprivation were ineffective. This speaks to the food-specific effects of the deprivation, and that the preferred food did not function as a reinforcer without the deprivation. Conversely, some have argued that dieting involves intermittent periods of brief food deprivation that may actually increase the reinforcing value of food, but more research is needed (see Epstein et al., 2007, for further discussion). Thus, with respect to healthy food consumption, deprivation may be utilized to increase the reinforcing value of a food delivered contingent on eating a healthy food, but general food deprivation under choice conditions may be contraindicated because it may increase the consumption of both healthy and unhealthy foods.

Research in satiation and food variety also have interesting implications for the consumption response. Research suggests that people will reduce responding (i.e., stop consuming or consume less) if the same food is repeatedly presented but will begin consuming again if a new food is presented (e.g., Temple, Kent, Giacomelli, Paluch, Roemmich, et al., 2006; see also discussion of satiation as habituation by Murphy, McSweeney, Smith, & McComas, 2003). Indeed, presenting a variety of foods will increase responding versus presentation of a single food for both adults (Myers Ernst & Epstein, 2002) and children (Temple, Giacomelli, Roemmich, & Epstein, 2008). This has important implications depending on the food group that is available. In particular, more variety leads to increased consumption across food groups, but body fat only increases in response to unhealthy, energy dense foods such as snacks, sweets, condiments, etc. (McCrary, Fuss, McCallum, Yao, Vinken, et al., 1999). One application of this research would be to limit the number of unhealthy options and provide more variety of healthy options, for example in a school cafeteria (see discussion by Epstein et al., 2007). Future research could also evaluate a combination of increased variety with prompts or tasting interventions to see if there is an additive effect.

Consequence Interventions

Although antecedent interventions are most commonly applied to the selection response, consequence interventions are most relevant when discussing the consumption response. Indeed, in the chain of selection, preparation, and consumption responses, the individual contacts the terminal reinforcer when consuming food. If the taste of a healthy food item is not reinforcing, it will decrease the likelihood that an individual will consume it. This will also have implications for selection and preparation. If I see a carrot at a store and I do not like the taste of carrots, I am unlikely to select or prepare the carrot. As such, establishing the taste of healthy food as a reinforcer is critical.

There are several studies indicating that taste preference (self-report) and consumption can be shifted through repeated taste exposure (e.g., Lakkakula, Geaghan, Zanolov, Pierce, & Tuuri, 2010). In particular, taste preferences and consumption will shift after an individual tastes an item several times. Moreover, studies suggest that adding condiments or dips are not necessary to increase preference, and in some cases,

may decrease the effectiveness of taste exposure as an intervention (Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012; Hausner, Olsen, & Moller, 2012; Solberg, Hanley, Layer, & Ingvarsson, 2007). Rather, one study found that adding tangible and social reinforcers was more likely to maintain changes in consumption than taste exposure alone (Cooke, Chambers, Anez, Croker, Boniface, et al., 2011). As such, rather than pairing healthy food items with dips or condiments, repeated tasting of the food item should be reinforced with tangible and/or social consequences. Additional research still needs to be conducted, however, regarding the timing between exposures, the preexisting level of aversion to the food item, and the effect exposures have on self-report of preference versus choosing to consume healthy food items over unhealthy ones. In addition, these studies utilized young children as participants, and whether these outcomes would be similar with adults has yet to be evaluated.

Additional consequences may also be necessary to increase responding until the taste of the food is sufficient to maintain consumption of a healthy food item. Food items high in fat or sugar will be automatically reinforcing (Nicholson & Xiao, 2010) but healthy food items are commonly categorized as such because they are lower in these macronutrients. There are several single and multicomponent studies that have utilized social, tangible, and virtual reinforcers to increase healthy eating. These studies typically target consumption, but many of them also implicitly or explicitly include selection and/or preparation. For some, direct measures of healthy eating are not taken but inferred based on changes in weight.

Much of the literature on utilizing reinforcement for consumption is with children. In one example, Riordan, Iwata, Finney, Wohl, and Stanley (1984) provided preferred food contingent on consumption of nonpreferred food. At the group level, tangible and social reinforcement has also been shown to increase the consumption of novel breakfast foods (Madsen, Madsen, & Thompson, 1974), and a token system with tangible reinforcers was used at 40 elementary schools to increase fruit and vegetable consumption (Loewenstein, Price, & Volpp, 2016). These latter studies provide support for utilizing tangible reinforcers in school settings with children. This is further supported by programs such as the Food Dudes, which use narratives and videos of superheroes (peer models) that battle villains who are equated with junk food and unhealthy choices (Lowe, Horne, Tapper, Bowdery, & Egerton, 2004). As the school increases its consumption of fruits and vegetables, various individual and group-level social and tangible reinforcers are provided.

The relative effectiveness of social versus tangible consequences is still questionable, however. One Food Dudes study found that tangible reinforcers were more effective than social reinforcers utilized by the program (Morrill, Madden, Wengreen, Fargo, & Aguilar, 2016). However, another study that taught children to "cue" for social praise found that providing stickers contingent on healthy food selection increased responding, but the "cue" was required for generalization to the home environment (Stark et al., 1986). Social consequences that maintain healthy eating may also come from peers. During the Good Nutrition Game, which is a modification of the Good Behavior Game (Barrish, Saunders, & Wolf, 1969) to address healthy eating, the authors anecdotally noted that peers were high-fiving and fist-bumping their peers contingent on consumption and also noted an increased interest in purchasing fruits and vegetables outside of the classroom (Cassey, Washio, & Hantula, 2016). Although tangibles were also included in these latter studies, it is possible that social

reinforcement from adults or peers increased the probability of generalization and maintenance of responding.

The Good Nutrition Game (Cassey et al., 2016) also capitalizes on group contingencies and elements of gamification (Morford, Witts, Killingsworth, & Alavosius, 2014). Other research supports the use of gamification elements that incorporate additional social and virtual reinforcers. One example is the Fit Game program, which modifies the Food Dudes program such that heroes move through a game scenario contingent on the school meeting consumption goals (Jones, Madden, & Wengreen, 2014a; Jones, Madden, Wengreen, Aguilar, & Desjardins, 2014b). Utilizing virtual reinforcers helps to eliminate some of the costs of the program by reducing the use of tangibles. Additional research is needed, however, on how best to utilize social contingencies, whether alone or in conjunction with virtual or tangible reinforcers.

It is also unclear how much of this applies to adult behavior. How social, tangible, and virtual reinforcers may be manipulated to increase healthy eating by adults requires additional research. For example, gamification has been applied to other behavior by adults but is lacking in the area of health-related behavior change (Baranowski, Buday, Thompson, & Baranowski, 2008), including healthy eating. Online shopping environments, in particular, may provide an opportunity to manipulate consequences for the selection response.

One exception to the lack of research on adult healthy eating behavior relates to social reinforcement and feedback. Providing feedback is the consequence intervention most frequently utilized for adult selection, preparation, and consumption. Though it can be argued that feedback may function as a consequence (Komaki, Barwick, & Scott, 1978), it has also been described as serving a discriminative function (Daniels, 1994), motivating function (Agnew, 1998), or as serving multiple functions (Sulzer-Azaroff & Mayer, 1991). Feedback on the nutritional content of food has been repeatedly demonstrated to increase healthy food selection and/or consumption, whether used in isolation (Normand & Osborne, 2010; Mahon, Neufeld, Mani, & Christophersen, 1984) or in combination with social reinforcement (Stock & Milan, 1993), educational material and models (Winett et al., 1988; Winett et al., 1991), or goal setting and response cost procedures (Loro, Fisher, & Levenkron, 1979). Much of this research is conducted in hospitals, living facilities, or supermarkets. These sites, along with online shopping environments, may be viable options for continued research on consequences for adult healthy eating.

New Directions and Concluding Remarks

In summary, if eating, and healthy eating in particular, is conceptualized as a series of choice responses in a temporally delayed chain, there are important implications for future research. First, that this is a choice response and should be researched and intervened upon as such. Second, that targeting one component of the chain may or may not affect other components of the chain. Finally, that much of the literature on healthy eating tends to focus on antecedent interventions, particularly with respect to selection, and although more is needed, consequence interventions also require further research. In contrast, package interventions attempt to target all points in the chain with multiple evidence-based interventions, but although these may be effective, may not be the most efficient use of resources and may be difficult to maintain.

Choice Response

Approaching selection, preparation, and consumption as choice responses has implications for how research is designed. That is, interventions need to be designed to increase these responses under environmental conditions in which there are several choices available (Rasmussen et al., 2016). For example, selection typically occurs in grocery stores or restaurants where there are many unhealthy options. Children at school will also have multiple food options available, including what their friends may have brought from home. Testing the various interventions reviewed in this article against one another for their relative effectiveness under typical choice conditions will be key to providing meaningful contributions to future healthy eating guidelines (DiClemente & Hantula, 2003). For example, Winett et al. (1988) evaluated various combinations of modeling and feedback procedures with shoppers in a grocery store. They compared video modeling, video lecture, and video participant modeling combined with no feedback, written feedback, and in-person, additional personal feedback conditions. They found that most change occurred during feedback conditions, specifically when combined with video modeling. Adding the extra personal interactions to the modeling didn't significantly improve healthy food selection.

If selection, preparation, and consumption are choice responses, then teaching someone how to choose, as an operant, is also relevant. Impulsivity, or the tendency to choose a reward that is smaller but available sooner, over something larger that is available later (Rachlin, 1995), has been found to be related to obesity. In particular, in the research on delay discounting, or the degree to which delay to an outcome reduces its value (as a measure of impulsivity), shows that individuals with a high percentage of body fat tend to discount at a faster rate (act more impulsively) than those with a low percentage of body fat (Rasmussen et al., 2010a). From this, one may conclude that addressing impulsivity as a target behavior might improve healthy eating. Indeed, several studies have indicated that providing brief 50-min mindful-eating trainings increases self-controlled choices for food (Hendrickson & Rasmussen, 2013, 2016; Stites, Singletary, Menasha, Cooblall, Hantula, et al., 2015). Taken together, these studies suggest that targeting impulsivity directly may help improve healthy food selection.

Temporally Delayed Behavioral Chain

In addition to choice, as a behavioral chain, healthy eating has several important characteristics. For example, there may be significant temporal delays between the components. This may influence an individual's decision at the point of selection, for example, the time to drive home from the store and to prepare food may be significant and delay consumption. Indeed, one way of breaking an inappropriate chain of responses is to introduce delay (see discussion by Cooper, Heron, & Heward, 2007). Thus, it is not surprising that individuals will select food that is available quickly, because the value of a food will decrease as the delay increases (e.g., Appelhans et al., 2018). This is particularly relevant for healthy eating, because the delay to consuming healthy food is typically longer than that of unhealthy food (e.g., time for preparing chicken and vegetables vs. microwaving pizza). There are several approaches to take

then in order to address this, including providing healthy food with little to no preparation required, teaching preparation directly to decrease time and effort, and teaching delay tolerance (e.g., mindful eating, Hendrickson & Rasmussen, 2013, 2016).

How such interventions affect not only selection, but also preparation and consumption is also warranted. Indeed, as mentioned previously, how many of the interventions in this article differentially effect each choice point is unclear. It's also unknown if there is value in addressing one, two, or all three choice points simultaneously. Indeed, if the focus is only on one point, shifts in the other choice points may not occur, and may have less of an effect on healthy eating as a result. For example, intervening on consumption may not affect selection or preparation. Indeed, if an individual doesn't select well (e.g., chooses no vegetables in a school cafeteria line) then there is no opportunity to consume healthy foods (desired terminal response). In addition, if individuals don't know how to cook food, it's unlikely that the taste will reinforce consumption. As such, more research is needed on how interventions that target only one response, affect others. For example, if tasting an item at a grocery store increases the probability of subsequent consumption more than a point-of-purchase prompt. Or, if a person has learned how to cook brussels sprouts, is that individual more likely to select brussels sprouts, prepare them, and consume them in the future? In addition, research needs to be conducted on the relative effectiveness of targeting selection versus preparation versus consumption responses.

Single and Multicomponent Interventions

With respect to targeting each of these choice points, although there has been extensive research, there seem to be several areas that deserve particular consideration for future studies. For example, the point-of-purchase literature has demonstrated that these types of prompts improve healthy food selection to some degree, but more research is needed around using other types of prompts (e.g., highlighting the smell or taste of the food; Bublitz & Peracchio, 2015) and content of the prompt (e.g., lack of aversive vs. presence of desired ingredients; Van't Riet, 2012). Environmental rearrangement, prepackaged healthy food, and tasting stations also need to be evaluated further (e.g., Sigurdsson et al., 2014; Steinberg & Yalch, 1978). Regarding preparation, BST has been utilized successfully to increase other behaviors (e.g., Johnson et al., 2005) and cooking should be no different. In addition, research should be conducted on prompts for cooking (e.g., shopping lists, recipes) specifically around complexity and how best to introduce and shape up responding around the number of steps, ingredients, etc. Finally, research on consumption should continue to evaluate how to best utilize tangible, social, and virtual reinforcement, particularly with respect to gamification (e.g., Cassey et al., 2016; Jones et al., 2014a; Morrill et al., 2016). How these methods can be used in combination with taste exposure to establish the taste of food as a reinforcer should continue to be examined. More research is also needed, particularly in the selection and preparation literature, with consequence manipulations. Most of the consequence research targets consumption and how these interventions either affect selection and preparation indirectly or how they would affect them more directly (e.g., gamification of food preparation) needs to be examined.

Much of the research in healthy eating, however, is multicomponent and addresses some combination of selection, preparation, and consumption responses. Although

many of these package interventions have been successful on some level, the relative contribution of each intervention is typically not evaluated (e.g., Epstein, Gordy, Raynor, Beddome, Kilanowski, et al., 2001; Epstein, Paluch, Beecher, & Roemmich, 2008). This is particularly problematic as monetary cost and response effort increase with additional interventions. Package interventions need component analyses to determine which aspects are necessary and which are not, and how best to optimize interventions to decrease financial expense and response effort. One example of this was the modification of some elements of the Food Dudes program to see if virtual reinforcement and automated progress through a comic script could maintain results (FIT Game, Jones et al., 2014a). Research is still being conducted in this area to further evaluate how best to implement the program and other package interventions could benefit from similar analyses.

In conclusion, although there is a great deal of research on the selection, preparation, and consumption of healthy foods, there are many unanswered questions. The relative effectiveness of each of the interventions on healthy eating and how they affect different points in the behavioral chain have yet to be examined. In addition, much of the literature focuses on antecedent interventions, and consequence interventions particularly for selection and preparation, need to be further explored. Some of the research also has methodological limitations, such as a lack of sufficient controls, is in a closed setting with limited choices or isn't a choice preparation, and evaluates only self-reported intentions to buy. Much of the research is also at the group level, which limits the conclusions that can be drawn for the individual. As such, the field of behavior analysis can help contribute to this important area through research in natural choice conditions and tracking the effect on actual selection, preparation, and consumption responses by individuals as well as groups. By doing so, this research may help inform individuals, families, schools, and other organizations on how they may adjust response requirements or environmental factors to increase healthy eating.

Compliance with Ethical Standards

Conflict of Interest The author states that there is no conflict of interest.

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