Anchoring Energy Intake and Expenditure Estimations to Adjust Nutrition and Exercise Decision Making

by

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Abstract

People frequently make decisions that might affect their health. Food consumption and physical activity are two pivotal determinants of good health. Frequently, people fail to estimate energy intake accurately (Carels, Conrad, & Harper, 2007) and are unaware of energy expenditure necessary to sustain a healthy balance (Mertz et al., 1991). Numerical anchors may be one method to improve estimations needed for good health. This research examined how implementing numerical anchors on nutritional intake and energy expenditure may influence decision making for health-related behaviors in two studies. In Study 1, participants were assigned a numerical anchor for calories (high, low, and no anchor) and completed a choice task for nutritional intake (i.e., choosing food and beverage preferences). Results indicated anchoring calories was an ineffective method to influence nutrition choices. Participants appeared to make selections on preference for each item instead of quantity of the item. In Study 2, participants were assigned numerical anchor for calories to burn (high, low, and no anchor) and completed a choice task for energy expenditure (i.e. choosing physical activity preferences). Results indicated anchoring calories to burn was an ineffective method to influence exercise choices. Participants appeared to make selections on preference for each activity instead of duration of the activity. Implications for these findings would suggest strong preferences for nutrition items and exercise activities create a significant barrier for anchoring to have an effect of choices in these areas. Limitations and alternatives for future research anchoring nutrition and exercise behaviors are discussed.

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Anchoring Energy Intake and Expenditure Estimations to Adjust Nutrition and Exercise Decision Making

The increased prevalence of obesity and cardiovascular disease are two significant indicators of concern in public health. Poor nutrition and inadequate exercise contribute to the development of obesity and cardiovascular disease and are considered major contributors of death in the United States each year (Mokdad, Marks, Stroup, & Gerberding, 2004). Currently over a third of the American population suffers from obesity (Ogden, Carroll, Kit, & Flegal, 2012) and nearly 600,000 people die from cardiovascular disease each year in the United States according to the National Center of Health Statistics (Murphy, Xu, & Kochanek, 2013). Behaviorally, the development of obesity is believed to be a product of daily energy intake exceeding daily energy expenditure (Hill & Melanson, 1999). Creating an energy balance can be accomplished by incorporating proper management of caloric intake and adequate amounts of physical exercise. Thus, establishing a balance between intake and expenditure can contribute to reducing health concerns that commonly occur from overconsumption.

Establishing a healthier lifestyle can be a challenging goal for many people. Food consumption and physical activity levels are two pivotal determinants of good health. However, people routinely struggle to properly evaluate and regulate food consumption and physical activity to realize significant health improvements. Frequently, people fail to estimate energy intake accurately (Carels, Conrad, & Harper, 2007) and are unaware of energy expenditure necessary to sustain a healthy balance (Mertz et al., 1991). One strategy that may impact intake and expenditure estimations is by implementing numerical anchors. An anchor can be characterized as a numerical reference point which can bias a decision maker evaluating information "toward the initial value" (Tversky & Kahneman, 1974, p. 6). Research has

demonstrated numerical anchors are effective methods of influencing judgments (Wilson, Houston, Etling, & Brekke, 1996). Because people struggle to make accurate judgments for energy intake and expenditure, anchoring this information could bias a decision maker toward a recommended value. Thus, applying numerical anchors associated with food intake and exercise duration could assist decision making to improve health behaviors. Accurately regulating energy intake and expenditure may facilitate improvements for health-related issues, such as obesity and cardiovascular disease.

Studies examining the effects of anchors on choice are often designed similarly to the original concept introduced by Tversky and Kahneman (1974). Initially, participants are frequently asked to determine the accuracy of a given anchor. For instance, "Does a candy bar have more or less than 1000 calories?" in which the anchor is "1000 calories" and participants respond by indicating it has fewer or greater calories. Participants are then asked to make a judgment on the approximate number of calories for the item. For example, "What are the total calories for a candy bar?" The reference point established by an arbitrary numerical anchor has the ability to bias judgments and estimations for an unknown quantity. There is a fairly substantial amount of evidence to support these findings (Chapman & Johnson, 1999; Epley & Gilovich, 2005; Jacowitz & Kahneman, 1995; McElroy & Dowd, 2007; Plous, 1989). Consider the study conducted by Jacowitz & Kahneman (1995) where participants were asked to estimate the length of the Mississippi river after determining the accuracy of an initial anchor (e.g. 2,000 miles long for high anchor participants and 70 miles for long for low anchor participants). Results revealed participants who received the high anchor estimated river length to be 1,500 miles while low anchor participants estimated river length to be 300 miles. Thus, there was a clear bias in subsequent estimations of river length from the initially presented value. Thus,

anchoring could prove powerful enough to bias cognition of estimations associated with health-related behaviors.

The concept of anchoring to influence judgments has been an effective technique in a variety of circumstances. For example, anchoring manipulations include personal alcohol consumptions estimations (Lombardi & Choplin, 2010), where participants demonstrated a tendency to estimate greater personal consumption of alcohol when anchored to higher average consumption rates among a college population. Additionally, anchoring has been an effective technique influencing consumer purchasing decisions (Ariely, Loewenstein, & Prelec, 2003). Ariely et al. (2003) asked participants to consider purchasing a product for a dollar value equal to the last two digits of their social security number. After the initial accept or reject response, participants reported the maximum price they would be willing to pay with participants anchored to a higher dollar value equal to the last two digits of their social security number willing to pay a higher price (Ariely et al., 2003). The current research aimed to implement an anchor for energy intake (i.e. calories consumed) and expenditure (i.e. calories burned) totals to serve as a reference point to influence health-related decisions regarding nutrition and exercise. Susceptibility to numerical anchors can impact the decision making process and could positively shift behaviors toward healthier choices by exploiting a reference point designed to increase physical activity or reduce overconsumption. Anchoring may be a useful approach for establishing an energy balance between diet and exercise.

The current research examined the effectiveness of anchoring for daily energy intake and expenditure to influence food consumption and exercise duration amongst a college population. In subsequent sections, a background on the effects numerical anchors have on decision making is explored and the circumstances when individuals are increasingly susceptible to a given

anchor are examined. Next, the significance of energy intake and expenditure on health and logic behind anchoring these values are described. Lastly, two studies investigated the effects of implementing a numerical anchor for energy intake and expenditure to influence food consumption and exercise duration is described, respectively.

Heuristics and the Anchoring Effect on Choice

Choices frequently occur with some degree of uncertainty. Tversky and Kahneman (1974) demonstrated judgments can often be biased because of uncertainties when making a decision. In general, Tversky and Kahneman (1974) argued people will rely on a set of principles known as heuristics to quickly reach a conclusion for a choice or solution to a problem rather than extensively calculate the probabilities associated with the uncertainty to optimize a decision. Often, heuristics identify a specific attribute that is easily accessible to reach a conclusion. The process allows an individual to make a decision while examining fewer cues, reducing effort to evaluate cues, and eliminating consideration of alternative solutions (Gigerenzer & Gaissmaier, 2011). Thus, a trade-off exists in the potential accuracy of a decision for the cost associated with greater effort. Consider consumer purchasing behaviors. Brand recognition is a common example of relying on heuristics to reach a decision. Rather than evaluating the quality of the item, people will often assume popular name brands to be a superior product. For instance, in a study assessing the taste preferences of jars of peanut butter, people were more likely to prefer the less popular brands when labels were removed eliminating the cues of brand recognition (Hoyer & Brown, 1990).

Heuristics are typically described as intuitive or rapid responses that reduce the complexity of choices by relying on mental shortcuts rather than extensive calculations for a decision (Shiloh, Salton, & Sharabi, 2002). People will use various heuristic strategies when

evaluating uncertain outcomes for a choice. For example, someone may estimate the calories of an item at a restaurant without nutritional information by recalling similar items when nutritional information was known. The retrieval of previously learned information, in this case calorie content of a similar item, can act as a substitute when current information is incomplete. This is an example of the availability heuristic. Many studies demonstrate circumstances where heuristics can lead to accurate decisions (Goldstein & Gigerenzer, 2008; Todd & Gigerenzer, 2003). However, the quick, intuitive responses associated with heuristic strategies also result in biased choices that may be susceptible to errors in the decision making process. When estimating calories at a restaurant for example, if an individual is unfamiliar with the preparation of the item, such as oils and butters the restaurant may include, the estimation could be substantially inaccurate. Thus, it is possible heuristics produce biased estimations when uncertainty is present. Additionally, uncertainty creates an opportunity to bias estimations by anchoring a person to an initial value when making a decision (Tversky et al., 1974). The anchoring and adjustment heuristic contends an initial value is believed to create a bias in choices as any adjustment from the given reference point, or arbitrary numerical anchor, will be insufficient (Furnham & Boo, 2011). Therefore, estimations can be biased toward a given anchor value and influence subsequent choices.

The cognitive processing of numerical anchors can be seen to have substantial biases on choices in a wide variety of circumstances. Specifically, anchoring health and nutrition claims is believed to make food choices more salient (Paek, Yoon, & Hove, 2011). However, improving food choices for more nutritious options is only one aspect of healthy eating. Quantity consumed of any item is necessary to consider as well. Therefore, manipulating cognitive processing of health information to increase quantities of consumption can be problematic for eating behaviors.

For example, supermarket purchasing behaviors have been known to be susceptible to biases where choices to purchase larger quantities were evident with the implementation of anchors (Wansink, Kent, & Hoch, 1998). It appears anchoring can be used to not only influence what people will consume, but how much they are willing to consume as well. Furthermore, research has suggested people may anchor food quantities on information surrounding them (McFerran, Dahl, Fitzsimons, & Morales, 2010). For instance, people are susceptible to adjusting food intake when others around them are consuming more or less (McFerran et al., 2010). Thus, it is important to implement an anchor where people will adjust toward healthier decisions, as opposed to consumer marketers who often implement anchors to increase the consumption of a product. Adjusting food intake from anchors appears an effective technique to influence consumption choices. This is significant because consumption quantity is an integral component of health. Evidence suggests dieters frequently misinterpret weight loss with consumption of the "right" foods as opposed to monitoring quantities (Antonuk & Block, 2006). These behaviors are in direct contrast with research emphasizing volume of foods consumed has a profound impact on weight management (Wansink, 2007). Therefore, a lack of familiarity with the quantities of food recommended for healthy eating behaviors may be a reasonable anchoring approach.

Applying a Sufficient Anchor

Anchors will typically have the most significant effects if they are relevant and plausible to the target response. Energy intake is often an overlooked aspect associated with eating behaviors (Carels et al., 2008) making it ideal for the target response of an anchor. Necessary intake and expenditure for a person can vary considerably depending on individual differences, such as basal metabolic rate, thermic effect on food and total physical activity (Hill, Pagliassotti,

& Peters, 1994). An individual's height, weight and physical activity can be used to calculate a rough estimation of expected caloric intake for a person (American Heart Association, 2014). According to information provided by the National Center for Health Statistics for average height and weight in the 20-29 age bracket, an individual who is moderately active according to the American Heart Association would burn an estimated 2590 calories a day (American Heart Association, 2014; Fryar, Gu, & Ogden, 2012). Thus, it would be reasonable to consider this number a suitable midpoint within the range of plausibility for anchoring. Furthermore, research suggests a 500-1000 calorie deficit/surplus is a safe and effective quantity to deviate from energy balance (NOEIE Panel, 1998). Therefore, anchoring anywhere between 1590 daily caloric intake and 3590 daily caloric intake would be a relevant and plausible range to achieve sufficient effects in a target response associated with energy intake goals for the average young adult.

Circumstances for Anchoring Success

There are a number of everyday tasks that require decision making involving numerical values and hence may be susceptible to anchoring effects. Research indicates the anchoring and adjustment strategy is often used for numerical estimations as assistance to making judgments and choices (Furnham et al., 2011). Depending on the application of the anchor, these choices can be biased to produce estimations that can serve positively or negatively for subsequent behaviors. Thus, anchoring can be an effective technique to guide behavior with the appropriate application.

However, anchors are not always effective. Therefore, one should consider factors which may render an anchor ineffective when considering an experimental design. There have been a few studies that examined factors that can determine the strength on an anchoring effect. For instance, research has suggested an individual with more knowledge of the content to which an

anchor is being applied is less susceptible to anchoring and has observed significantly weaker effects (Alevy, Landry, & List, 2011). Consistent with these findings, the more familiar or even confident an individual feels with the content also appears to weaken anchoring effects (Wu, Chen & Yen, 2012). Furthermore, anchors are also weaker for people with higher cognitive ability and reasoning skills (Bergman, Ellingsen, Johannesson, & Svensson, 2010). Thus, the target of the anchor is an important component to establish an effective method. According to previous work, it appears a naive population is ideal for introducing anchors before subsequent decisions are made. As previously mentioned, people struggle to estimate energy intake accurately (Carels et al., 2007). Therefore, the naivety for healthy intake numbers could be an appropriate concept to anchor.

Manipulating the anchor or reference point itself can also contribute to the strength of observable effects. Janiszewski and Uy (2008) reported people are less likely to adjust further from a given anchor point when the anchor point references a more precise numerical value (e.g. 3,492) than when providing a rounded numerical value (e.g. 3,500) in comparison. Therefore, subsequent estimations and decision making following a precise anchor will create a stronger effect to the numerical value. However, it is important that the anchor stay within a plausible range for a topic as well. Frequently, anchoring studies contend that the presence of an anchor is only effective if it results from the activation of information that is consistent with values that appear reasonable (Chapman et al., 1999). Mussweiler and Strack (2001) determined anchoring with unreasonable values, either too high or too low with a numerical value, eliminates the effects of an anchor. Thus, extreme anchors are often not an appropriate application to maximize the potential effects. Wegener, Petty, Detweiler-Bedell, & Jarvis (2001) corroborate with these findings, demonstrating a curvilinear relationship may exist for anchoring effects, where

extremely low or high anchors display weaker effects and moderate anchors displayed stronger effects. Identifying an acceptable range of plausibility of an anchor is necessary for adequate reception and usage of information to influence subsequent choices. Examining eating behaviors more closely is necessary when determining an anchor's range of plausibility to implement and improve unhealthy lifestyles.

Anchoring for Energy Intake – The Effects on Health

High energy intake is one behavioral factor facilitating an unhealthy lifestyle. Although the body has some ability to adjust energy expenditure to negate acute bouts of excess intake (Horton et al., 1995; Tremblay, Després, Theriault, Fournier, & Bouchard, 1992), chronic overconsumption results in the accumulation of unhealthy body fat mass to restore energy balance (Drewnowski & Darmon, 2005; Swinburn, Caterson, Seidell, & James, 2004). However, many people remain inattentive or undereducated on an acceptable level of consumption. Self-monitoring food quantities may be a necessary component of establishing a healthy diet. For instance, research suggests participants who regularly monitor energy intake are more likely to develop a healthier body weight and consistently achieve energy balance more frequently than participants who failed to self-monitor as often (Carels et al., 2008). Additionally, evaluating total calories of food choices varies considerably and should be a cause for concern. Research has indicated roughly one third of individuals give no consideration to total calories before consumption (Wills, Schmidt, Blocka, & Cairns, 2009). People who consistently neglect to account for caloric intake are more susceptible of consuming greater amounts of total fat, saturated fat, and sustain higher cholesterol levels (Lin, Lee, & Yen, 2004). Anchoring may be one method to improve self-monitoring of caloric intake and increase awareness to avoid overconsumption. For instance, calorie estimation of food items can be

affected with the application of numerical anchors (Frederick & Mochon, 2012), where participants are more likely to underestimate calorie content after the initial presentation of a low value. If people are responsive to caloric intake estimations, anchoring recommended intake totals could be an effective method to increase monitoring of quantities consumed and improve overall health.

Measuring Eating Behaviors

Measurements for eating behaviors can be conducted with self-reported measurements and behavioral lab tasks. Reliable self-reported measurements administered to assess eating behaviors include the Dieters Inventory for Eating Temptations – Self Efficacy (DIET-SE: Stich, Knauper, & Tint, 2009) which examines eating behaviors in tempting scenarios and the Dietary Attitudinal Questionnaire (Pettinger, Holdsworth, & Gerber, 2004) which assesses eight subscales of nutrition attitudes: convenience, food quality, weight control/body image, worry (guilt/anxiety), locus of control, health, self-efficacy, and pleasure/social. A second method to determine eating behaviors uses behavioral paradigms, such as a choice task for food items (Jackson, Franco-Watkins, & Gillis, in 10reparation). Individuals who demonstrate unhealthier eating behaviors on self-reported measurements and choice tasks may be at a higher risk of developing problematic behaviors such as obesity and cardiovascular disease.

Study 1

Study 1 Overview

Previous research has demonstrated anchoring numerical values can impact subsequent decision making (McFerran et al., 2010; Paek et al., 2011, Tversky et al., 1974). Anchoring food intake could adjust decision making for subsequent caloric choices. This experiment implemented a numerical anchor on caloric intake to examine adjustments for food choices in

reference to the recommended daily intake. Thus, participants were expected to prefer items containing fewer calories if anchored to a low caloric intake and prefer items containing greater calories if anchored to a high caloric intake. This study used a nutritional intake choice task (e.g. nutrition intake choices) to assess eating behaviors. Participants were randomly assigned to receive one of three anchoring conditions: high anchor, low anchor, or no anchor. The current research was the first study to examine if anchoring energy intake numbers were an effective technique to shift eating preferences to match a suggested total. In addition to the nutritional intake choice task, several self-reported measurements also examined eating behaviors (e.g. DIET-SE, Dietary Attitudinal Questionnaire and PANSE). Performance on the nutritional intake choice task and self-reported measurements was used to determine if anchoring energy intake numbers can create differences in eating habits to promote healthier decision making.

Hypotheses

If anchoring energy intake numbers can bias preference choices for eating behaviors, then participants anchored to a high numerical value for energy intake should be more likely to choose higher calorie items than participants who are anchored to a low numerical value for energy intake.

Hypothesis 1: Participants who are anchored with a higher caloric intake will select higher calorie food and beverage items more frequently than participants who are anchored with a lower caloric intake on the nutrition intake choice task.

Behaviorally, the development of obesity is believed to be a product of daily energy intake exceeding daily energy expenditure (Hill & Melanson, 1999). With obesity currently on the rise, if a poor understanding of energy needs is a contributing factor then individuals without

a reference point for energy intake recommendations should be more likely to choose higher calorie food items more frequently than lower calorie food items.

Hypothesis 2: Participants who complete the nutrition intake choice task with no anchor will select food and beverage items with greater calories more frequently than food and beverage items with fewer calories.

Given that self-reported measurements of eating behaviors should correspond with a level of interest in establishing healthier behaviors, individuals who report healthier eating behaviors should respond more strongly to the anchoring information and adjust less by selecting choices that achieve the recommended amount of energy intake.

Hypothesis 3: Participants who report healthier eating behavior on the DIET-SE, the Dietary Attitudinal Questionnaire, and the PANSE will be more likely to have stronger anchoring effects to their target response for caloric intake in the nutrition intake choice task than participants who report unhealthier eating behaviors.

If anchoring effects can bias preferences toward food choices, then anchoring intake quantity should have a greater impact on subsequent decision making with stronger emphasis on the quantity consumed than the type of item being consumed.

Hypothesis 4: Ratings on the likability for each food and beverage item will not have a significant impact on choices in the nutritional intake choice task as participants will be more likely to select items based on the quantity of consumption after being anchored for recommended intake quantity.

Study 1 – Method

Participants

One hundred thirty three undergraduate students from Auburn University recruited from the Department of Psychology Research Participant Pool completed the study. Each participant was compensated with extra credit towards a psychology course upon completion of the study.

Table 1. Participant Demographic Information Study 1.

	(n = 133)
Gender	
Male	23%
Female	77%
Age (years)	
18	31%
19	23%
20	14%
21	18%
22 or older	14%

Design

A between-subjects design will be used for the study. Participants were randomly assigned to a numerical anchor condition: high anchor (n = 42), low anchor (n = 46), or no anchor (n = 45). Participants completed a choice task (i.e. choosing food and beverage preferences) assessing nutritional intake behavior over a simulated week. Self-reported assessments (DIET-SE, Dietary Attitudinal Questionnaire, and PANSE) were collected to measure eating behaviors and nutrition attitudes with stronger attitudes for healthy behaviors expected to be more responsive to anchoring effects associated with intake recommendations.

Materials

Anchor

Numerical anchors recommending caloric intake were administered to participants to examine effects on subsequent decision making for food items. Anchors were determined using the average height and weight of an individual in the 20-29 age bracket (i.e. 2590 calories) according to the National Center for Health Statistics (Fryar, Gu, & Ogden, 2012) and were calculated using an online calculator (American Heart Association, 2014). Participants did not use the online calculator. The calculator was only used to determine a plausible range of anchoring for nutritional intake values for design of an acceptable caloric value. Research suggests a 500-1000 calorie deficit/surplus is a safe and effective quantity to deviate from energy balance (NOEIE Panel, 1998). Therefore, low anchors were adjusted roughly 750 calories below the total daily energy expenditure of an average adult in the 20-29 age bracket and high anchors were adjusted roughly 750 calories above the total daily energy expenditure of an average adult in the 20-29 age bracket. Anchors were presented to participants as calories per choice to eliminate issues with numeracy for daily totals. Thus, low anchors for nutritional intake was presented as 350 calories per choice and high anchors for nutritional intake was presented as 700 calories per choice (See Appendix A.1 for sample screen shots of high and low anchor instructions).

Nutritional Intake Choice Task

Participants completed a nutritional intake choice task designed to analyze nutritional intake intentions over the course of a simulated week. The nutritional intake choice task consisted of 35 trial pairs. Each day of the simulated week consisted of 5 choices, or 5 trial pairs. Each trial pair consisted of one higher calorie food or beverage item and one lower calorie food or beverage item to choose between. For each item, only the serving size was indicated

below the item (See Appendix A.2 for a sample screen shot of trials with serving size indicated for each item). Thus, participants should select more items similar to the anchor of calories per choice they were randomly assigned based on given serving sizes of each item. Serving size per item varied depending on the item. Participants had as long as necessary to make a decision on each trial pair. Only once a decision was made did the task move forward to the next trial pair. Trial pairs proceeded in a standard sequential order with higher and lower calorie items counterbalanced on the left and right positions on the computer screen for each trial pair. Participants indicated responses by selecting the bubble for the preferred item using the mouse. Responses were recorded.

Ratings Task

Participants completed a ratings task designed to analyze the degree of likability for each food and beverage item in the nutritional intake choice task. The nutritional intake choice task consisted of 70 unique food and beverage items for participants to rate how strongly they like or dislike each item. Participants rated each item 1 at a time until a rating was indicated for all 70 items. Ratings occurred on a Likert-type rating scale ranging between 1 and 7, where a rating of 1 indicated a strong dislike for the item and a 7 indicated a strong like for the item. Participants indicated responses by selecting the bubble for the preferred rating using the mouse. Responses were recorded.

Dieters Inventory for Eating Temptations – Self Efficacy

The DIET-SE (Stich et al., 2009) consists of 11 scenario based questions designed to assess eating behaviors. Participants responded to each scenario using a Likert scale (see Appendix B for items and response scale). Scoring was determined by a summation of the

responses with higher totals indicating greater levels of self-control for healthy eating behaviors. The reliability of the measure was strong ($\alpha = 0.81$) with a mean of 21.29 (*SD* = 7.92).

Dietary Attitudinal Questionnaire

The Dietary Attitudinal Questionnaire (Pettinger et al., 2004) consists of 37 statements to assess nutrition attitudes. Participants responded to each statement on a Likert scale (see Appendix C for items and response scale). The scale identifies eight subscales of nutrition attitudes within scoring which include convenience, food quality, weight control/body image, worry (guilt/anxiety), locus of control, health, self-efficacy, and pleasure/social. Scoring was determined by a summation of the responses with higher totals indicating stronger attitudes for each subscale. Overall, reliability was fair for the entire scale ($\alpha = 0.58$) with a mean response of 121.73 (*SD* = 9.24).

Physical Activity and Nutrition Self-Efficacy Scale

The Physical Activity and Nutrition Self-Efficacy Scale (Latimer et al., 2011) consists of 11 questions to assess nutrition and exercise behaviors. Participants responded to each question using a Likert scale (see Appendix D for items and response scale). Scoring was determined by a summation of the responses with higher totals indicating greater confidence to maintain healthy nutrition and exercise behaviors. The measure produced strong reliability ($\alpha = 0.87$) with a mean of 67.68 (*SD* = 15.12).

Procedure

Participants completed the study in one session on Qualtrics online. Participants were randomly assigned to an anchoring condition. High or low anchor conditions received information about the importance of energy intake prior to the task. Participants were asked to enter their age, gender, height, and activity level to simulate the calculation of their total daily

energy expenditure and received the assigned numerical anchor for caloric intake per choice as the results of the calculation. Participants were instructed to keep their calories per choice in mind while completing the subsequent task. Participants randomly assigned to the no anchor condition received information about the importance of energy intake but did not simulate total daily energy expenditure and did not receive an anchor for caloric intake prior to the nutritional intake choice task.

All participants then completed a nutritional intake choice task. Participants were instructed to make a preference choice between each trial pair of food and beverages with serving size for each item presented on the computer screen. The participants had unlimited time to make a choice. Following the nutritional intake choice task, participants completed a ratings task for each food and beverage item presented in the nutritional intake choice task. Participants were instructed to rate how strongly they like the food or beverage item and had unlimited time to indicate a rating for each item.

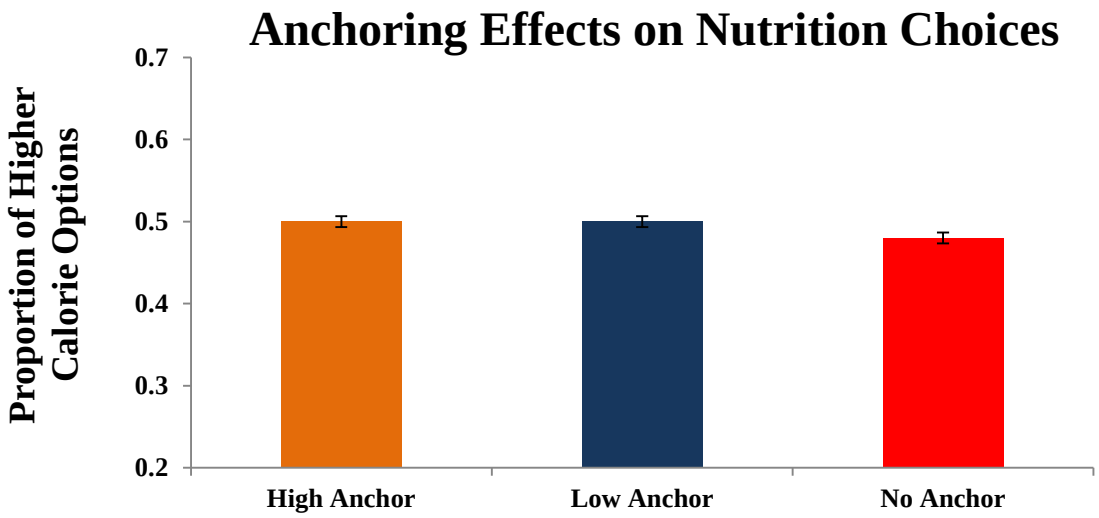
After completion of the nutritional intake choice task and ratings task, participants responded to a series of questionnaires (DIET-SE, Dietary Attitudinal Questionnaire, PANSE). Specific instructions for each questionnaire were provided on the computer screen. Participants were instructed to read each question or statement carefully, and indicate their response using the scale provided. Participants indicated responses by selecting the bubble for the preferred option using the mouse.

Study 1 – Results

Anchoring and Nutrition Choices

Hypothesis 1 predicted that participants anchored to a higher caloric intake number would display stronger preferences for higher calorie nutrition options than participants who are

anchored with a lower caloric intake number to determine if anchoring influenced nutrition choices. Paired comparisons analyses were conducted to assess if differences in proportion of high calorie nutrition options differed among the high anchor, low anchor, and control conditions. Results revealed no significant differences in the proportion of high calorie nutrition options selected between the high anchor and the low anchor (t (86) = -0.19, p = 0.85), the high anchor and the control (t (85) = 0.75, p = 0.45), or the low anchor and the control (t (89) = 1.04, p = 0.30). Participants in the high anchor condition selected a proportion of high calorie options (M = 0.50, SD = 0.10) similarly to participants in the low anchor condition (M = 0.50, SD = 0.09) and no anchor condition (M = 0.48, SD = 0.09). Thus, hypothesis 1 was not supported. Figure 1. Proportion of higher calorie nutrition options selected on the nutritional intake choice task selected for each anchoring condition in Study 1



Hypothesis 2 predicted that participants without an anchor for recommended caloric intake would display behaviors consistent with overconsumption and select a greater proportion of higher calorie nutrition options more frequently than lower calorie options. One sample t-test was used to determine if the proportion of high calorie nutrition options selected significantly

differed from the hypothesized value of an equal selection of high and low calorie options. Analysis revealed no significant differences in participants who received no caloric anchor to select a greater proportion of high calorie nutrition options than average (t (44) = -1.25, p = 0.22). Thus, hypothesis 2 was not supported.

Self-Reported Measures and Nutrition Choices

Hypothesis 3 predicted that participants who reported healthier eating behavior on the DIET-SE, Dietary Attitudinal Questionnaire, and the PANSE would be less likely to adjust from their anchor for recommended caloric intake than participants who reported unhealthier eating behaviors. A stepwise regression was conducted to determine if participants who report having strong values for healthy eating behaviors were more likely to respond and meet energy intake recommendations when provided with them. Results revealed only the PANSE (b = -0.002, t (44) = -2.22, $p < 0.05$) as a significant predictor of the low anchor participants for responding to meet energy intake recommendations. Self-reported measures of physical activity and nutrition also explained a significant amount of variance in choices on the nutritional intake choice task (R^2 = 0.10 F (1, 44) = 4.94, $p < 0.05$). The weak effects observed for the anchors likely contributed in the inability to establish a strong relationship between anchoring and self-reported measurements for nutrition behaviors.

Ratings and Nutrition Choices

Hypothesis 4 predicted that ratings of the likability for each nutrition item would not have a significant impact on choices on the nutritional intake choice task. Paired t-test was conducted to analyze if differences existed between the ratings of items selected for each participant with the ratings of items that were not selected by each participant. Results revealed a significant relationship between ratings and selections (t (132) = 22.09, $p < 0.01$) indicating nutrition

choices was influenced by likability of each item. As a result, it is possible anchoring conditions recommending nutrition intake was ignored when making choices in favor of how strongly each item was liked or disliked. Thus, hypothesis 4 was not supported.

Given ratings was a significant predictor of choice, exploratory analyses between items and ratings were conducted to examine behavioral responses more closely. Eight items of the 35 trial pairs were found to be selected by participants with a frequency of greater than 70% of selections. For instance, participants had an option between grilled cheese and cheesesteak in one of the trial pairs. Grilled cheese was overwhelmingly preferred among participants with nearly 77% selecting the item compared to only 23% selecting cheesesteak. The ratings for each item resulted in a similar disparity where grilled cheese was rated significantly higher (e.g. 5.6 vs. 3.8).

Table 2. Items selected with high and low frequency in Study 1

	Item	**Percent Selected**	**Rating**
Trial Pair #4	Spaghetti	71%	5.7
	Macaroni & Cheese	29%	5.7
Trial Pair #12	Ham & Cheese Sandwich	71%	4.5
	Tuna Sandwich	29%	3.2
Trial Pair #16	Muffin	71%	5.3
	Donut	29%	5.3

Trial Pair # 19	Quesadilla	80%	6.0
	Nachos	20%	5.1
Trial Pair #20	Nutrigrain Bars	88%	4.5
	Cottage Cheese	12%	2.2
Trial Pair #21	French Toast	71%	5.2
	Cheese Danish	29%	3.7
Trial Pair #23	Grilled Cheese	77%	5.6
	Cheesesteak	23%	3.8
Trial Pair #24	Steak	79%	6.1
	Lobster	21%	4.7

Additional analyses examined the relationship between self-reported measurements for nutrition behaviors with ratings. As expected, all questionnaires were significantly correlated with each other. Table 3. Correlation matrix of self-reported measures for nutrition behaviors in Study 1.

	DIET-SE	**DAQ**	**PANSE**
DIET-SE	-	0.20*	0.39**
DAQ		-	0.47**

PANSE			-

Note: ** p < .01, * p < .05

Multiple regression analysis revealed only the DIET-SE (b = -0.02, t (131) = -2.27, p < 0.05) was a significant predictor of item ratings explaining a significant amount of variance in the ratings (R^2 = 0.04, F (1, 131) = 5.14, p < 0.05). Thus, participants who reported more restrained eating behaviors on the DIET-SE also reported rating food items significantly higher than participants who did not report restrained eating behaviors on the DIET-SE.

Study 2 – Rationale

Quantity of foods consumed is merely one aspect associated with health-related problems. Energy intake recommendations can only be determined in relation to energy expenditure when approximating a sustainable balance. Despite the ineffectiveness of an anchor to influence nutrition choices in Study 1, if people are responsive toward changing exercise behaviors based on recommendations a healthy balance can still be achieved. Thus, examining motivation for each component is a pathway to facilitate healthy behavior and should be explored. Inadequate exercise is believed to be a major factor reinforcing a decline in health (Mokdad et al., 2004). Anchoring may have the ability to positively influence physical activity choices. Specifically, Kahneman and Tversky (1979) noted individual preferences are often constructed relative to an anchor or reference point. Research supports this contention, suggesting anchoring can influence perceptions for a behavior or activity (Lewis & Neighbors, 2006). For example, consider a common barrier often cited as a reason for low levels of physical activity: lack of time (Allison, Dwyer, & Makin, 1999; Welch, McNaughton, Hunter, Hume, & Crawford, 2008). Studies revealed anchoring the amount of exercising necessary to reach

recommendations in shorter duration intervals (e.g. 17 minutes per day) shifts the perception of time resources necessary to exercise and led to an increase in physical activity participation compared to anchoring with larger intervals (e.g. 2 hours a week) (Peetz, Buehler, & Britten, 2011). Additionally, research has demonstrated the perception of social norms can largely impact the choice to engage in a behavior (Schultz, 1999). For instance, studies determined exercise adherence is more successful when an individual is within a social network that values physical activity (Gruber, 2008). Therefore, increased levels of exercise may be attributed to greater expectations to be physically active. These findings would indicate a possibility of increasing exercise intentions simply by anchoring average activity levels higher than current participation for exercise among sedentary populations.

Anchoring for Energy Expenditure – The Effects on Health

Exercise is a practical activity to help people regulate energy expenditure and achieve an energy balance. Currently, there exists a considerable gap between recommendations of exercise and actual activity, thus negatively impacting health. According to the U.S. Department of Human Health and Services, 85% of adults in America fail to regularly engage in the recommended amount of physical activity or are completely inactive altogether (U.S. Department of Human Health and Services, 2000). Changing an otherwise sedentary lifestyle is believed to have a number of health benefits. Benefits from regular exercise not only include physiological advantages (e.g. regulating energy levels, reducing the effects chronic heart disease, and prevents excessive weight gain) but also improve psychological functioning (e.g. improvements in mood, self-esteem, memory, and psychomotor development) (Fentem, 1994; McAuley, Mihalko, & Bane, 1997; Yeung, 1996). Research has suggested physical activity monitors (e.g. pedometers and accelerometers) are a strategy frequently implemented to increase

motivation to exercise (Morgan, Pangrazzi, & Beighle, 2003). Physical activity monitors are designed to estimate daily energy expenditure (O'Dwyer & Coote, 2010). If people are responsive to daily energy expenditure estimations, anchoring recommended energy expenditure totals could be an effective method to increase exercise intentions and reduce the risk of developing obesity and cardiovascular diseases.

Measuring Exercise Behaviors

Measurements for exercise behaviors can be conducted with self-reported measurements and behavioral lab tasks. Recent self-reported measurements for exercise behaviors include the Godin-Shephard Leisure-Time Exercise Questionnaire (Godin, 2011) to analyze differences in exercise intensity and the Motives for Physical Activities Measure – Revised (MPAM-R: Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997) to investigate exercise motivation. A commonly used self-reported measurement, the Physical Activity and Nutrition Self-Efficacy Scale (PANSE: Latimer, Walker, Kim, Pasch, & Sterling, 2011), has been used to address both eating and exercise behaviors. A second method to determine exercise behaviors uses behavioral paradigms, such as a choice task for physical activity. Individuals who demonstrate unhealthier exercise behaviors on self-reported measurements and choice tasks may be at a higher risk of developing problematic behaviors such as obesity and cardiovascular disease.

Study 2 – Overview

Anchoring numerical values has been demonstrated to impact subsequent decision making (McFerran et al., 2010; Paek et al., 2011, Tversky et al., 1974). Anchoring energy expenditure could shift exercise intentions for subsequent physical activity choices. This experiment administered a numerical anchor for recommended calories to burn to determine adjustments participants make for physical activities. Thus, participants were expected to select

physical activities that burn greater calories if anchored to higher recommendations than participants anchored to lower recommendations. This study used a choice task (e.g. energy expenditure choices) to assess exercise behaviors. Participants were randomly assigned to receive one of three anchoring conditions: high anchor, low anchor, or no anchor. The current research was the first study to examine if anchoring energy expenditure numbers are an effective technique to shift exercise intentions to match a suggested total. In addition to the energy expenditure choice task, several self-reported measurements also examined exercise behaviors (e.g. PANSE, MPAM-R, and Godin-Shephard Leisure-Time Exercise Questionnaire) with stronger attitudes for exercise behaviors expected to be more responsive to anchoring effects associated with expenditure recommendations. Performance on the energy expenditure choice task and self-reported measurements was used to determine if anchoring energy expenditure numbers can create differences in exercise to promote healthier decision making.

Hypotheses

If anchoring energy expenditure numbers can bias preference choices for exercise behaviors, then participants anchored to a high numerical value for energy expenditure should be more likely to choose physical activities that burn more calories than participants who are anchored to a low numerical value for energy expenditure.

Hypothesis 1: Participants who are anchored with a higher energy expenditure number will select items of greater physical activity more frequently than participants who are anchored with a lower energy expenditure number on the energy expenditure choice task.

Behaviorally, the development of obesity is believed to be a product of daily energy intake exceeding daily energy expenditure (Hill & Melanson, 1999). With obesity currently on the rise, if a poor understanding of energy needs is a contributing factor then individuals without

a reference point for energy expenditure recommendations should be more likely to exercise less to burn a sufficient amount of calories necessary to achieve an energy balance.

Hypothesis 2: Participants who complete the energy expenditure choice task with no anchor will select physical activity items that burn fewer calories more frequently than physical activity items that burn greater calories.

Given that self-reported measurements of exercise intentions should correspond with a level of interest in establishing healthier behaviors, individuals who report greater intentions to exercise should respond more strongly to the anchoring information and adjust less by selecting choices that achieve the recommended amount of energy expenditure.

Hypothesis 3: Participants who report healthier exercise behaviors on the PANSE, MPAM-R, and the Godin-Shephard Leisure-Time Exercise Questionnaire will be more likely to have stronger anchoring effects to their target response for calories burned in the energy expenditure choice task than participants who report unhealthier exercise behaviors.

If anchoring effects can bias preferences toward physical activity choices, then anchoring energy expenditure should have a greater impact on subsequent decision making with stronger emphasis on the energy expended than the type of physical activity being performed.

Hypothesis 4: Ratings on the likability for each physical activity item will not have a significant impact on choices in the energy expenditure choice task as participants will be more likely to select physical activities based on the energy expended after being anchored for recommended energy expenditure levels.

Study 2 – Method

Participants

One hundred thirty four undergraduate students from Auburn University recruited from the Department of Psychology Research Participant Pool completed the study. Each participant was compensated with extra credit towards a psychology course upon completion of the study.

Table 4. Participant Demographic Information Study 2

	(n = 134)
Gender	
Male	14%
Female	86%
Age (years)	
18	40%
19	31%
20	8%
21	10%
22 or older	11%

Design

A between-subjects design was used for the study. Participants were randomly assigned to a numerical anchor condition: high anchor (n = 46), low anchor (n = 44), or no anchor (n = 44). Participants completed an energy expenditure choice task (i.e. choosing physical activity preferences) assessing exercise behavior over a simulated month. Self-reported assessments (PANSE, MPAM-R, and the Godin-Shephard Leisure-Time Exercise Questionnaire) were collected to measure motivation for exercise and current exercise activity.

Materials

Anchor

Numerical anchors recommending caloric expenditure were administered to participants to examine effects on subsequent decision making for food items. Anchors were determined using the average basal metabolic rate of an individual in the 20-29 age bracket (i.e. 1600 calories burned) according to the National Center for Health Statistics (Fryar, Gu, & Ogden, 2012) and average daily caloric intake simulated by participants. The average daily caloric intake calculated represented the daily energy expenditure for an average 20-29 year for the high anchor condition (i.e. 2500 calories) or the subtraction of 500 calories for the low anchor condition (i.e. 2000 calories). The difference between the simulated daily intake and the basal metabolic rate actually represented either a high anchor or low anchor for remaining calories necessary to expend with exercise to establish an energy balance for an average day. Anchors were presented to participants as calories to burn per activity. Thus, low anchors for energy expenditure were presented as 400 calories to burn per activity and high anchors for energy expenditure were presented as 900 calories per activity (See Appendix A.3 for sample screen shots of high and low anchor instructions).

Energy Expenditure Choice Task

Participants completed an energy expenditure choice task designed to analyze energy expenditure intentions over the course of a simulated month. The energy expenditure choice task consisted of 30 trial pairs with each trial pair representing 1 day of physical activity options. Each trial pair consisted of one higher calories burned physical activity and one lower calories burned physical activity to choose between. For each activity, only the length of time each activity was to be performed was indicated below the item (See Appendix A.4 for a sample screen shot of exercise trials). Thus, participants should select more items similar to the anchor of calories to burn per choice they were randomly assigned. Length of time each activity was to

be performed varied depending on the item. Participants had as long as necessary to make a decision on each trial pair. Only once a decision was made did the task move forward to the next trial pair. Trial pairs proceeded in a standard sequential order with higher calories burned and lower calories burned physical activities counterbalanced on the left and right positions on the computer screen for each trial pair. Participants indicated responses by selecting the bubble for the preferred item using the mouse. Responses were recorded.

Ratings Task

Participants completed a ratings task designed to analyze the degree of likability for each physical activity item in the energy expenditure choice task. The energy expenditure choice task consisted of 60 unique physical activity items for participants to rate how strongly they like or dislike each item. Participants rated each item 1 at a time until a rating had been indicated for all 60 items. Ratings occurred on a Likert-type rating scale ranging between 1 and 7, where a rating of 1 indicates a strong dislike for the item and a 7 indicates a strong like for the item. Participants indicated responses by selecting the bubble for the preferred rating using the mouse. Responses were recorded.

Physical Activity and Nutrition Self-Efficacy Scale

The Physical Activity and Nutrition Self-Efficacy Scale (Latimer et al., 2011) consists of 11 questions to assess nutrition and exercise behaviors. Participants responded to each question using a Likert scale (see Appendix D for items and response scale). Scoring was determined by a summation of the responses with higher totals indicating greater confidence to maintain healthy nutrition and exercise behaviors. The measure produced strong reliability ($\alpha = 0.86$) with a mean of 64.93 ($SD = 13.84$).

Motives for Physical Activities Measure – Revised

The Motives for Physical Activities Measure – Revised (Ryan et al., 1997) consists of 30 statements to assess exercise motivation. Participants responded to each statement on a Likert scale (see Appendix E for items and response scale). The scale identifies five motives for participating in exercise within scoring which include fitness, interest/enjoyment, appearance, competence, and social. Scoring was determined by a summation of the responses with higher totals indicating greater motivation. Overall, reliability was strongest for the entire scale (α = 0.96) with a mean response of 151.18 (*SD* = 33.13).

Godin-Shephard Leisure-Time Exercise Questionnaire

The Godin-Shephard Leisure-Time Exercise Questionnaire (Godin, 2011) consists of 3 exercise intensities (strenuous, moderate, and mild) to assess physical activity levels. Participants responded by indicating the number of times per week they engage in each exercise intensity category (see Appendix F for items and response scale). Scoring was calculated with a formula (9 x number of strenuous activities per week + 5 x number of moderate activities per week) to obtain an activity score. The higher the activity score indicates greater physical activity for an individual. The reliability of the measure was fair (α = 0.54) with a mean activity score of 40.37 (*SD* = 37.08).

Procedure

Participants completed the study in one session on Qualtrics online. Participants were randomly assigned to an anchoring condition. High or low anchor conditions received information about the importance of energy expenditure prior to the task. Participants were asked to enter their age, gender, and height to simulate the calculation of their basal metabolic rate. Participants were then asked to simulate a day of caloric intake and received the assigned numerical anchor for calories to burn per choice as the results of the calculation. Participants

were instructed to keep their calories to burn per choice in mind while completing the task. Participants randomly assigned to the no anchor condition received information about the importance of energy expenditure but did not simulate basal metabolic rate and daily intake or receive an anchor for caloric expenditure prior to the energy expenditure choice task.

All participants then completed the energy expenditure choice task. Participants were instructed to make a preference choice between each trial pair of physical activities with length of time performing each activity presented on the computer screen. The participants had unlimited time to make a choice. Following the energy expenditure choice task, participants completed a ratings task for each physical activity item presented in the energy expenditure choice task. Participants were instructed to rate how strongly they like the physical activity item and had unlimited time to indicate a rating for each item.

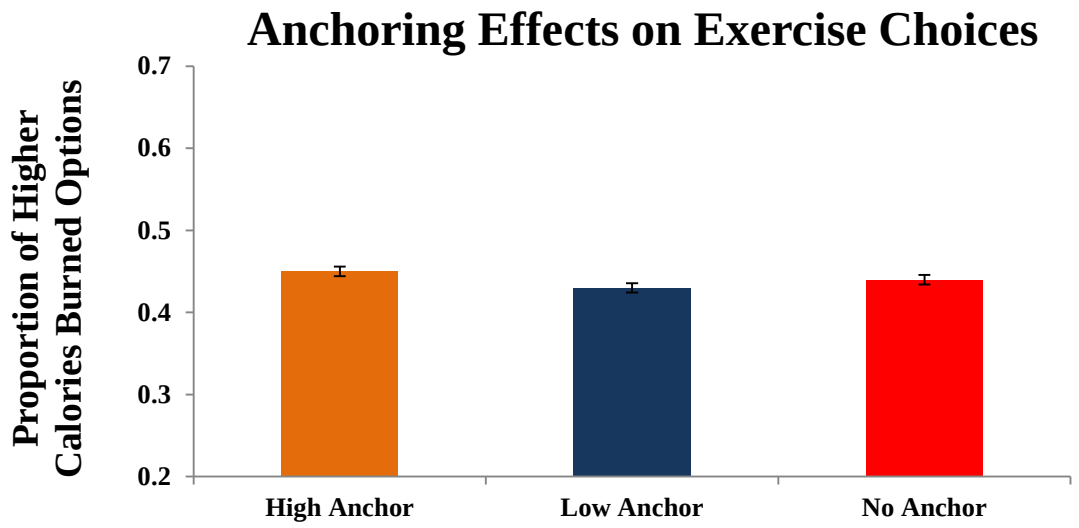
After completion of the energy expenditure choice task and ratings task, participants responded to a series of questionnaires (PANSE, MPAM-R, and the Godin-Shephard Leisure-Time Exercise Questionnaire). Specific instructions for each questionnaire were provided on the computer screen. Participants were instructed to read each question or statement carefully, and indicate their response using the scale provided. Participants indicated responses by selecting the bubble for the preferred option using the mouse.

Study 2 –Results

Anchoring and Exercise Choices

Hypothesis 1 predicted that participants anchored to a higher energy expenditure number will have stronger preferences for exercises burning more total calories than participants who are anchored with a lower energy expenditure number to determine if anchoring influenced exercise choices. Paired comparisons analyses were conducted to assess if differences in proportion of

high calories burned exercise options differed among the high anchor, low anchor, and control conditions. Results revealed no significant differences in the proportion of high calories burned exercise options selected between the high anchor and the low anchor (t (88) = 0.46, p = 0.65), the high anchor and the control (t (88) = 0.30, p = 0.77), or the low anchor and the control (t (86) = -0.12, p = 0.91). Participants in the high anchor condition selected a proportion of high calories burned options (M = 0.45, SD = 0.13) similarly to participants in the low anchor condition (M = 0.43, SD = 0.14) and no anchor condition (M = 0.44, SD = 0.16). Thus, hypothesis 1 was not supported. Figure 2. Proportion of higher calories burned exercise options selected on the energy expenditure choice task selected for each anchoring condition in Study 2



Hypothesis 2 predicted that participants without an anchor for recommended energy expenditure would display behaviors consistent with a lack of exercise and select a lower proportion of higher calories burned exercise options more frequently than higher calories burned options. One sample t-test was used to determine if the proportion of high calories burned exercise options selected significantly differed from the hypothesized value of an equal selection of high and low calories burned options. Analysis revealed significant differences in

participants who received no expenditure anchor to select a lower proportion of high calories burned exercise options than average (t (43) = -2.58, $p < 0.05$). Therefore, it appears individuals who have no reference point for daily exercise activity have a tendency to prefer exercise options that result in fewer calories burned. It should be noted, however, that high and low anchoring conditions also displayed preferences for options that burned fewer calories. Thus, preferences for exercise options burning fewer calories cannot be contributed to the lack of a presence of an anchor. However, the results indicate a tendency to prefer the less vigorous exercise option when given a choice. These findings are significant because these behaviors reinforce recent patterns observed in a decline in overall physical activity level.

Self-Reported Measures and Exercise Choices

Hypothesis 3 predicted that participants who reported healthier exercise behavior on the PANSE, MPAM-R, and the Godin-Shephard Leisure-Time Exercise Questionnaire would be less likely to adjust from their anchor for recommended energy expenditure than participants who reported unhealthier exercise behaviors. A stepwise regression was conducted to determine if participants who report having strong values for healthy exercise behaviors were more likely to respond and meet energy expenditure recommendations when provided with them. Results revealed no significant predictors from the self-reported measurements for exercise behaviors of meeting energy expenditure recommendations for either anchoring condition. The weak effects observed for the anchors likely contributed to the inability to establish a relationship between anchoring and self-reported measurements for exercise behaviors. Thus, hypothesis 3 was not supported.

Ratings and Exercise Choices

Hypothesis 4 predicted that ratings of the likability for each exercise item would not have a significant impact on choices on the energy expenditure choice task. Paired t-test was conducted to analyze if differences existed between the ratings of items selected for each participant with the ratings of items that were not selected by each participant. Results revealed a significant relationship between ratings and selections (t (133) = 27.44, $p < 0.01$) indicating exercise choices was influenced by likability of each item. As a result, it is possible anchoring conditions recommending energy expenditure was ignored when making choices in favor of how strongly each item was liked or disliked. Thus, hypothesis 4 was not supported.

Given ratings was a significant predictor of choice, exploratory analyses between items and ratings were conducted to examine behavioral responses more closely. Six items of the 30 trial pairs were found to be selected by participants with a frequency of greater than 70% of the time. For instance, participants had an option between fishing and golf in one of the trial pairs. Fishing was overwhelmingly preferred among participants with nearly 75% selecting the item compared to only 25% selecting golf. The ratings for each item resulted in a similar disparity where fishing was rated significantly higher (e.g. 4.3 vs. 3.2).

Table 5. Items selected with high and low frequency in Study 2.

	Item	Percent Selected	Rating
Trial Pair #8	Tennis	78%	4.7
	Driving Range	22%	3.2
Trial Pair #12	Spin Class	71%	4.6
	Free Weights	29%	4.5

Trial Pair #13	Tubing	83%	5.9
	Water Ski	17%	4.3
Trial Pair # 19	Clean	78%	4.4
	Yard Work	22%	3.5
Trial Pair #22	Fishing	75%	4.3
	Golf	25%	3.2
Trial Pair #23	Horseback Riding	70%	4.7
	Martial Arts	30%	3.2

Additional analyses examined the relationship between self-reported measurements for exercise behaviors with ratings. As expected, all questionnaires were significantly correlated with each other. Table 6. Correlation matrix of self-reported measures for exercise behaviors in Study 2.

	PANSE	**Godin-Shephard**	**MPAM-R**
PANSE	-	0.21*	0.49**
Godin-Shephard		-	0.38**
MPAM-R			-

Note: ** p < .01, * p < .05

Multiple regression analysis revealed only the MPAM-R (b = 0.01, t (132) = 5.19, p < 0.01) was a significant predictor of item ratings explaining a significant amount of variance in the ratings (R^2 = 0.17, F (1, 132) = 26.92, p < 0.01). Thus, participants who reported greater motivation for physical activity on the MPAM-R also reported rating exercise items significantly higher than participants who reported lower motivation for physical activity on the MPAM-R.

Follow Up Study

Results from Study 1 and Study 2 had difficulty establishing an anchor to influence subsequent choices for nutrition or exercise. In an attempt to determine if methodological errors in the experiment limited the effectiveness of anchors a follow up study was conducted with adjustments to the design. The primary objective of the follow up study was to minimize the difficulty between the anchor and the target response. Therefore, Study 1 was redesigned in efforts to simplify the task to ensure the anchors provided were relevant to the target response. One hundred twenty nine participants were recruited from the Department of Psychology Research Participant Pool and completed the follow up study. Table 7. Participant Demographic Information Follow Up Study.

	(n = 129)
Gender	
Male	16%
Female	84%
Age (years)	
18	19%
19	28%

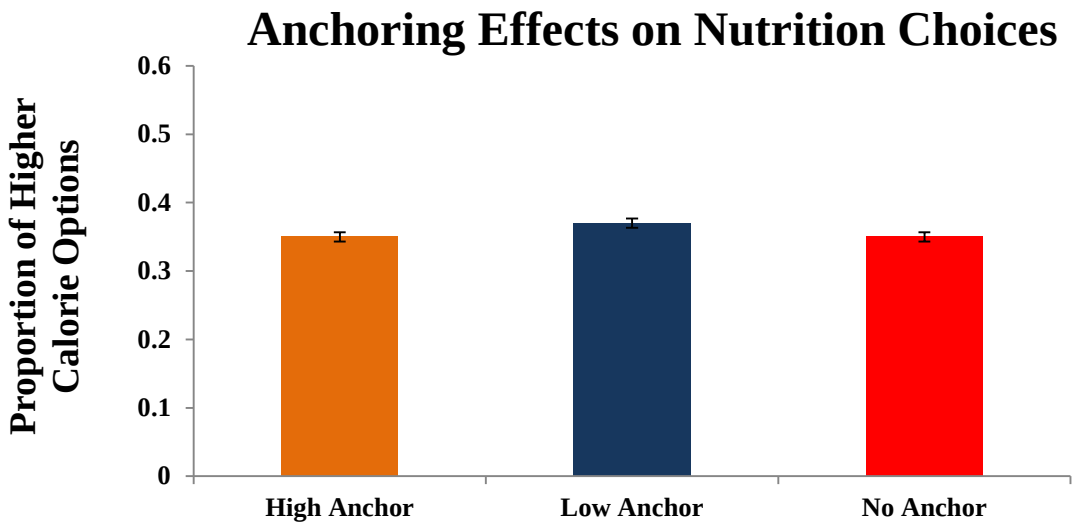
20	17%
21	19%
22 or older	17%

Participants were randomly assigned to a numerical anchor condition: high anchor (n = 45), low anchor (n = 41), or no anchor (n = 43). Anchors remained identical to Study 1, while trial pairs on the nutritional intake choice task were modified. For each item, calories were indicated below the item (See Appendix A.5 for a sample screen shot of trials with calories indicated for each item) as opposed to serving size in the original design (See Appendix A.2 for comparison).

Follow Up Study - Results

Anchoring and Nutrition Choices

Paired comparisons analyses were conducted to assess if differences in proportion of high calorie nutrition options differed among the high anchor, low anchor, and control condition. Results revealed no significant difference in the proportion of high calorie nutrition options selected between the high anchor and the low anchor, the high anchor and the control, or the low anchor and the control. Participants in the high anchor condition selected a proportion of high calorie options (M = 0.35, SD = 0.15) similarly to participants in the low anchor condition (M = 0.37, SD = 0.18) and no anchor condition (M = 0.35, SD = 0.16). Figure 3. Proportion of higher calorie nutrition options selected on the nutritional intake choice task selected for each anchoring condition in Follow Up Study



Therefore, even by simplifying the target response for the anchors presented there was no significant effects observed in anchoring condition on nutritional choices. These findings suggest modification of design to simplify the nutritional intake choice task was not an effective solution to strengthen nutritional intake anchors. However, it should be noted by incorporating caloric information into the nutritional intake choice task, participants selected the lower calorie option with greater frequency (M = 0.36, SD = 0.16) than participants in Study 1 (M = 0.49, SD = 0.09) who were only given serving size. The differences in selections observed between the studies indicate participants may be more susceptible to consume larger quantities of food when it is necessary to evaluate serving size rather than a simplified version of total calories being consumed.

Ratings and Nutrition Choices

Since ratings appeared to influence choices in Study 1 and Study 2, the follow up study looked to substantiate previous findings in the significance item likability can have on choices despite a simplified version of the target response. Paired t-test was conducted to analyze if differences existed between the ratings of items selected for each participant with the ratings of

items that were not selected by each participant. Results revealed a significant relationship between ratings and selections (t (128) = 19.97, $p < 0.01$) indicating nutrition choices were influenced by likability of each item. Thus, results were consistent with previous findings suggesting choices were made in favor of how strongly each item was liked or disliked while the anchors were largely ineffective.

Given ratings was a significant predictor of choice, exploratory analyses between items and ratings were conducted to examine behavioral responses more closely. Sixteen items of the 35 trial pairs were found to be selected by participants with a frequency of greater than 70% of the time. For instance, participants had an option between grilled chicken and salmon in one of the trial pairs. Grilled chicken was overwhelmingly preferred among participants with nearly 73% selecting the item compared to only 27% selecting salmon. The ratings for each item resulted in a similar disparity where grilled chicken was rated significantly higher (e.g. 6.0 vs. 4.5). Table 8. Items selected with high and low frequency in Follow Up Study.

	Item	**Percent Selected**	**Rating**
Trial Pair #2	Snickers	75%	4.3
	Oreos	25%	4.8
Trial Pair #4	Spaghetti	78%	5.7
	Macaroni & Cheese	22%	5.9
Trial Pair #5	Yogurt	79%	5.0
	Trail Mix	21%	3.7

Trial Pair # 8	Fries	78%	5.9
	Cookies	22%	5.4
Trial Pair #14	Tacos	74%	5.6
	Cheeseburger	26%	5.2
Trial Pair #16	Muffin	74%	5.2
	Donuts	26%	5.1
Trial Pair #17	Chicken Tenders	84%	5.9
	Peanut Butter & Jelly Sandwich	16%	4.2
Trial Pair #18	Hot Dog	71%	4.2
	Peanuts	29%	3.7
Trial Pair #19	Quesadilla	85%	6.2
	Nachos	15%	5.3
Trial Pair #20	Nutrigrain Bar	73%	3.9
	Cottage Cheese	27%	2.2

Trial Pair #22	Doritos	73%	4.4
	Cinnamon Rolls	27%	5.1
Trial Pair #23	Grilled Cheese	78%	5.6
	Cheesesteak	22%	3.8
Trial Pair #26	Wings	75%	5.4
	BBQ Sandwich	25%	4.5
Trial Pair #29	Grilled Chicken	73%	6.0
	Salmon	27%	4.5
Trial Pair #31	Greek Yogurt	77%	4.5
	Quiche	23%	3.6
Trial Pair #32	Caramel Frappuccino	76%	4.5
	Hot Chocolate	26%	5.0

Additional analyses examined the relationship between self-reported measurements for nutrition behaviors with ratings. Consistent with Study 1, the PANSE was significantly

correlated with both the DIET-SE and DAQ. However, the DIET-SE was not significantly correlated with the DAQ. Table 9. Correlation matrix of self-reported measures for nutrition behaviors in Follow Up Study.

	DIET-SE	**DAQ**	**PANSE**
DIET-SE	-	-0.06	0.30**
DAQ		-	0.25**
PANSE			-

Note: ** p < .01, * p < .05

However, multiple regression analysis revealed only the DIET-SE (b = -0.02, t (127) = -2.98, p < 0.01) was a significant predictor of item ratings explaining a significant amount of variance in the ratings (R^2 = 0.07, F (1, 127) = 8.90, p < 0.01). Consistent with Study 1, participants who reported more restrained eating behaviors on the DIET-SE also reported rating food items significantly higher than participants who did not report restrained eating behaviors on the DIET-SE.

Discussion

The development of obesity and cardiovascular disease are major contributors of death in the United States each year with poor nutrition and inadequate exercise as behavioral indicators of significant concern in public health (Mokdad et al., 2004). People often have difficulty regulating food consumption and physical activity and frequently fail to estimate appropriate levels of caloric intake (Carels et al., 2007) and the amount of exercise necessary for good health (Mertz et al., 1991). Previous work has established numerical anchors as an effective strategy to influence estimations and subsequent choices (Wilson et al., 1996). The current research

consisted of two studies attempting to incorporate numerical anchors for energy intake and energy expenditure recommendations to influence nutrition and exercise choices, respectively. Findings demonstrated numerical anchors, for both energy intake and expenditure, resulted in inconclusive evidence for influencing nutrition or exercise choices. A possible explanation as to why anchors were ineffective on responses could be from methodological errors in the design of the nutritional intake choice task in Study 1 and the energy expenditure choice task in Study 2. In Study 1, participants were anchored to a numerical value representing calories, but were asked to make choices with only serving size information in efforts to make the task more realistic. Likewise in Study 2, participants were anchored to a numerical value representing calories to burn, but were asked to make choices with only activity duration in efforts to make the task more realistic. Increasing the degree of difficulty of the nutritional intake choice task and energy expenditure choice task is one possible factor restricting anchoring effectiveness for each study. Modifications were made in the follow up study to decrease the degree of difficulty of the nutritional intake choice task; however, the ineffectiveness of the numerical anchors to influence nutrition choices was demonstrated even with simplified target responses.

It should be noted in Study 2 participants had a tendency to select the exercise option that burned fewer calories. Therefore, it is possible participants responded to the task to minimize exercise activity. Minimizing exercise activity is a behavioral pattern consistent with data suggesting the majority of people in the United States fail to meet exercise recommendations (U.S. Department of Human Health and Services, 2000). Thus, one reason it is possible numerical anchors for energy expenditure was ineffective could be a lack of desire to adhere to recommendations altogether. Likewise, participants in the follow up study to Study 1 had a tendency to select lower calorie options much more often. These findings indicate a desire to

avoid overconsumption of foods in terms of total calories. Serving sizes may complicate the evaluation of quantity consumed and resulted in participants less likely to select lower quantity options by comparison. One explanation for the differences in selections is participants may not be as familiar with typical serving size measurements (e.g. grams, ounces, cups) as they are with calories. Future studies could look to counter inadequate knowledge with typical food measurements by implementing training with certain units to determine if increased experience with common measurements can lead to healthier proportions of foods consumed.

Self-reported measurements designed to identify healthy eating patterns (e.g. the DIET-SE; Stich et al., 2009; the Dietary Attitudinal Questionnaire; Pettinger et al., 2004; and the PANSE; Latimer et al., 2011) and healthy exercise patterns (e.g. the PANSE; Latimer et al., 2011; the MPAM-R; Ryan et al., 1997; and the Godin-Shephard Leisure-Time Exercise Questionnaire; Godin, 2011) were also unsuccessful establishing a relationship between reporting healthy behaviors and adherence to intake or expenditure recommendations provided from a numerical anchor. Similar to the previous findings, the ineffectiveness of the numerical anchor was most likely responsible for an inability to establish a relationship with self-reported behaviors for eating and exercise. The lack of significant findings for self-reported measurements with anchors could see improvement if an effective anchor was to be established prior to assessment. Thus, self-reported measurements for nutrition and exercise behaviors may still be valid predictors of anchoring effects once a stronger anchor has been implemented to influence nutrition and exercise choices.

The poor results obtained involving numerical anchors leads to speculation inappropriate application or development of the anchor may have occurred. Improper use of an anchor has been shown to result in weakened effects if participants do not consider the range of the

numerical anchor plausible (Mussweiler et al., 2001). However, a more likely confound which could weaken the effects of an anchor is familiarity with the topic of interest. Previous work has identified individuals who are more familiar or have more knowledge with a topic are more confident making choices without assistance from an anchor, weakening any potential strength an anchor may have to influence choice (Alevy et al., 2011; Wu et al., 2012). Lastly, difficulty establishing effective numerical anchors has also been observed in participants with higher cognitive ability and reasoning skills (Bergman et al., 2010). Because the population of these studies consisted of college students, it is reasonable to assume a higher level of reasoning skills may have been present in participants negatively influencing the expected results.

However, it is possible the numerical anchors were constructed and applied properly but different factors were given precedence over the numerical anchors while completing each choice task minimizing the strength to influence decisions. Specifically, the likability of each item available to select in the task could mitigate the strength of a numerical anchor when making nutrition or exercise choices. Results demonstrated a significant relationship between ratings for each item selected and items not selected, where participants rated items selected more favorably on average than items not selected. These findings provide some insight as to why numerical anchors for energy intake and energy expenditure were unsuccessful in these studies. The likability of each item could have been the primary consideration determining choices. Thus, the numerical anchor was ineffective because participants were not considering recommendations for intake or expenditure as strongly as the degree in which they preferred each item. Preferences for items within trial pairs were so strong the effect of the anchor was significantly weakened. Potential solutions for future studies attempting to anchor nutrition or exercise choices could look to create trial pairs with items rated similarly in the degree of

likeness for the item. The manner in which items were paired in the current research was a clear limitation in the present findings. Rating the items prior to development of the trial pairs could help mitigate at least some of the bias for items that was observed in the current studies.

Additional limitations to Study 1, Study 2, and the follow up study were the restrictive design of each choice task. It is possible different effects would be observed with a more natural design where participants are able to choose more freely on nutrition choices and exercise activities. Possible modifications to designs could include anchoring participants with intake or expenditure recommendations and have them track daily nutrition and exercise activity in a journal over a period of time to eliminate forced choices in a simulated choice task. Establishing a realistic environment to apply concepts could significantly alter behavioral responses in a healthier direction.

In conclusion, numerical anchors were not established as an effective method to influence nutrition or exercise choices in the nutritional intake choice task or energy expenditure choice task, respectively. While a number of possibilities may have contributed to weak anchoring effects, the strongest evidence suggests people are more likely to make selections based on preferences than rely on information regarding energy intake or expenditures numbers provided from the anchors. Furthermore, individuals had a tendency to select exercises that burned fewer calories more frequently. Food consumption and physical activity remain an integral component of good health. If anchoring is not an effective method to facilitate changes in unhealthy eating or sedentary exercise habits, future research should consider exploring other strategies to increase awareness about the importance of establishing healthier behaviors.

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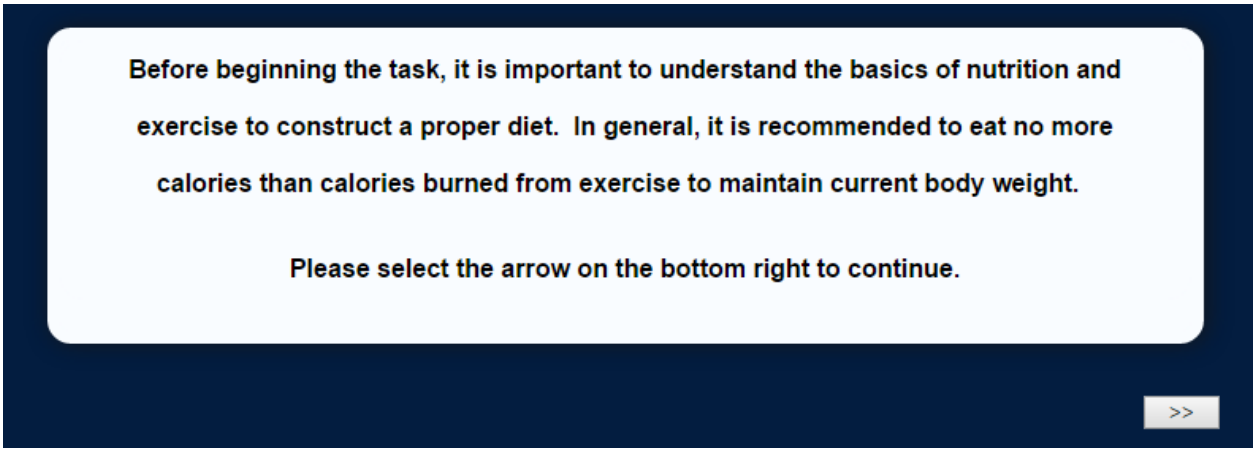
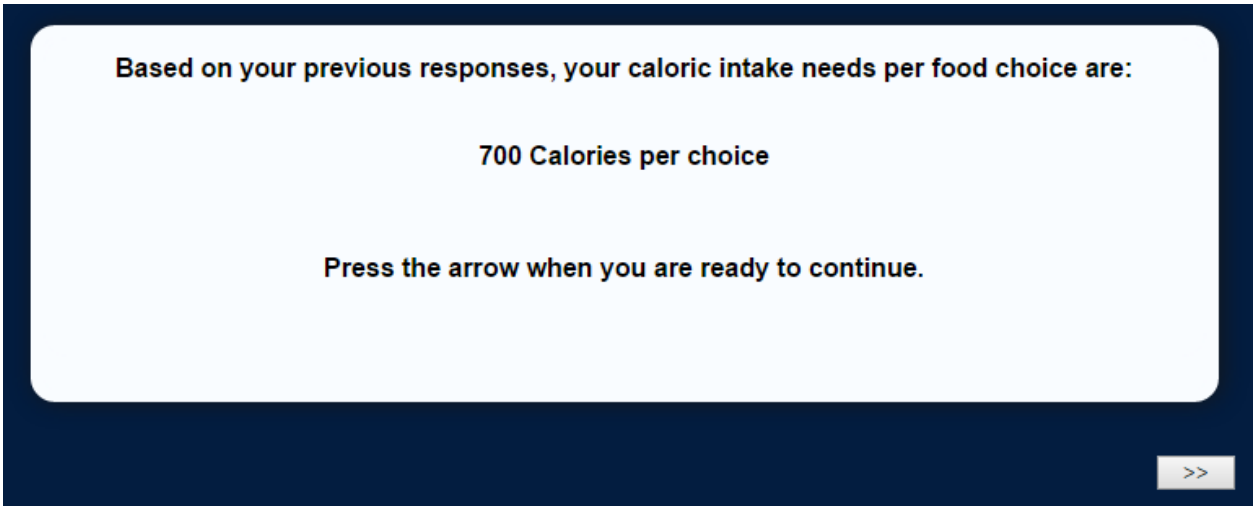
Appendix A

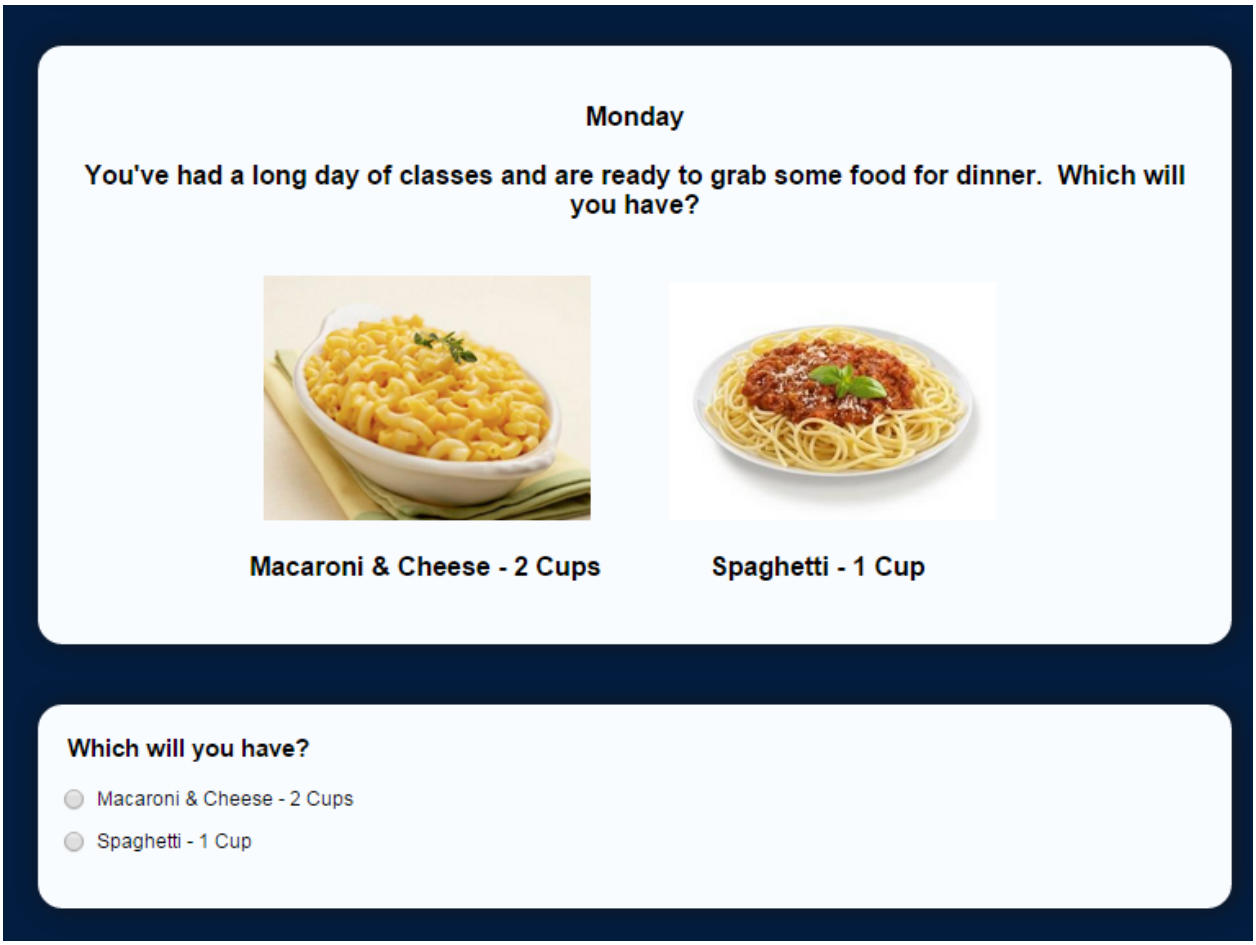
Screenshots of Tasks

A.1 – Nutritional Intake Anchoring Instructions

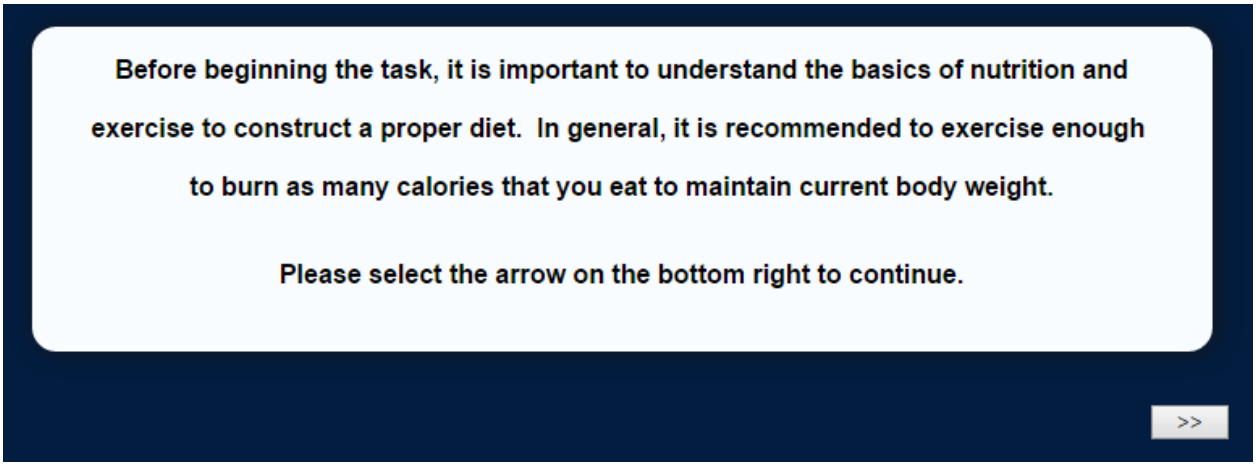


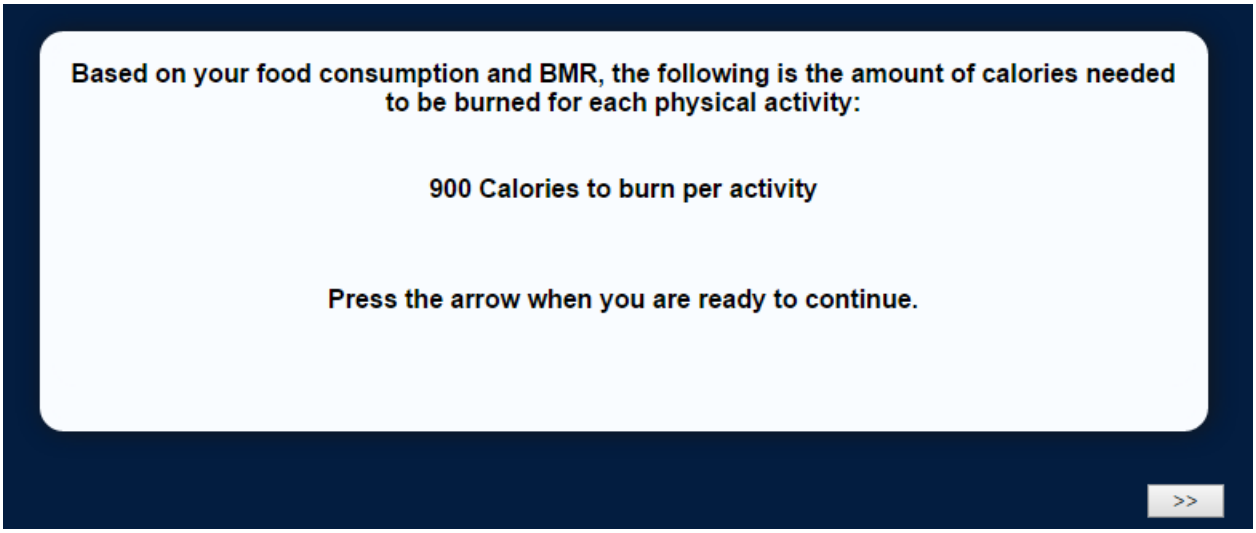


A.2 – Nutritional Intake Choice Task Example

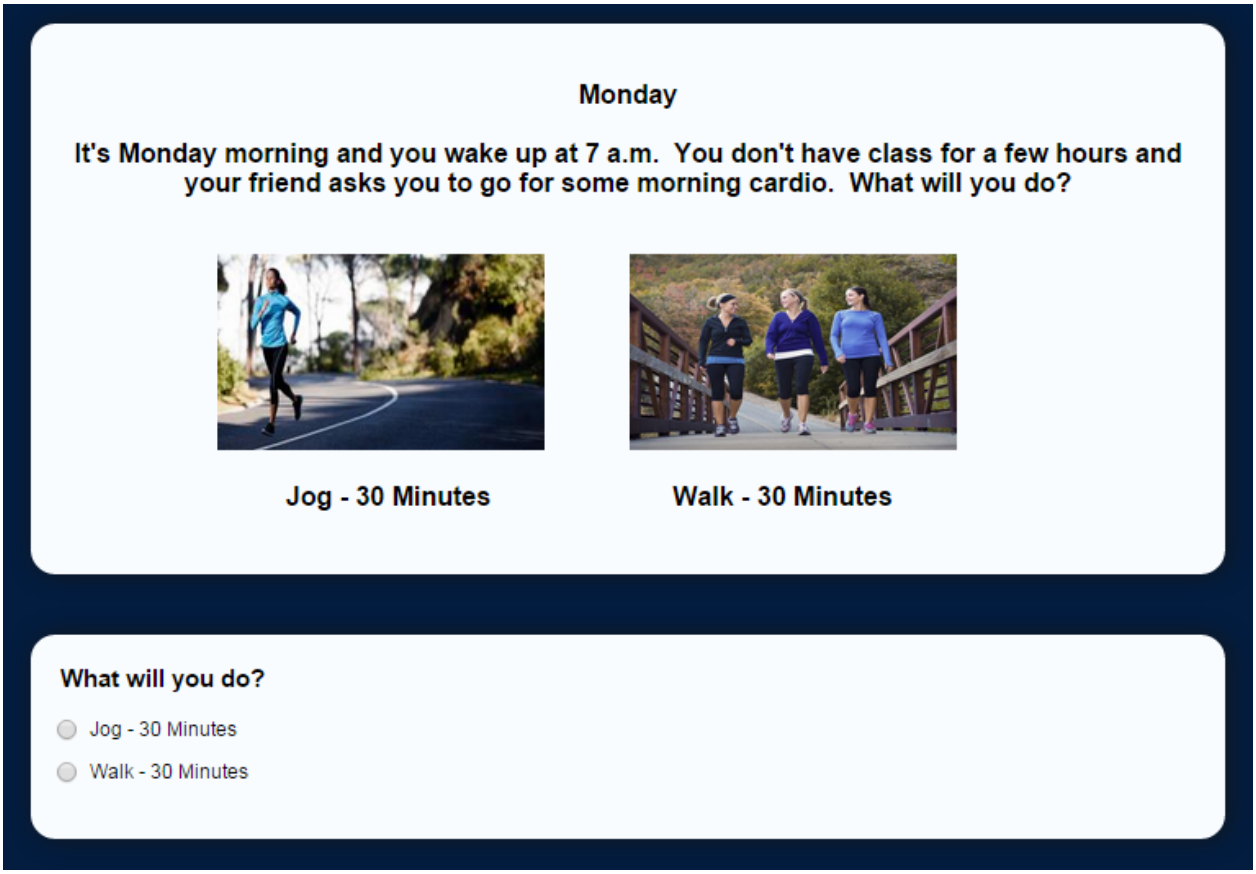


A.3 – Energy Expenditure Anchoring Instructions





A.4 – Energy Expenditure Choice Task Example



A.5 – Follow Up Study Nutritional Intake Choice Task Example

Appendix B

The DIET-SE

***Instructions**:* Please imagine yourself in each of the following situations and rate how confident you are that you could overcome them, using the 5-point scale below. Completely fill in the circle that best indicates how confident you feel that you could overcome the situation.

1. You are having dinner with your family and your favorite meal has been prepared. You finish the first helping and someone says, "Why don't you have some more?" How confident are you that you would turn down a second helping?

2. You often overeat at supper because you are tired and hungry when you get home. How confident are you that you would not overeat at supper?

3. There is a party at work for a coworker and someone offers you a piece of cake. How confident are you that you would turn it down?

4. You just had an upsetting argument with a family member. You are standing in front of the refrigerator and you feel like eating everything in sight. How confident are you that you would find some other way to make yourself feel better?

5. You are invited to someone's house for dinner and your host is an excellent cook. You often overeat because the food tastes so good. How confident are you that you would not overeat as a dinner guest?

6. You finished your meal and you still feel hungry. There are cakes and fruits available. How confident are you that you would choose the fruits?

7. You are at a friend's house and your friend offers you a delicious looking pastry. How confident are you that you would refuse this offer?

8. You are having a hard day at work and you are anxious and upset. You feel like getting a candy bar. How confident are you that you would find a more constructive way to calm down and cope with your feelings?

9. You feel like celebrating. You are going out with friends to a good restaurant. How confident are you that you would celebrate without overeating?

10. You are out with a friend at lunch time and your friend suggests that you stop and get some ice cream. How confident are you that you would resist the temptation?

11. You just had an argument with your boyfriend or girlfriend. You are upset, angry, and you feel like eating something. How confident are you that you would talk the situation over with someone or go for a walk instead of eating?

Participants respond with the following scale: 0 = Not at all confident, 1 = A little confident, 2 = Moderately confident, 3 = Quite confident, and 4 = Very confident

Appendix C

Dietary Attitudinal Questionnaire

Instructions: Please indicate how much each of the following statements reflects your attitude.

1. Making time for food shopping each week is a priority in my life. (R)
2. I always make time in the day to cook healthy and nutritious meals. (R)
3. I always take the time to sit down and enjoy my meal. (R)
4. I am prepared to wait in a shop if it means getting fresh and quality food products.
5. A 'home-cooked' meal is the basis of healthy eating.
6. Money spent on food is money well spent.
7. Quality is more important than cost when I choose food.
8. I buy organically produced foods where possible (no use of fertilizers and pesticides).
9. I think natural/organic foods are healthier than regular foods.
10. I think natural/organic foods taste better than processed foods.
11. I choose food in a way that minimizes cruelty to animals.
12. I am satisfied with my current weight. (R)
13. The way I look is important to me.
14. I am currently 'dieting' to control my weight.
15. I eat certain foods and then feel guilty about it afterward.
16. I do not worry about food, I just eat what I like. (R)
17. Cost of food is a source of worry for me.
18. I prefer being with people who do not worry about what they eat. (R)
19. As far as I am concerned food is just fuel to keep me going. (R)
20. I do not think about the nutritional aspects of the types of foods I eat. (R)
21. The best way to eat healthily is to eat what your body tells you to eat. (R)
22. Most illnesses can be avoided if you take the right steps.
23. My state of health and well-being is influenced mainly by factors over which I have little control. (R)
24. There is nothing more important to me than good health.
25. Good health is only of minor importance in a happy life. (R)
26. If you do not have health, you do not have anything.
27. It would be difficult for me to change my eating habits. (R)
28. I feel confident I could change certain aspects of my eating habits if I wanted to.
29. Someone else decides on most of the food that I eat. (R)
30. What my family/partner will eat has the greatest influence on the food I choose to buy. (R)
31. My lifestyle prevents me from eating a healthy and balanced diet. (R)
32. My choice of food is generally influenced by habit. (R)
33. I find there are a lot of conflicting messages concerning healthy eating. (R)
34. I get a lot of pleasure out of eating.
35. Providing someone with food is a way of showing how you feel about them.
36. I consider eating very much as an enjoyable social occasion.
37. I prefer to eat alone. (R)

Participants respond with the following scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, 4 = Agree, and 5 = Strongly Agree

Appendix D

Physical Activity and Nutrition Self-Efficacy Scale (PANSE)

Instructions: Please rate how confident you feel about doing the identified behavior.

1. How confident are you that you can reduce your portion sizes at meals and at snacks each day?

2. How confident are you that you can increase the number of fruits and vegetables you eat daily?

3. How confident are you that you can reduce the amount of butter and other fats or oils that you eat each day?

4. How confident are you that you can eat only a very small amount of fried food like fried chicken, French fries, potato chips, or other fried food each week?

5. How confident are you that you can reduce or omit drinking sugary drinks like cola, sugared teas and coffee, Kool-Aid, or other sugared soft drinks?

6. How confident are you that you can reduce or omit fats (butter, fatty meats or oils) in cooking vegetables, beans, or frijoles.

7. How confident are you that you can substitute lower calorie food – like fruits, vegetables, or yogurt – for high-calorie snacks, like cakes, pies, or ice cream?

8. How confident are you that you can reduce the amount of time you sit and watch TV?

9. How confident are you that you can increase time spent in physical activity while at home, given your current family responsibilities?

10. How confident are you that you can increase time spent in physical activity by walking or other activities outside the home?

11. How confident are you that you can select lower-calorie food at a fast food restaurant?

Participants respond on a scale of 1 (not at all) to 9 (completely). All responses are summed to obtain a total score. Scores can range from 11 to 99.

Appendix E

Motives for Physical Activities Measure – Revised (MPAM-R)

Instructions: Please indicate how true each response is for the reason you exercise.

1. Because I want to be physically fit.
2. Because it's fun.
3. Because I like engaging in activities which physically challenge me.
4. Because I want to obtain new skills.
5. Because I want to look or maintain weight so I look better.
6. Because I want to be with my friends.
7. Because I like to do this activity.
8. Because I want to improve existing skills.
9. Because I like the challenge.
10. Because I want to define my muscles so I look better.
11. Because it makes me happy.
12. Because I want to keep up my current skill level.
13. Because I want to have more energy.
14. Because I like activities which are physically challenging.
15. Because I like to be with others who are interested in this activity.
16. Because I want to improve my cardiovascular fitness.
17. Because I want to improve my appearance.
18. Because I think it's interesting.
19. Because I want to maintain my physical strength to live a healthy life.
20. Because I want to be attractive to others.
21. Because I want to meet new people.
22. Because I enjoy this activity.
23. Because I want to maintain my physical health and well-being.
24. Because I want to improve my body shape.
25. Because I want to get better at exercising.
26. Because I find this activity stimulating.
27. Because I will feel physically unattractive if I don't.
28. Because my friends want me to.
29. Because I like the excitement of participation.
30. Because I enjoy spending time with others doing this activity.

Participants respond on a scale from 1 (not true at all) to 7 (very true). All responses are summed to obtain a total score.

Interest/Enjoyment: 2, 7, 11, 18, 22, 26, 29
Competence: 3, 4, 8, 9, 12, 14, 25
Appearance: 5, 10, 17, 20, 24, 27
Fitness: 1, 13, 16, 19, 23
Social: 6, 15, 21, 28, 30

Appendix F

Godin-Shephard Leisure Time Physical Activity Questionnaire

***Instructions*:** During a typical 7-day period (a week), how many times on average do you do the following kinds of exercise for more than 15 minutes during your free time?

1. Mild Exercise (Minimal Effort) – e.g. yoga, archery, fishing from river bank, bowling, horseshoeing, golf without using a cart, snow-mobiling, easy walking.

2. Moderate Exercise (Not Exhausting) – e.g. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing.

3. Strenuous Exercise (Heart Beats Rapidly) – e.g. running, jogging, hockey, football, soccer squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling.

Participants respond by indicating the number of times per week they engage in each exercise intensity level.

Scores are determined using the following formula:

Weekly leisure-time activity score = (9 x Number of strenuous exercise a week) + (5 x Number of moderate exercise a week)