



12-13-2021

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Incorporating behavior analysis to address risk factors for obesity

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## Abstract

There is a rising prevalence for obesity in the United States. Obesity is associated with health issues such as heart disease, diabetes, and other health complications including worsened mental health. Because of this, it is important to look for effective solutions to address risk factors, such as overeating and a sedentary lifestyle, that are associated with obesity. Applied behavior analysis, the application of learning principles to socially significant issues, has potential in addressing factors that lead to obesity. Functional analysis and the antecedent-behavior-consequence (ABC) model can help explain “cause and effect” relationships between environment and behavior and why and how some behaviors occur from frequently over others. Some environmental factors can influence how an individual consumes, such as variety of food within certain food groups, distractions present when eating, portion size. Delay discounting, the devaluing of a reinforcer due to a delay, can also be useful in understanding how individuals become obese. Individuals who are obese display steeper discounting relative to controls, that is, prefer a smaller immediate reinforcer relative to a larger delayed one. Potential interventions based on the ABC model, such as changing discounting or manipulating antecedent and/or consequent stimuli, could be enhanced by individualized functional analyses. Goal setting and self-monitoring are also interventions to be considered. Although, there is support for a behavioral analytic approach to address risk factors associated with obesity, more research into specific areas, such as functional analyses of overeating, needs to be conducted to potentially improve clinical outcomes.

### Incorporating behavior analysis to address risk factors for obesity

According to a report from the National Health and Nutrition Examination Survey (NHNES), 39.6% of American adults are considered obese (National Health Interview Survey, 2015). From 1999-2000 through 2017-2018, the prevalence of adult obesity has increased from 30.5% to 42.4% according to the CDC (2021). The CDC found that among children and adolescents the prevalence for obesity is 18.5% and 13.7 million children and adolescents are considered obese (CDC, 2019). How an individual is determined to be obese, or overweight is typically by their Body mass index (BMI). BMI is a measure of body fat based on height and weight that applies to adult men and women (National Institutes of Health, n.d.). To be considered overweight the BMI would fall within the range of 25.0 to <30 and to be considered obese the BMI would fall within the range of 30.0 and higher. Although BMI is not the perfect system in determining the measure of body fat because it does not consider sex, body structure and distribution of fat, it can be still used to determine basic health (Rothman, 2008). Being obese is a major risk factor for heart disease, the leading cause of death in Americans (CDC, 2021). Along with increased risk of heart disease, obesity can also lead to type 2 diabetes, high blood pressure, sleep apnea with breathing problems and other health complications (CDC, 2021). Behavioral factors associated with obesity are a sedentary lifestyle and high calorie diets. These same factors have also been associated with worsened mental health. There is a negative stigma associated with obesity implying people who suffer obesity are responsible for the weight gain because it is assumed that they might be lazy or that they might not have the determination to get back to a healthy lifestyle. This is because emphasis is placed on individual responsibility rather than external factors. As a result, this causes people who are obese to also suffer from depression, anxiety, and declining self-esteem (WHO, 2017).

Even though there is a robust association between obesity and deleterious effects on physical and mental health, its prevalence in Americans continues to increase. Moreover, if a person was overweight as an adolescent, they were 70% more likely to remain overweight into adulthood (Barlow & Dietz, 1998). These adolescents are more likely to develop serious health conditions for example, diabetes. Diseases such as type 2 diabetes is linked with obesity (Leitner et al., 2017) and in the past it was usually seen in adults, however with the rising numbers of obesity it can now be also seen in younger children. Because of the health effects of obesity and its incidence has and continues to rise, identifying and addressing factors related to obesity that can be easily implemented is of the utmost importance.

### **Addressing Obesity**

While obesity is related to genetic and environmental factors, individuals can only meaningfully affect personal risk factors of obesity via behavior change using evidence-based interventions (Wakefield, 2004). Applied behavior analysis (ABA) is the application of principles of learning to predict and control socially significant behavior for the benefit of the individual while emphasizing observable behaviors (Baer et al., 1968). According to Skinner (1953) a functional analysis is the identification of the external variables by which behavior is controlled, demonstrating a “cause and effect” relationship between environmental factors and behavior. “The term *function* refers to *characteristic effect* produced by either a behavioral or an environmental event” (Pierce & Cheney, 2017, p. 33). Functional analyses are at the core of applied behavior analysis as one of the core tenets of behavior analysis in identifying functional relationships between contexts that precede behaviors, and the consequences that follow behavior to influence how likely a behavior is to occur. Historical relationships between behaviors and the events that surround them help to provide context for why individuals continue

or cease engaging in certain behaviors. Functional analysis is a part of Functional Behavior Assessment (FBA). FBA is used to address problematic behaviors by identifying variables that are to be targeted to create interventions to help reduce occurrence of the problematic behavior (Horner, 1994). This type of analysis has proven to be effective in empirically identifying variables that trigger a problematic behavior (Carr, 1994). It is important to understand why and what is maintaining a problematic behavior to create interventions to decrease the frequency of the problematic behavior, and this is important in making the intervention effective.

ABA emphasizes interventions catered to each individual to solve problem behaviors, ideally by identifying the functional relationships between behavior of interest and the environment. This allows more investigation on the events that reinforce (i.e., increase or maintain) maladaptive behavior using functional analysis or alternatively identify events that may punish (i.e., decrease) certain behaviors. To help promote identification of relationship between environment and behavior, the antecedent-behavior-consequence (Cooper et al., 2019) model is used. This model can be used to help identify what changes a behavior, why a certain behavior is occurring, what is triggering that behavior and what are the consequences of that behavior.

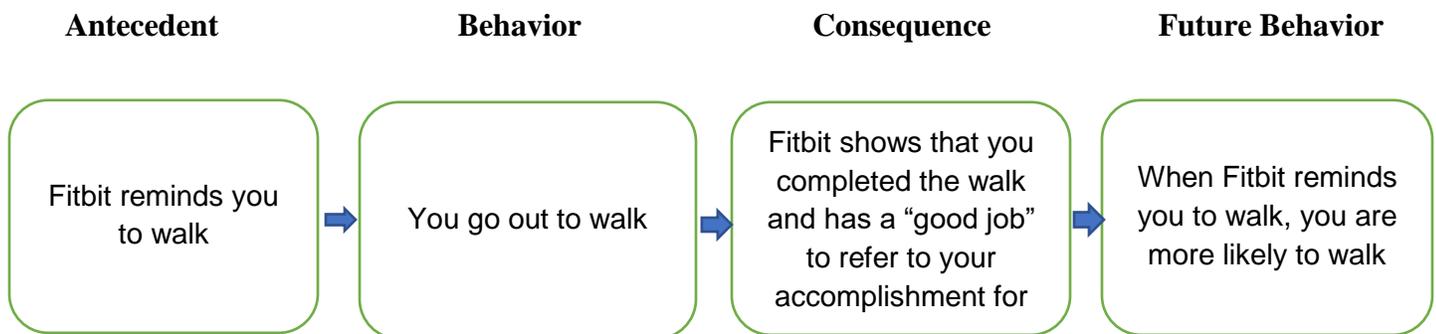
In a situation or setting (also discriminative stimulus;  $S^D$ ), the behavior (also response; R) engage with the environment resulting in consequences (also stimulus that follows the response;  $S^r$ ) (Pierce & Cheney, 2017).

Antecedents ( $S^D$ ) are events or situations that increase the likelihood of a behavior being emitted. This event occurs or is presented before the behavior occurs. Environmental factors, social factors and verbal behavior of another person can trigger or initiate a behavior. Learning the antecedents of a certain behavior can be useful in figuring out how to manipulate the trigger

of a certain behavior to either decrease or increase the chances of the behavior occurring in the future.

Behaviors (R) are the defined, observable actions of the individual and it follows the antecedent. Behaviors can either be adaptive or maladaptive based on their effects on the individual.

Consequences ( $S'$ ) refer to the outcomes that are a result of the behavior. It can either increase or decrease the frequency of the behavior. The consequences or the outcomes of the behavior can help determine whether there is a need to increase the frequency of a certain behavior or decrease it. This model can conceptually be applied to some of the behavioral risk factors to obesity (e.g., sedentary lifestyle, overeating). Figure 1 is an example of how the ABC model could be applied to increasing physical activity.

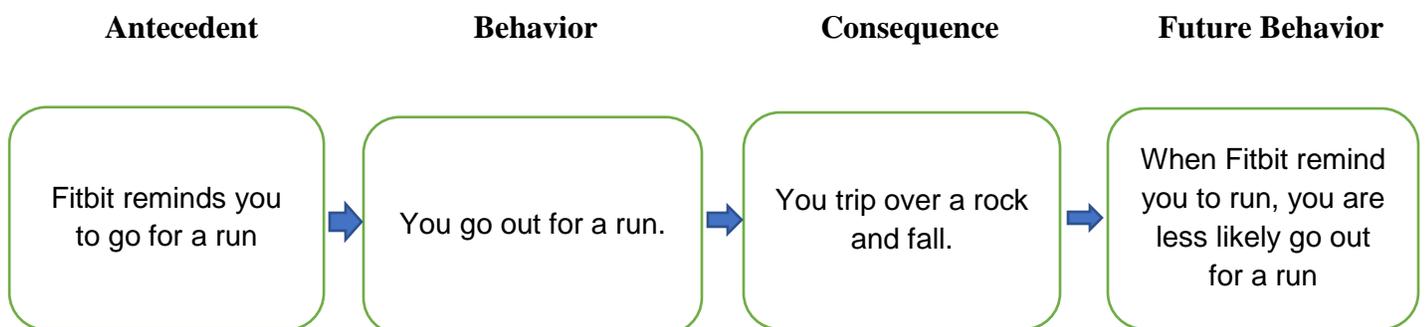


*Figure 1.* This example shows how the behavior of going out to walk in the future increases using the ABC model. Antecedent, which is the situation that occurs before the behavior, in this case the Fitbit sends a reminder to walk. The behavior that occurs due to this reminder is this individual going out for a walk. Consequence which is the outcome of the result of the behavior is that Fitbit sends a “good job” notification for completing the walk. In future, the behavior of going for a walk will increase when receiving the notification from Fitbit to go on a walk.

Referring to Figure 1, the individual in future, will more frequently go on that walk to accomplish the task of going on that walk and to receive the “good job” which is a form of praise. This increases the frequency of the behavior of that individual to walk more frequently.

Understanding that completing a task and receiving praise is what increases the “wanted” behavior to walk more is a knowledge that can be used to increase this behavior.

However, this model can also help explain why some people may not engage in healthy lifestyle choices. For example, if an individual got hurt when exercising, if an individual got hurt when going out for a run, this will decrease the likelihood of the individual going out for a run in the future. Below (Figure 2) displays this using the ABC model.



*Figure 2.* This example shows how the behavior of going out for a run in the future decreases using the ABC model. Antecedent, which is the situation that occurs before the behavior, in this case is that the Fitbit reminds this individual to go out for a run. This antecedent leads to the behavior of going out for a run. In this example, this individual trips over a rock and falls. The consequence, or the result of this behavior is that this person is in immense pain. In future, when this individual receives the reminder from the Fitbit to go out for a run, this individual is less likely to go out for a run.

The situation in Figure 2 illustrates that this individual got hurt when they went out for a run, and this may be the cause of why this individual’s behavior of going out for a run decreased. Understanding this, can help create effective intervention to increase the frequency of this individual running in the future.

It is important to note that this general model can be applied to more proximal and distal consequences, with a larger emphasis on proximal (i.e., immediate) factors and consequences. However, this model can still be broadly applied to long-term outcomes or consequences and is discussed later.

When creating interventions, a functional analysis is typically done to determine the environment an individual is in and to determine which reinforcers would be more effective. Lack of physical activity in adolescence is a strong predictor of obesity in young adulthood, therefore reinforcing the importance of encouraging physical activity as a means of obesity prevention (Pietiläinen et al., 2008). Ladabaum et al. (2014) study found that it is lack of exercise that seem to play a major factor in the rising prevalence for obesity. When possible, a functional analysis is conducted to determine the function of a behavior by observing causes and consequences of a particular behavior. Applied behavior analysts specialize in the organization of the antecedents and consequences that affect the behavior of the individual, therefore applied behavior analysts or anyone using the knowledge of functional analysis (Skinner, 1953) and understanding the ABC model (Cooper et al., 2019) can help create interventions to target and decrease the frequency of unhealthy lifestyle behavior. This is where behavior analysts can come in and investigate the unwanted behavior and determine the most effective intervention for an individual.

For example, (Larson et al., 2013) conduct a functional analysis of physical activity on children to investigate whether manipulating certain variables would increase or decrease the behavior of engaging in physical activity. The results of the study concluded that when children were engaged with some form of attention, the children were more physically active.

### **Antecedent Factors**

Some of the factors that can influence consumption are how the food is presented such as food being cheap or receiving food that is more convenient or the portion size of the food. This can lead to the behavior of overeating food as these factors reinforce the behavior of eating it for example, in the case of food being cheap, the consequence is eating and saving money. Food is

usually served exceeding the recommended portions and this exposure to the portion size can influence how much a person will eat. Although there are systemic factors that also influence overeating, such as low-cost high caloric foods (Brantley et al., 2005), only individual-level issues will be described.

### **Variety of food supply**

A variety of food supply contributes to the prevalence of obesity. When presented with a meal with a lot of variety it increased food consumption and a diet with greater variety is associated with increased body weight and fat (Raynor & Epstein, 2001). A single meal consisting of various taste, texture and appearance stimulates consumption (Johnson & Wardle, 2014). In most food groups, when variety of food was present, it increased food consumption however, this is not true for food groups involving fruits and vegetables (McCrorry et al., 1999). When there was a variety of food within the food group of fruits and vegetables, it was not associated with obesity. In a study conducted in Hong Kong found that a variety of snack food over one week was associated with obesity, whereas a variety of grains and meats was not associated with obesity (Sea et al., 2004). This concludes that individuals who suffer from obesity tend to consume a variety of food within certain food groups over others. Therefore, encouraging to eat a variety of fruits and vegetables is an intervention to consider.

### **Distraction**

When eating people usually watch tv or do other things that are distracting. While distracted people are less aware of when they become full therefore taking longer to feel full. Studies done show that when a tv show is familiar food intake in women increases. TV viewing also made the female participants insensitive to interoceptive cues across a meal (Braude & Stevenson, 2014). In addition to that, this effect lasts throughout the day as this causes disruption

to awareness of how full you are which causes you to be more likely to eat more later in the day. Studies show that distraction during eating increased later snacking and reduced meal memory. Mindful eating reduced the likeness of snacking later suggesting attentive eating may be a condition to consider when forming interventions to help with overeating (Higgs, 2015). When practicing mindful eating, it involves learning to pay more attention, therefore increasing awareness, and contributing to the ability to make healthier choices (Baer et al., 2005). Mindful practices have been associated with weight loss (Forman et al., 2009), decreased BMI (Tapper et al., 2009) and decreased food cravings (Alberts et al., 2010). When creating interventions, implementing mindfulness should be a factor to be considered.

### **Portion size**

A study was conducted to see whether visual cues and portion size of the food influenced intake of the food. Participants in the study who ate from refilling bowls unknowingly ate more soup compared to the other group who ate soup from a normal bowl. The results show that despite eating 73% more, the participants did not feel more satiated than those eating from the normal bowl. These results were uninfluenced by BMI. These findings show that increasing portion size increases consumption (Wansink et al., 2012).

Studies consistently show there is a positive correlation between portion size and how an individual would consume food (Freedman & Brochado, 2010; Kral et al., 2004; Steenhuis & Vermeer, 2009; Wansink et al., 2005; Wansink et al., 2006). Individuals who are overweight or obese are more prone to overeating when they are served a larger portion size (Burger et al., 2011).

There are aids such as the Portion Size Measurement Aids that help visually identify how much food must be served for example by using parts of the hand (Byrd-Bredbenner &

Schwartz, 2004) however, they did not prove to be very effective when teaching this method to the children (Foster et al., 2009). In Applied Behavior Analysis the concept of stimulus equivalence that describe how relations can be formed among stimuli. In Applied Behavior Analysis the concept of stimulus equivalence is a situation in which two or more related stimuli elicit the same response (Pierce & Cheney, 2017). Stimulus equivalence has been used to successfully teach a variety of skills (Fienup & Critchfield, 2010; Toussaint & Tiger, 2010; Walker et al., 2010). To test the hypothesis, in one study (Hausman et al., 2014), participants were taught to estimate one-half cup portion size of Cheerios without any measurement aid. After several session, most of the participants were precisely hitting the intended portion size of Cheerios. The results of this study proposed teaching individuals who are overweight to accurately measure the portion size as portion size seems to play a significant reason as to why someone may gain weight. The limitation of this study for this purpose is that there has not been any study done as to whether the ability to learn how to accurately estimate portion size can help someone consume less however, the theory is that it is possible.

### **Consequent Factors**

Studies theorize that obese individuals would most likely prefer unhealthy high-caloric food compared to healthy food, however, results of these studies show otherwise. Study conducted by (McKenna et al., 2016) hypothesized that there is a preference for high-caloric food amongst obese individuals, however when the results of the self-reports were assessed no such tendencies were found. Craeynest et al. (2005) conducted a study including children who are obese and a control group to see their preference for unhealthy food and their attitude towards physical activity. It was hypothesized that the children who were obese would lean towards unhealthy food compared to the control group and prefer sedentary activities compared

to the control group. However, there were no such biases found. Children who were obese preferred food in general and not just unhealthy food. When understanding why people lean towards eating unhealthy food it is because of how cheap it can be, its convenience, it's added factor of food being tasty with the combination of all salty, sweet, and finally, this preference for unhealthy food can be traced back to good marketing by fast food restaurants. This implies that creating interventions such as by removing oneself from stimuli that may trigger behavior that contribute to unhealthy habits should be considered. An example would be not going to fast food restaurants, in turn the individual will not be exposed to unhealthy food, therefore helping prevent the individual from indulging in unhealthy food.

### **Preference for Immediate versus Delayed Outcomes**

Unhealthy food lacks a good balance of nutrients which has high fat/sugar content. It is overconsumption of food with an unhealthy balance of nutrients that lead to obesity (Jacques et al., 2019). A factor that seems to be related to overeating, and thus obesity, is preference for smaller immediate outcomes over larger delayed ones. Those who tend to choose the more advantageous, delayed, outcome is considered to have more self-control. However, those who engage in unhealthy eating typically prefer the smaller immediate outcome, indicating less self-control relative to controls. For example, the choice of eating chips that is next to an individual versus going out to the gym to exercise. The chips that are next to this individual can be easily reached out to and consumed and generally it is tasty as well, therefore making eating chips an immediate reward. To go work out is to ignore the immediate reward that is just in reach and focus on the reward long term which is being healthier. Although, the chips are an immediate reward, in the long run it does contribute to obesity but delaying the reward would contribute to better health long-term. Delay discounting measures the degree to which an individual is driven

by immediate gratification versus the possibility of a larger but delayed reward or reinforcer (Pierce & Cheney, 2017). If an individual chooses the immediate smaller reinforcer/reward over the larger, delayed reinforcer/reward it would indicate that the individual displays a higher rate of delay discounting. This means that these individuals are more likely to be able to have self-control which is a preference for a “better” delayed option relative to the immediate “worse option”.

Impulsive choice is defined as choosing a small immediate reinforcer over a larger and delayed reinforcer. Impulsivity plays a major role in learning how people who are obese prefer choosing smaller and immediate reward over the larger, delayed reward. On the other end of the spectrum is self-control, which is choosing a large, delayed reinforcer over the smaller immediate reinforcer (Pierce & Cheney, 2017, p. 317). Since an impulsive choice is about choosing the smaller immediate reinforcer, lack of premeditation and lack of perseverance to amplify the effect of the smaller immediate reinforcer/reward. Data shows that obese persons usually also have increased levels of urgency, lack of premeditation, lack of perseverance and are sensitive to rewards (Mobbs et al., 2010).

Individuals who are obese tend to display less preference for delayed outcomes, indicating increased discounting (Bickel, et al., 2014; Borghans & Golsteyn, 2006; Ikeda, Kang, & Ohtake, 2010; Jarmolowicz, et al., 2014; Weller, Cook, Avsar, & Cox, 2008) (i.e., higher preference towards immediate rewards) compared to controls. With delay discounting it can be determined that, people who are obese have a higher rate of impulsivity therefore, forming a barrier from helping them choose a delayed reinforcer instead of the smaller reinforcer which provides immediate gratification. Individuals with increased discounting display behavior that harmful behavior such as addiction and has associations with obesity. This may be why people

who prefer smaller and immediate rewards over larger and delayed rewards are more likely to be prone to poorer health consequences (Deshpande et al., 2019).

As established, self-control issues are linked to impulsive eating behaviors, and since self-control can be adequately established by psychological interventions, to help overcome the problems of dealing with obesity, psychological interventions or targeted interventions to behaviors would be more effective (Mobbs.et.al., 2010) instead of just focusing on dieting to deal with obesity. So far research shows that targeted interventions to behaviors dealing with self-control or impulsivity can be more effective to help prevent weight gain and this may be the key to help curb the obesity epidemic (Hill et al., 2003).

### **Interventions Targeting Obesity Risk Factors**

While obesity cannot be directly intervened upon, there are interventions that can target the risk factors that either lead to or sustain obesity. Individual interventions should focus on increasing healthy behavior and decreasing unhealthy eating habit. Behavioral contingencies would be beneficial because these interventions can be used to encourage and reinforce healthy eating and habits (Freedman, 2011, p. 47). The following sections will overview some of the ways that antecedents and consequences have been manipulated to improve behaviors such as overeating or how exercising was implemented. Because all interventions discussed generally involve both antecedent and consequent manipulations, they are instead organized on immediate and delayed interventions.

### **Interventions emphasizing immediate antecedents/outcomes**

One way of manipulating antecedents is to nudge consumers towards buying healthy food such as fruit and vegetables. In the U.S. roughly 23% of adults report to have consumed vegetables less than one time per day, however the recommendation for consuming vegetables is with every meal (McGuire, 2013). Nudging according to Thaler and Sunstein (2008) is “any

aspect of the choice architecture that alters people's behavior predictably without forbidding any options or significantly changing their economic incentives" (Carroll et al., 2018) found that displaying healthy food in grocery stores encourages consumers to buy more fruits and vegetables. Decreasing accessibility to unhealthy foods is another way to manipulate the environment and nudge consumers towards eating healthy food. Making unhealthy food less accessible decreases can reduce the intake of unhealthy food by 8-16% (Rozin et al., 2011). An organization that has implemented nudging and concepts of behavioral economics in the cafeteria at Google's New York office (Kuang, 2012). To reach for M&Ms, one would have to reach into opaque bins making effortful and the result of this intervention has decreased caloric consumption of candy by 9% in one week. Other interventions placed include, placing the salad bar near the entry, making more people get salad for their meals. Placing flyer informing about how portion size can increase food consumption does not by itself change behavior but it "nudges" the consumer to watch out for the portion size and that increased the usage of small plates by half. Moving bottled waters to eye level in coolers and moving soda to the bottom shelf has increased water intake by 47%, and caloric intake from sodas decreased by 7%.

In a study conducted by Larson et al. (2013) participants consisted of two healthy weight children. During baseline, no interventions were administered. During interactive play condition, the experimenter interacted with the participant if the participant engaged in physical activity however, if the participant did not engage in physical activity, the participant was ignored. During the praise intervention, if participants engaged in physical activity, praise was provided. For the escape intervention, escape from work was provided if the participant engaged in physical activity and for the alone condition, no consequences were provided. In control condition an experimenter colored with a participant near the playground but did not provide any

consequence for whether the participant engaged in physical activity. Results displays an increase of physical activity in conditions of interactive play and when attention was provided contingent on whether the participant engaged in physical activity. This study indicates on how to promote physical activity amongst children.

In another study conducted by Belot et al. (2016) used the concept of token economy to create interventions to encourage fruits and vegetable consumption. Token economy is a reinforcement based on token reinforcement where an individual exchange tokens to receive reward, good or services (Pierce & Cheney, 2017). Students in a primary school were given stickers for choosing vegetables or fruits at lunch. In this case stickers are tokens. The students could receive another reward at the end of the week depending on how many stickers they had received; this is an example of token economy. There was an increased consumption of fruits and vegetables however, the effects of this did not last six months later.

### **Interventions emphasizing delayed/bridged outcomes**

Rule-governed behavior refers to the behavior when the listener's or reader's performance is affected by contingency-specifying stimuli (Pierce & Cheney, 2017, p. 386). According to Skinner (1969), rules, instructions, advice, and laws are contingency-specifying stimuli. Rule-governed behavior is behavior that is maintained by and controlled by verbal behavior and is maintained by indirect acting consequences. For example, in an everyday context, when crossing the street an individual would look left and right before crossing even though the individual may have not experienced anything bad when crossing the street, However, the behavior of looking left and right before crossing the street is under the control of the verbally mediated rule, "If I cross the street without looking left and right, I may get hurt or killed". An example of rule-governed behavior relevant to obesity would be when patients

follows advice given by doctors to reduce portion size. Goal setting and self-monitoring are forms of interventions that involved rule-governed behavior that have been applied to risk factors of obesity.

### ***Goal Setting***

Creating goals helps aiming to reach a certain objective and holds the individual to reach the goal. Accomplishing these objectives can serve as positive reinforcement therefore increasing the frequency of the behavior to meet the set objectives. Further reinforcement can be provided by rewarding yourself when the goals are met. Although the long-term goal is to lose weight, it is important to create specific goals to begin the weight loss treatment. Specific goals or short-term goals are objectives you want to accomplish soon for example in a week or a month. Some examples may be eating healthy four times a day or exercising for two to three hours every alternate day. This ensures a clear evaluation of progress of meeting the long-term goal. In the programs using a behavioral approach, participants usually have a target for each week for their daily average intake and the number of minutes spent on physical activity. At the weekly meeting these goals and the progression of meeting these goals are discussed. The participants have been reported to recognize the accountability for the weekly check-in and appreciate it. During these sessions, other goals of specific behavior are set that maintain and improve weight management habits. When stating the goals, the participants are advised to be as clear as possible regarding the when and how the goals will be accomplished (Butryn et al., 2011).

A study conducted by VanWormer (2004) assessed the effect of using a pedometer (device that counts each step a person takes) and attending a brief e-counseling session. The participants included three over-weight adults and the goal of the study was to increase physical activity and lose weight. In the study the participants were required to self-record the steps taken

and their weight at the time each week at home. In the brief 10-min counseling session, the participants discussed setting goals for the week with the experimenter. This study included both goal-setting and self-monitoring. All participants daily number of steps increased during treatment. One participant's steps were higher in the self-monitoring with the counseling phase than just the self-monitoring phase. Although, an increase in the number of steps taken is generally positively correlated with weight loss, one of the participants that had lost weight gained some of the weight back during a follow up session. The limitation of this study was that the study had a smaller number of participants however, the results propose that providing pedometers to self-monitor and help setting goals to individuals who are overweight can help decrease weight.

### ***Self-Monitoring***

Self-monitoring is self-recording target behaviors being met. Self-monitoring shows constant feedback on whether there is progression, decline or if it is being kept steady (Butryn et al., 2011). A study conducted showed that participants who self-monitor had a significant weight loss (Baker & Kirschenbaum, 1993). Looking at data showing results of decrease in weight can also provide positive reinforcement. In the case the weight loss program is not working, these recorded data can give information on where the problem lies and how to solve it. Self-monitoring can also be used to help modify plans to maximize the impact of the weight loss program. Many apps are available to help track progress of weight loss. In the programs where the behavioral approach is implemented, participants consistently observed their progress by recording food and beverages consumed along with calorie intake and minutes of physical activity (Butryn et al., 2011).

<b>Monitoring Record</b>
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<b>Day of Week</b> <u>Monday</u>		<b>Date</b> <u>7/26</u>	
<b>Time</b>	<b>Food: Amount &amp; Description</b>	<b>Calories</b>	
7:00 AM	Cheerios, 1 cup	100	
	Skim milk, 1.5 cup	45	
	1 small apple	55	
	Orange juice, 6fl. Oz.	84	
10:00 AM	1 medium banana	105	
1:00 PM	Turkey sandwich		
	2 oz. turkey	60	
	1 tbsp light mayo	50	
	2 slices whole wheat bread	140	
	1 slice tomato	5	
	1 light yogurt	100	
	1 chocolate chip cookie	50	
3:30 PM	1 oz. pretzels	108	
6:30 PM	3 oz. chicken breast, roasted	140	
	1 small baked potato with 1 pat of butter	164	
	1.5 cup chopped broccoli	27	
<b>Daily Total</b>		1233	
<b>Type of Physical Activity</b>		<b>Minutes</b>	
	Brisk walking	25	

*Figure 5.* This figure is an example of self-monitoring record from the study conducted by

Butryn et al. (2011). Self-recording number of calories consumed, like how it is listed in the figure and recording the amount of physical activity accomplished are forms of self-monitoring.

### Discussion

Understanding functional analysis (Skinner, 1953) and the ABC model (Cooper et al., 2019) can help identify the “cause and effect” relationship between environmental factors and

behavior by indicating why and how a frequency of a behavior is increasing or decreasing. Using that information can help understand why an individual is overeating or not exercising and can be useful in creating interventions to achieve “wanted” behavior. Employing the concept of functional analysis Larson et al. (2013) created interventions to determine which conditions was more effective in getting participants to engage in physical activity and results produced identified conditions that increase the behavior of participating in physical activity. and Delay discounting is a model that can show an individual’s preference for smaller immediate gratification or larger delayed gratification (Pierce & Cheney, 2017). Changing discounting reduced significantly by employing methods of future episodic thinking to produce lasting effects when decision making (Rung & Madden, 2018). Learning-based manipulations also has lasting effects in changing discounting.

Although, these approaches have promising results there are limitations of these studies that need to be addressed. For the study conducted by Rung & Madden, (2018) more translational research needs to be done to decide the generality and clinical utility of these methods. Although Larson et al. (2013) was able to identify which intervention would increase behavior of engaging in physical activity, the participants of for that study consisted of only two children, therefore, decreasing the chances of generalizing the study without further research. In the Belot et al. (2016), even though the intervention to give children sticker if they picked fruit or vegetable for lunch was effective, these results did not last beyond six months.

There seems to be research done on how obese individuals have a steep delay discounting, but there hasn’t been enough translational research done on using this knowledge to create interventions to decrease behaviors that contribute to obesity. Another factor to consider is to understand whether people who overeat prefer immediate reward or do prefer immediate

reward overeat. For future directions, researchers should consider using the knowledge of delay discounting, reinforcer pathology to create interventions by teaching and reinforcing proper portion control, healthy eating habits and increasing physical activity. It is also suggested to incorporate functional analyses to identify effective reinforcers for increased physical activity and making healthier food choices. Using functional analyses can help identify conditions under which the behavior(s) of interest would be most likely to (not) occur, tailoring interventions to the individual, and potentially resulting in better outcomes.

Other factors that should be considered is creating legislations to reinforce healthy eating habits can be beneficial. One of the countries that imposed “junk food” tax is Hungary. World Health Organization, (2015) investigated the results of the tax imposed by Hungary and it showed that consumption of junk food decreased because of the tax and the effort to educate the public about the tax placed. 7-16% of the consumers of unhealthy food who surveyed has chosen a cheaper, often a healthier option. 5 -16% consumed less of the unhealthy product and 5-11% switched to a different brand or substituted to another food often to a healthier alternative. Pomeranz et al. (2018) found that the Hungary model, imposed tax based on the nutritional value of the food therefore compelling 40% of the junk food manufacturers to modify their recipes to make their product healthier. The socioeconomic status of an individual can also be a factor to consider since unhealthy food is usually cheaper, that is the kind of food preferred by the group in lower socioeconomic status. In this case a government’s initiative to impose tax or regulate the sugar content and reinforce serving appropriate portions can have an impact on how individuals consume food.

### **Conclusion**

The prevalence of obesity is increasing and due to associated health and mental issues, the obesity epidemic needs to be addressed. Using behavioral analytic approach such as using the ABC model, and functional analyses, it is possible to create effective interventions to address risk factors that contribute to obesity by promoting healthy habits. Although research indicates the efficacy of using this approach, more needs to be done to identify the most effective interventions to address risk factors for obesity.

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