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Episodic future thinking and grocery shopping online

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Abstract

Grocery shopping shapes the home food environment, which can contribute to the development of obesity. Episodic future thinking (EFT) helps adults make healthier decisions by initiating prospective thinking, which guides one to forego smaller immediate rewards in favor of larger delayed rewards. EFT could help parents improve grocery purchases thereby improving the home food environment and family eating behaviors. The effect of EFT on food shopping was evaluated in two studies with mothers who were overweight/obese and primary household shoppers. In Study 1, 24 mothers were randomized to goal-directed process EFT versus a money saving control. In Study 2, 33 mothers were randomized to goal-directed process EFT, general EFT, or an episodic recent thinking (ERT) control. Following cue generation, participants completed a task where they purchased one week of groceries from an online store. Food purchases were analyzed for calories purchased per family member. In Study 1 the goal-directed process EFT group purchased fewer calories per person ($F(1, 23) = 25.16$, $p < .001$; $\eta_p^2 = .522$). In Study 2 the goal-directed process EFT purchased fewer calories ($F(1, 30) = 5.98$, $p = 0.02$; $\eta_p^2 = .166$) than the ERT control as did the EFT general group ($F(1, 30) = 4.61$, $p = 0.04$; $\eta_p^2 = .133$). The two EFT groups did not differ from each other ($F(1, 30) = 0.16$, $p = 0.69$; $\eta_p^2 = .005$). EFT may be an effective intervention when grocery shopping to reduce energy intake of foods purchased and could be a helpful component to a behavioral family-based obesity treatment program.

Two in three adults and one in three children were obese in America in 2016 and that rate has been steadily increasing since 1999 (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018). A major cause of obesity is a high intake of calorie-dense, nutrient-poor foods in tandem with a low intake of nutrient-rich foods (Dehghan, Akhtar-Danesh, & Merchant, 2005). Families that include children consume a majority of their calories from food that is purchased by parents, and mothers in particular tend to have greater control and influence over what their families consume when compared to other influences (Gibson et al., 2012; Raynor, Kilanowski, Esterlis, & Epstein, 2002; Savage, Fisher, & Birch, 2007; Scaglioni, Arrizza, Vecchi, & Tedeschi, 2011). Further, the home food environment includes micro- and macro- level influences and cues that shape eating behavior (Kegler et al., 2014).

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Given the influence of the home food environment on eating behaviors, targeting parent grocery selections may be an avenue for changing the shared home food environment which could improve a family's dietary patterns and combat obesity.

The access and availability of obesity promoting foods is an important mediator of the relationship between the home food environment and obesity. Cross-sectional research has shown that having sweet and savory snacks and sugar sweetened beverages available in the home has been associated with overconsumption of high-calorie foods, under consumption of fruits and vegetables, and overweight and obesity (Campbell et al., 2007; Larson, Laska, Story, & Neumark-Sztainer, 2012; Rosenkranz & Dzewaltowski, 2008). While access and availability of fruits and vegetables in the home has been related to greater consumption of fruits and vegetables and less consumption of "junk" foods (Campbell et al., 2007; Larson et al., 2012).

Episodic future thinking (EFT) is an intervention that has been used to help people consume fewer calories in tempting food situations in the laboratory (Daniel, Stanton, & Epstein, 2013b) and in cafeteria settings (O'Neill, Daniel, & Epstein, 2016). When making a decision about what to buy or eat in the present people vary in how much and how well they automatically engage prospective thinking (e.g. future-oriented thoughts) to consider how their decision in the present will affect their long terms goals (Atance & O'Neill, 2001; Bickel, Jarmolowicz, Mueller, Koffarnus, & Gatchalian, 2012; Daniel, Stanton, & Epstein, 2013a). This is thought to be related to the concept of delay discounting or the preference for a small immediate reward (e.g. dessert now) over a large distal reward (e.g. weight loss or weight stability later). Discounting of the future is thought to be one facet of impulsivity that is associated with a number of maladaptive behaviors and health outcomes, such as smoking, alcohol and drug use, gambling, obesity, and more (Rung & Madden, 2018).

Participants who engage in EFT vividly imagine specific future events they are looking forward to as though the event were happening in the present moment (Daniel et al., 2013a, 2013b). This episodic simulation reorients and potentially lengthens one's temporal window while decision-making and improves self-regulation (Atance & O'Neill, 2001; Bickel et al., 2012; Schacter, Benoit, & Szpunar, 2017). In previous experiments, those trained in EFT are consistently better able to resist the tempting scenario or make the more future-oriented decision than those in control conditions. EFT effects have been observed in *ad libitum* eating tasks with sweet and savory foods (Daniel et al., 2013b; O'Neill et al., 2016; Dassen, Jansen, Nederkoorn, & Houben, 2016), a cigarette purchasing task (Stein, Tegge, Turner, & Bickel, 2018), a cigarette smoking task (Stein et. al, 2016), and an alcohol purchasing task (Snider, LaConte, & Bickel, 2016).

To date, no studies have utilized EFT to help mothers choose lower calorie foods for their families while grocery shopping. We focused on mothers because of consumer and academic literature that suggests mothers are the primary food shoppers for their families, and are therefore a better target for a grocery purchasing intervention (Campbell et al., 2007; PLMA, 2013; Raskind et al., 2017). We included mothers who were overweight or obese to facilitate generalization to women who might be attempting to improve family food selection as an effort to promote a healthier body weight, and because parental overweight and obesity is a

strong risk factor for childhood obesity (Naess, Holmen, Langaas, Bjorngaard, & Kvaloy, 2016; Whitaker, Jarvis, Beeken, Boniface, & Wardle, 2010).

In two experiments we investigated whether training mothers in EFT before grocery shopping for a week's worth of food would modify their purchasing behavior online. In Study 1, we compared an EFT intervention group with goal-directed process-oriented cues (EFT_{GDP}) to a savings control condition. The EFT_{GDP} group generated cues about positive future events personalized with the participant's health goals and the shopping behaviors that would help them to reach that goal, while the savings control condition had participants focus their cues on how people save money while grocery shopping and controlled for the act of having participants generate and read cues while shopping. We hypothesized that the EFT_{GDP} group would purchase fewer calories than the savings control.

In Study 2, we conducted a systematic replication in which we kept EFT_{GDP}, but also added a general EFT group (EFT_{GEN}) and compared EFT to a standardized episodic recent thinking (ERT) control. The EFT_{GEN} group focused cues on positive future events that were planned or could really happen for the participant, and the standardized ERT control group had participants generate cues based on the recent experience of playing mobile application games during their appointment. ERT controls for engaging in episodic thinking, but varies the temporal window from recent experience (ERT) to future thinking (EFT).

For Study 2 we tested whether EFT_{GDP} adds beyond the EFT_{GEN} effect. We hypothesized that mothers hypothetically purchasing food for their families would purchase fewer calories in the EFT_{GDP} group than the EFT_{GEN} group. We also hypothesized mothers would purchase fewer calories in EFT groups when compared to the ERT control.

Study 1

METHODS

Power Analysis—For Study 1, we conducted an a priori power analysis using the effect size from a prior EFT intervention on calories consumed in a school cafeteria (O'Neill, Daniel, & Epstein, 2016). No prior studies have examined the effect of EFT on grocery shopping, but the study selected for the power analysis provided a close theoretical link due to employing the same intervention to intervene on calories. The EFT group in that study consumed 540.44 ± 178.20 (mean ± SD) calories while the ERT group consumed 749.32 ± 169.90 (mean ± SD) calories, ($F(1,27) = 10.38$, $p = 0.003$), for a Cohen's f effect size of .601. Based on an alpha of 0.05 and 0.80 power, the estimated sample size for Study 1 required 24 participants.

Participants—Participants for the present study were 24 mothers aged 18 – 65 with at least one child between the ages of 2 and 15 and a body mass index (BMI) greater than 24.9. See Table 1 for detailed participant characteristics.

Potential participants were recruited from Craigslist and targeted Facebook ads (women, aged 18 – 65) as well as via e-mails to our participant database. All recruitment ads directed to a SurveyMonkey eligibility screener that included questions on: family demographics

(age, sex, and race of all household members), health history (self-reported height and weight, untreated psychopathology, illnesses that impair the ability to use a computer for a prolonged period), recent participation in EFT studies (participation in an EFT study within the past six-months), desire to buy healthier food, and a one-item delay discounting question.

Desire to buy healthier food was used as an exclusion criterion because we wanted to enroll participants that were at least in the contemplation stage of behavior change (intending to change behavior within the next six months (Prochaska & Velicer, 1997)) and therefore open to dietary modifications.

The one-item delay discounting measure was from a U.K. study (n = 42,863) which asked "Would you rather have 45 euros in 3 days or 70 euros in 3 months?" and found that answers to this one question predicted multiple impulsive or protective behaviors (Reimers, Maylor, Stewart, & Chater, 2009). We adapted the question for inflation rates and United States dollar values to "Would you rather have $50 dollars in 3 days or $75 dollars in 3 months?" Those who selected $75 dollars in 3 months were excluded as we wanted to test the effectiveness of EFT among a more impulsive sample.

Other exclusion criteria included untreated psychopathologies (e.g. depression and anxiety) which was determined by a question which asked "Do you currently have any psychological conditions (such as a psychological disorder, anxiety, or depression)? If yes, please describe (when diagnosed and treatments)." Those who indicated "yes" and did not currently report receiving treatment were excluded because untreated depression and anxiety have been associated with greater discounting of the future and fatalism towards the future (Imhoff, Harris, Weiser, & Reynolds, 2014). Individuals with untreated medical conditions that would affect prolonged computer usage (e.g. carpal tunnel, computer induced migraines) were excluded as there was concern the risks of participation may outweigh the benefits.

Additionally, individuals with medical conditions or treatments that affect eating behaviors and consequent food purchasing (e.g. weight loss medication, bariatric surgery) were excluded because these conditions could influence how people eat and therefore how they buy food. We excluded participants who were dieting as to not bias the results with people who may already be purchasing and eating healthier by nature of participation in a new diet program. Lastly, we excluded those who had participated in a prior study where they generated EFT cues to ensure there were no carryover effects.

160 people completed the eligibility screener online on a rolling basis, of which 43 were eligible and invited to participate. Eligible participants were contacted via their preferred method of contact (e.g. by phone or email) and invited to participate. 5 people indicated they no longer wanted to participate or ignored recruitment contact and 14 people did not arrive for their appointment. Of the 43 eligible, 24 people arrived for their scheduled appointment, were consented, and participated in the study.

This study was approved by the university's Institutional Review Board. Participants were consented in a private study room and participated in the study in April and May of 2017. All data was collected by the first and second author.

Procedures

After consent procedures, participants were randomized to one of two groups, EFT_{GDP} or a savings control group. Prior to coming to the laboratory for their appointment, participants were instructed not to eat for at least three hours to control for the effects of hunger and satiety on grocery shopping (Tal & Wansink, 2013). Participants rated their subjective hunger and fullness and completed a same day dietary recall to confirm they had not eaten for the last three hours and that there was no group difference in hunger and satiety before the grocery shopping task. Upon completion of the dietary recall participants generated cues with a study staff member on Qualtrics.

Participants generated three cues with the content of the cue varying dependent on their group assignment. The intervention group in Study 1 was the EFT group with goal-directed process-oriented cues, which is a combination of two kinds of future-oriented cues that have been studied by our laboratory – goal-directed cues (O'Donnell, Daniel, & Epstein, 2017) and process-oriented cues (O'Donnell et. al, 2018). When creating goal-directed cues participants are asked to include a future goal related to the study's dependent outcome of interest, for eating behavior or grocery shopping studies it is often health related "*In about six months I am 10 pounds lighter*". Process cues have a participant identify and describe a process that will benefit the future event they are describing, which in health-related studies is often a description of behaviors that will help them to meet their health goal "*I am buying more water instead of pop or juice*".

In this study we combined the two unique aspects of these cues to create the EFT_{GDP} group, with a health goal and a grocery shopping behavior that would help the participant to reach that goal. This was completed in a three step process. First, participants identified a positive future event that they were looking forward to and could vividly imagine at three, six, and twelve months in the future. Next, they were provided with some example health goals (e.g. being more physically active, feeling more energized, eating healthier food, etc.) and were asked to identify their goal from the list or provide their own unique health goal. Finally, participants selected a shopping behavior that would help them to achieve their goal (e.g. replacing sugar sweetened beverages with water, buying more fruits and vegetables, buying less processed foods, etc.). A sample **goal-directed process EFT** cue is exemplified below:

> "*In about 1 month I am at my niece's birthday party with my children. We are dressed up in our costumes at my sister's house. The kids are playing hide-and-seek with their cousins and I am chatting with my family at the dinner table. I am feeling more energized throughout the party because I am buying less processed foods and eating less snacks*."

The savings group (semantic control) was provided with a list of savings goals (e.g. buying less prepared foods saves people money, buying produce in season saves people money, buying generic or store brand saves people money, etc.) and were asked to create three cues that focused on how a savings goal could help people to save money while shopping. "*Buying produce in season saves people money*" is an example of one of the **savings cues**. This control allowed us to account for the act of generating and reading cues about shopping

behavior throughout the study, but did not focus on the nutritional quality of the food being purchased, the future, or the process of meeting health goals.

After generating cues, participants started the grocery shopping task. The task was completed using a national retailer's existing online grocery store. The online store was selected for the usability of the site and the availability of 30,000+ products. First, participants were trained on how to use the store with a pre-task that asked them to search for, select, and add six common breakfast food items to their cart. After the pre-task, study staff explained how to complete the actual grocery task. See Supplemental Materials for instructional notecards that were provided to participants to supplement verbal instruction. The script read as follows:

> *"Imagine that you leave here and there is no food left in your home, so you head to the grocery store. You are grocery shopping for one week's worth of food. Because there are [NUMBER] of people in your family, the amount of money you can spend is [NUMBER FROM NOTECARD], if you forget it is also listed on this notecard. If you go over the amount of money listed, you will be asked to remove an item of your choice. Please do not include any paper products, toiletries, or cosmetics - imagine that you are solely food and beverage shopping. You can purchase drinks and you are free to select any brand of the food item you are purchasing.* [DEMONSTRATE THE FOLLOWING WHILE YOU EXPLAIN] *You can add more of an item by clicking on that item in your cart and hitting the plus sign button. You can also remove an item by hitting the minus button or by selecting "remove." Throughout the task we want you to keep your cues in mind, so once I leave I will come over the intercom and ask you to read your cues out loud and then you can begin shopping. About five minutes in, I will ask you to pause to read your cues out loud again. If you have any questions or once you have completed the task, please call out your question or say "I'm done." You will be asked to turn off your computer and then we will start the questionnaire. Do you have any questions?"*

Based on data from the 2017 USDA moderate-cost plan (USDA, 2017) participants were provided a hypothetical $50 per person in their household to spend while shopping (e.g. $200.00 for a family of four). We standardized the grocery budget so that variability in purchasing wouldn't be affected by the amount of money spent. Participants were not required to spend all of the money allotted and had as long as needed to grocery shop. Participants concluded the task when they said, "I'm done" out loud. If participants went over budget they were asked to remove an item of their choice from their cart.

Measures

Manipulation Check: After participants finished shopping they completed a paper questionnaire that asked "How often did you think about your cues during the task?" on a scale from one to five where one was "not at all" and five was "very often" and "How vivid were your thoughts about your cues?" where one was "not at all vivid" and five was "very vivid". After the manipulation check, participants completed a SurveyMonkey® questionnaire on a separate computer in the study room which included the following measures:

Demographic variables: Household income, education, occupation, marital status, household size, and the gender and age of each person in the home were collected using the sociodemographic questionnaire developed by the MacArthur Network.

Usual Fruit and Vegetable Intake and Fast Food/Restaurant Intake: These questions were modified from the Center for Disease Control (CDC) Behavioral Risk Factor Surveillance System (BRFSS) survey (Moore et al., 2015). We included 6-items pertaining to fruit and vegetable intake and 1-item pertaining to fast food/sit down restaurant food intake. Participants reported how often within the last week they consumed the item of interest. Usual fast food/restaurant intake was measured to determine how often families eat outside of the home as that could influence how much food they account for while shopping. Usual fruit and vegetable intake was recorded as differences could influence shopping behaviors and study outcomes.

Three Factor Eating Questionnaire (TFEQ): Although a newer 18-item questionnaire exists, we used the 51-item questionnaire to measure cognitive restraint, dietary disinhibition, and susceptibility to hunger (Stunkard & Messick, 1985). We measured the TFEQ to determine if any of these eating behavior factors influenced participant's grocery purchasing.

Grocery purchases were calculated from screenshots taken of the grocery cart items. The screenshots included the total number of items in the cart, specific details of the cart items (e.g. the quantity purchased, the size of the item, the weight of the item, etc.), and the grocery cart total. See Supplemental Materials for an example of a grocery cart screenshot. The research assistant checked the screenshots twice to ensure the data was complete, specifically they confirmed no items were visibly missing from the screenshots and that the cart "item total" matched the number of items counted.

After shopping, height and weight were measured using a digital scale (TANITA Corporation of America Inc., Arlington Heights, IL) and a digital stadiometer (Measurement Concept and Quick Medical, North Bend, WA). Body mass index (BMI) was calculated as BMI = kg/m2. Participants were then thanked for their participation and paid $25.00 in cash. Upon completion of the study, participants were entered into a drawing where they had a one in ten chance to win a $100.00 gift card to a local grocery store. After every ten participants, subject identification numbers were entered into an online random number generator by the first author. The first author matched the selected subject identification number to the participant information and that person returned to pick up a gift card and sign a receipt.

Grocery Cart Analysis—The total amount spent on the grocery shopping task was entered into excel and divided by the total number of people in the household to derive the variable "task spending", which is the amount participant's spent on groceries for each member of the household during the experimental shopping task (Table 1).

Grocery cart calorie and macronutrient content were analyzed using Nutritionist Pro software (Stumbo, 2008). Research assistants entered each item, the item quantity, and weight into Nutritionist Pro. The team created a standardization sheet for data entry that was

followed by all team members. For example, if the item did not have a weight listed on the retailer website (e.g. bell peppers, tomatoes, etc.) we found the standard weight for that food and that was input for all participants who bought that item. If the specific brand of an item was unavailable, the USDA standard was selected. For meats with a range listed (e.g. 1 – 1.5 pounds), staff were instructed to always select the highest weight. Grocery carts were triple checked for accuracy and standardization by a second research assistant and the first author. Calories and grams of fat, protein, and carbohydrates were divided by household size to derive calories and grams of macronutrients per person in the household per week as our dependent variable of interest.

Analytic Plan—Between groups analysis of variance (ANOVA) was calculated for all continuous variables and Chi-square tests were computed for categorical variables to assess group differences at baseline and as a function of the intervention. In addition, a multivariate analysis of variance (MANOVA) was run in which between group differences among each of the macronutrients (e.g. fat, protein, carbohydrates) were tested simultaneously, as the nutrients which make up a food item are not independent of each other. Analyses were performed both with and without covariates that differed between groups.

RESULTS

The unadjusted model found that the EFT_{GDP} group purchased significantly fewer calories/person (14,341 ± 2,866, mean ± SD) than the savings control group (22,156 ± 4,687, mean ± SD), ($F(1, 22) = 25.16$, $p < .001$, $\eta_p^2 = .522$ (Figure 1A). Additionally, the MANOVA showed an overall EFT_{GDP} group effect ($F(2, 44) = 5.77$, $p < .01$; Figure 1B, and contrasts showed that grams of fat ($F(1, 22) = 15.70$, $p < .001$) and carbohydrates ($F(1, 22) = 11.87$, $p < .01$) were significantly different while grams of protein were not ($F(1, 22) = 2.59$, $p = 0.12$). Between group differences were observed for analyses of participant's age and how vividly participants imagined their cues while shopping (Table 1). When included as covariates the EFT_{GDP} group purchased 14,254 calories/person, while the savings control purchased 22,258 calories/person, ($F(1, 22) = 17.27$, $p < .001$, $\eta_p^2 = .440$).

Study 2

While the first study showed that EFT_{GDP} produced significant differences in calories and macronutrients purchased, the savings control group used semantic, not personalized or episodic cues, which may have accounted for the difference between groups. The EFT_{GDP} findings could also be due to health priming. Priming occurs when an environmental stimulus (e.g. picture, word) leads to encoded memory without effortful processing, which can then influence cognition or behavior (Bargh & Pietromonaco, 1982). To alleviate those concerns, in Study 2 we included the EFT_{GDP} group and an EFT group that created general cues (EFT_{GEN}) to determine whether changes in shopping behavior are greater if health goals and a process for meeting those goals are included in EFT or if EFT alone improves shopping behavior. We also included an ERT control group to confirm whether there is an independent EFT effect.

Many prior EFT studies have used an ERT control that focuses participant cues on recent personal experiences (e.g. “About 24 hours ago I was eating dinner with my family…”) (Daniel, Said, Stanton, & Epstein, 2015). ERT provides a strong control condition because it has the participant engage in similar cue formation and rehearsal, with the difference being the temporal orientation of the cue. However, it has been hypothesized that the process of prospection may be reliant upon the recall of past memories, and recall may thus unintentionally initiate prospective thinking (Demblon & D’Argembeau, 2014; Schacter, Addis, & Buckner, 2007).

To reduce the potential that ERT would initiate prospection around future health behaviors, the present control condition was a novel standardized ERT condition that focused the participant on the recent personal experience of playing mobile games in the laboratory. The task allowed us to control for the process of generating a personalized cue of an episodic memory, but standardized the recent experience for all participants. We think this is an ideal control for EFT studies because it manufactures and standardizes the content of the recent episodic memory, which could limit the potential for participants to initiate personalized prospective thinking about food habits or weight loss. Further, playing the mobile games in the laboratory was rated by participants as a highly enjoyable activity that was able to be vividly imagined while grocery shopping, which controls for those aspects of the EFT cues.

In previous experiments it was found that goal-directed EFT led to improvements in delay discounting when compared to general EFT (O’Donnell et al., 2017), but new research has not seen benefits of process-oriented EFT beyond general EFT for adults (O’Donnell et. al, 2018). In the present study we were curious if goal and process cues together would improve behavior similarly to goal-directed cues. In the present study we hypothesized that the EFT_{GDP} group would purchase grocery carts with lower caloric content and better macronutrient profiles than both the general EFT group and the ERT control. We also hypothesized that we would see an independent EFT effect, such that the general EFT group would also purchase significantly fewer calories and better macronutrient profiles than the ERT control.

METHODS

Power Analysis

Before Study 2, we conducted an a priori power analysis using the effect size from Study 1 (Cohen’s f = 1.024 or η_p^2 = .522) to determine how many participants were needed. Using alpha of 0.05 and power of 0.80, the effect size from Study 1 suggested that Study 2 required 5 participants per group or 15 subjects total.

Participants

Participants (n = 33) consented and participated in the study from November 2017 through January 2018. All data was collected by the first and second author. The same recruitment methods and eligibility screener from Study 1 were used to recruit participants for Study 2. All of the inclusion criteria applied, except that we no longer excluded participants based on

the one-item delay discounting measure in order to make the study more generalizable by including people with a wide range of prospective thinking.

228 people completed the eligibility screener and 62 were contacted to participate in the study. 166 people were excluded for not meeting one or more criteria, 24 participants declined to participate, and 3 people failed to show up for their appointment. 35 participants were randomized to one of three groups and completed the study. Two of the 35 participants (one from the EFT_{GDP} group and one from the general EFT group) were excluded from analyses because their data had methodological problems, in that their questionnaire data was inconsistent (e.g. the first reported two different answers for income and birth date, the second refused to answer multiple questions). See Table 2 for detailed participant characteristics.

Procedures

Participants were randomized to one of three experimental groups: EFT_{GDP}, EFT_{GEN}, and the novel ERT control. At the start of the appointment we conducted similar procedures as Study 1 (e.g. measuring hunger and fullness as well as a dietary recall). We also wanted to simulate the experience of shopping in a grocery store where unhealthy food cues tempt shoppers. To do this, visual cues (e.g. packages of common "junk foods," such as cookies, chips, and candies) surrounded the computer where the participant went grocery shopping. In addition, a freshly popped bag of Wegman's® brand movie theater buttery popcorn was placed in the room to provide pleasant olfactory cues while shopping, which would accompany shopping in a brick and mortar grocery store. See Supplemental Materials for sample stimuli.

Before cue generation, all participants played six of the top-rated free mobile application games for one minute each and rated each game on a scale from one to five where one was "do not like at all" and five was "like very much." After rating the games, participants went back and circled the picture of their three favorite games and played those games for an additional five minutes. After playing the games, the participant generated cues on Qualtrics with a study staff member. The EFT_{GDP} cues were crafted exactly as they were in Study 1. The EFT_{GEN} cues were created as described in prior studies where the participant is asked to vividly imagine and describe a specific positive event in the future. A sample **general EFT cue** reads as follows:

> "*In about one month I am at the Great Wolf Lodge with my family. I am inside the water park floating in the clear warm water. I am laughing and splashing around with my kids. I am feeling excited and happy*."

As previously mentioned, the ERT control cues detailed the recent experience of playing mobile application games during the laboratory appointment. An example of an **ERT cue**:

> "*About 5 minutes ago I was playing Bubble Witch in a beige room at UB. I was holding a tablet and sitting in a chair. I was using my finger to shoot colorful bubbles from a wand. As I matched the bubbles, it made them disappear. I was feeling accomplished and happy as the bubbles popped and I moved up each level*."

After cue generation participants completed the grocery shopping task, questionnaire, and payment procedures exactly as they had in Study 1.

Analytic Plan

Grocery carts were analyzed using the same methodology, standardization, and analytic plan as was used in Study 1.

RESULTS

Participant characteristics are shown in Table 2. Between groups ANOVAs showed that groups significantly differed in calories purchased ($F(2, 30) = 3.56$, $p = 0.04$; $\eta_p^2 = 0.191$). The EFT_{GDP} group purchased 14,667 ± 3,978 (mean ± SD) calories, the EFT_{GEN} group purchased

15,306 ± 3,458 (mean ± SD) calories, and the ERT group purchased 18,614 ± 3,709 (mean ± SD) calories (Figure 2A). Both the EFT_{GDP} ($F(1, 30) = 5.98$, $p = 0.02$; $\eta_p^2 = .166$) and EFT_{GEN} group ($F(1, 30) = 4.61$, $p = 0.04$; $\eta_p^2 = .133$) were significantly different than the control. The two future thinking groups did not significantly differ from one another ($F(1, 30) = 0.16$, $p = 0.69$; $\eta_p^2 = .005$). Analysis revealed that the frequency at which participants thought about their cues differed by group ($F(2, 30) = 5.48$, $p < 0.01$) and that findings are still significant when included as a covariate ($F(2, 29) = 3.94$, $p = 0.03$; $\eta_p^2 = .208$). Effects remained for the EFT_{GDP} versus control ($F(1, 29) = 6.64$, $p = 0.02$; $\eta_p^2 = .186$) and EFT_{GEN} versus control ($F(1, 29) = 4.47$, $p = 0.04$; $\eta_p^2 = .133$) as well.

The MANOVA analyzing grams of protein, carbohydrates, and fat was also significant, ($F(4, 60) = 3.97$, $p < 0.01$; Figure 2B). Contrasts showed that both EFT groups purchased significantly fewer carbohydrates than the ERT control ($F(1, 30) = 3.97$, $p < 0.01$) as well as independently purchased fewer carbohydrates than the ERT control (EFT_{GDP} versus ERT ($F(1, 30) = 5.58$, $p = 0.03$); EFT_{GEN} versus ERT ($F(1, 30) = 7.75$, $p < 0.01$)). We observed a trend towards significant differences in fat purchased for the EFT_{GDP} group when compared to the ERT control ($F(1, 30) = 3.04$, $p = 0.09$), which wasn't as strong when comparing the EFT_{GEN} group to the ERT group ($F(1, 30) = 1.12$, $p = 0.30$).

DISCUSSION

Goal-directed process EFT and general EFT helped mothers purchase fewer calories in an online grocery store, with no differences in calories purchased between the EFT_{GDP} and the EFT_{GEN} group ($\eta_p^2 = .166$ vs. $\eta_p^2 = .133$, $p = 0.69$). Therefore, EFT_{GDP} does not improve calorie outcomes beyond $EFT_{GEN.}$ Our findings were contrary to our expected hypothesis, but consistent with research showing similar changes in delay discounting for EFT process and EFT general cues for adults (O'Donnell et. al, 2018). These results suggest that the effects found in the present studies are not due to health priming or demand characteristics associated with the health focus of the EFT cues, but are due to having participants vividly imagine their own personal future while decision-making.

Changing the home food environment should be a priority of obesity treatment or familybased health improvement programs because it is where families are consuming a majority of their meals. In the present studies, mothers on average reported eating outside of the home 1 to 3 times during the past week, which would only account for 5–15% of family meals each week. Prior research has estimated that 65–76% of daily energy intake is from food consumed at home for both adults and children (Poti & Popkin, 2011; Smith, Ng, & Popkin, 2013). Our findings from the studies presented and prior literature suggest that foods from home account for a majority of the meals and calories consumed by all age groups. The present studies provide a novel intervention that could help parents to replace high calorie high carbohydrate foods with lower calorie lower carbohydrate foods while grocery shopping. This would reduce the total calories available at home and subsequently reduce total calories consumed.

A strength of the presented studies is the systematic internal replication of an EFT effect on purchasing behavior, but the studies have limitations. First, the studies only provide data on hypothetical shopping in an online grocery store. While behavioral simulations provide the opportunity to test novel interventions in a controlled environment, hypothetically choosing healthy foods is not the same as incurring the real cost of buying and subsequently eating healthy foods.

Additionally, there is some evidence that pre-selecting grocery choices, such that occurs in online grocery shopping, could help people to make healthier decisions because they are committing to decisions in a neutral environment (Just, Mancion, & Wansink, 2007). To address this limitation, we used techniques commonly employed by grocery stores to increase impulsive purchases (e.g. scenting the lab room, displaying unhealthy food packaging) (Soars, 2009), which we believe provides justification for testing this intervention in the real-world.

A confound of Study 1 is that we had participants in the control group think about saving money and we did not control for the fact that more calorie dense foods could be cheaper. A systematic review of 27 studies found that the healthiest diets cost an extra $1.48 each day when compared to the least healthy diets, or about $10.50 per week (Rao, Afshin, Singh, & Mozaffarian, 2013). In Study 1, participants selected cues from a pre-determined list that included an equal number of health promoting or neutral suggestions for saving money while shopping (e.g. "*Buying* ***produce*** *in-season saves people money*," "*Buying* ***fewer prepared foods*** *saves people money*"). Nevertheless, participants may perceive less healthy foods as "thrifty" purchases and therefore be more likely to buy them.

Another limitation is that our studies report the calories and macronutrients purchased, but cannot provide a total picture of the nutritional quality of the purchased foods. While our macronutrient findings suggest that EFT may influence participants to purchase fewer carbohydrate heavy foods and that participants are trending towards purchasing fewer grams of fat as well, future studies will go beyond macronutrient content to evaluate overall diet quality using either the Healthy Eating Index (Appelhans, French, Tangney, Powell & Wang, 2017) or the Nutrient Rich Food Index (Drewnowski, 2010). These analyses are not possible with the data collected for the present study due to the ages and dietary recommendations

varying by member of the household, but future studies could explore how to quantify grocery cart or receipt data for multi-age households. Another limitation of the studies is that samples focused on mothers with overweight and obesity who are the primary food shoppers for their families, and as such results may not generalize to mothers of normal weight, fathers, or adults with no children.

There is a chain of decisions that EFT can influence from purchase to consumption. Prior studies have shown that EFT can reduce calories consumed in tempting food situations in the laboratory (Daniel et al., 2013b) and in the cafeteria (O'Neill et al., 2016), which are decisions further down in the decision-making chain. The present study adds to these findings and suggests that EFT may also be able to compete with the desire to *purchase* highly reinforcing foods and improve mother's grocery shopping habits which would prevent the food from ever reaching the home. By prompting someone to vividly imagine their personal future while they are making decisions (e.g. what groceries to buy to feed one's family) they may be better able to connect how purchasing unhealthy or healthy foods for their household today will have an impact on their life and their family's life in the future, which would help them to resist the temptation of buying and consuming highly reinforcing foods in the present.

The hypothetical nature of the purchasing task provides the opportunity to standardize the shopping experience, but online shopping may be different from shopping in a grocery store. A logical extension would be to implement EFT in a grocery store, similar to the way we implemented EFT in a cafeteria setting (O'Neill et al., 2016). Prior studies have established that EFT can be delivered remotely via one's mobile device (Sze, Daniel, Kilanowski, Collins, & Epstein, 2015). Reading or listening to EFT cues on one's mobile device while inside the grocery store could be an easy intervention to implement to reduce impulsive spending and unhealthy purchasing. EFT could also be a useful intervention for a dieting population, and future studies should recruit individuals who are actively trying to lose weight. EFT could help families meet their lower calorie shopping goals, and be a helpful component to established family or home-based weight loss or health improvement interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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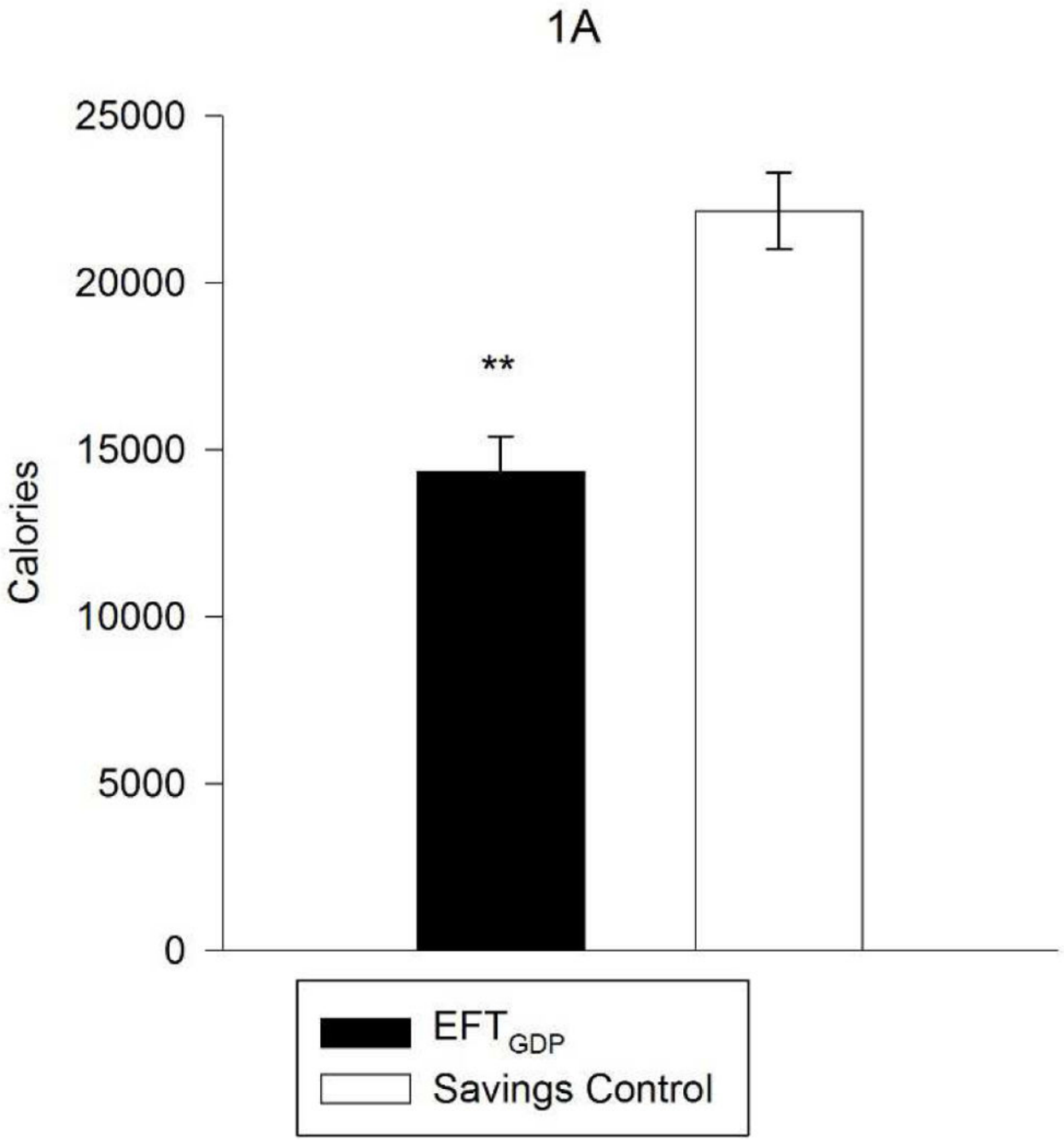

Fig. 1A.

Calories purchased (mean ± SE) for one week of groceries per person in the family. Participants randomized to the EFT_{GDP} group purchased fewer calories than those who were randomized to the savings control group ($p < .001$). * p ≤ .05 ** p ≤ .01 *** p ≤.001

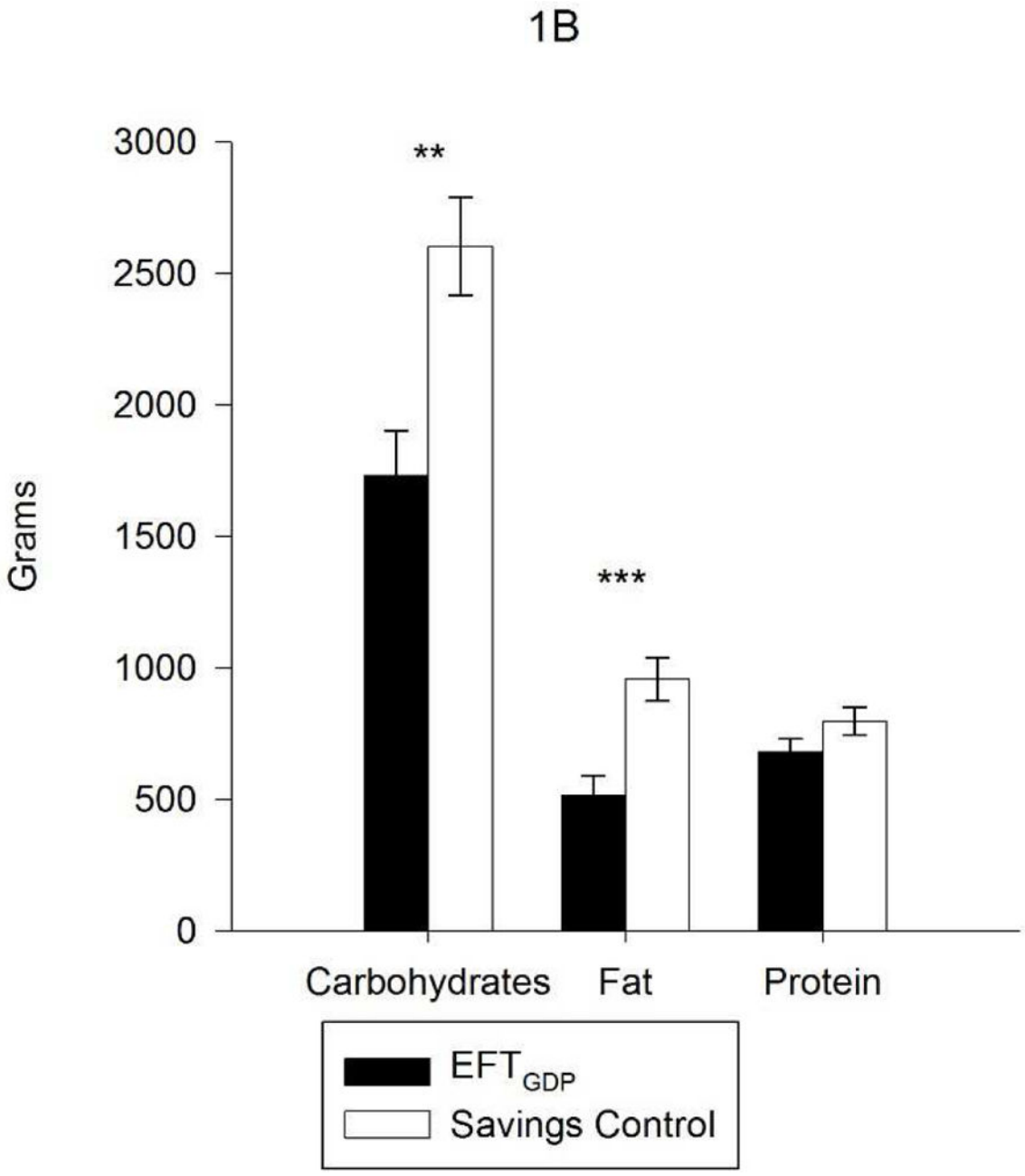

Fig. 1B.

Grams of macronutrients purchased (mean ± SE) for one week of groceries per person in the family. Participants randomized to the EFT_{GDP} group purchased fewer grams of carbohydrates ($p = .002$) and fat ($p = .001$) than those who were randomized to the savings control group, but similar grams of protein ($p = .12$). * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

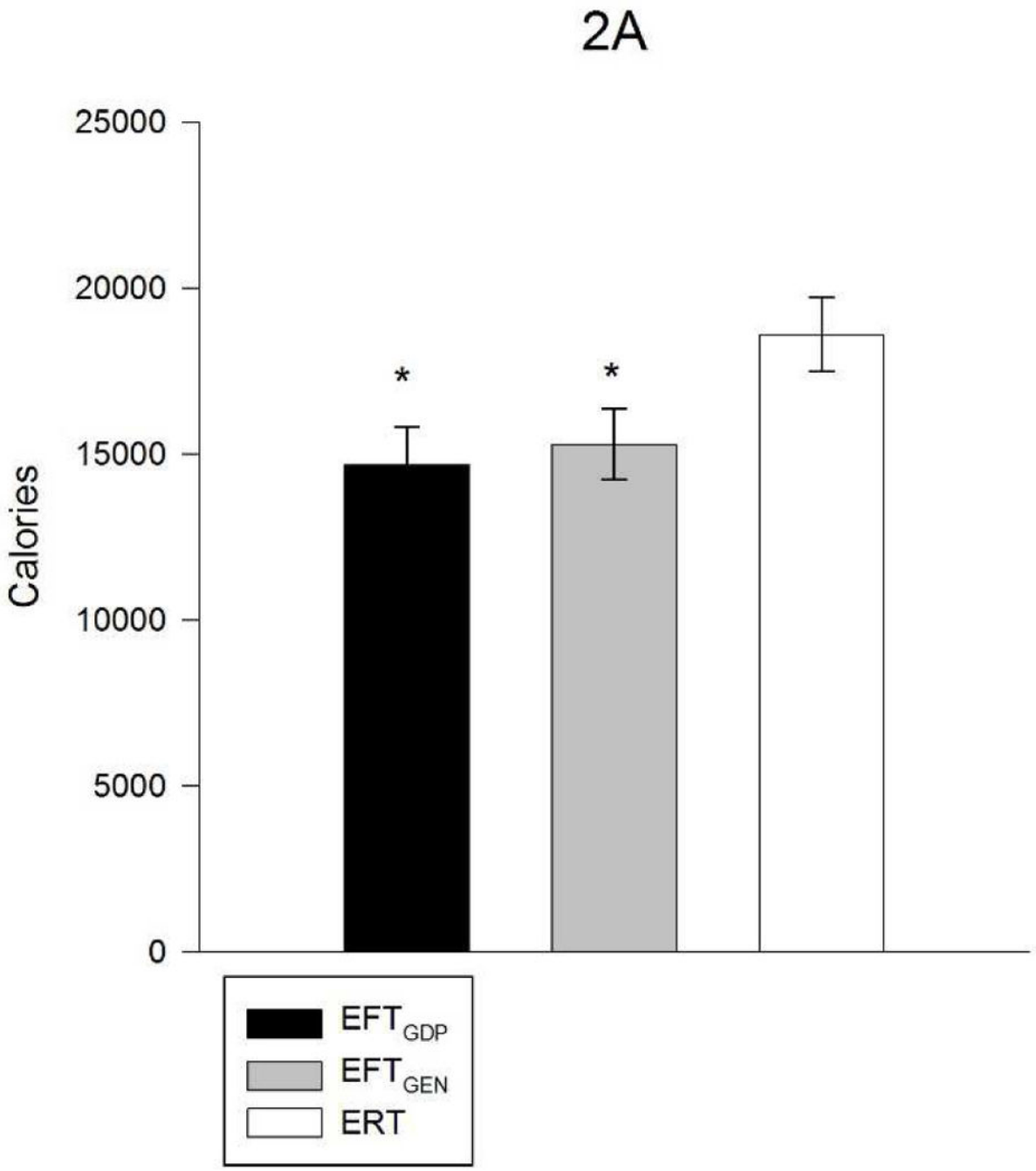

Fig. 2A.

Calories purchased (mean ± SE) for one week of groceries per person in the family. Participants randomized to the EFT_{GDP} group and EFT_{GEN} group purchased fewer calories than those who were randomized to the ERT games control group ($p = .04$), but the two EFT groups were not significantly different from each other ($p = .69$). * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

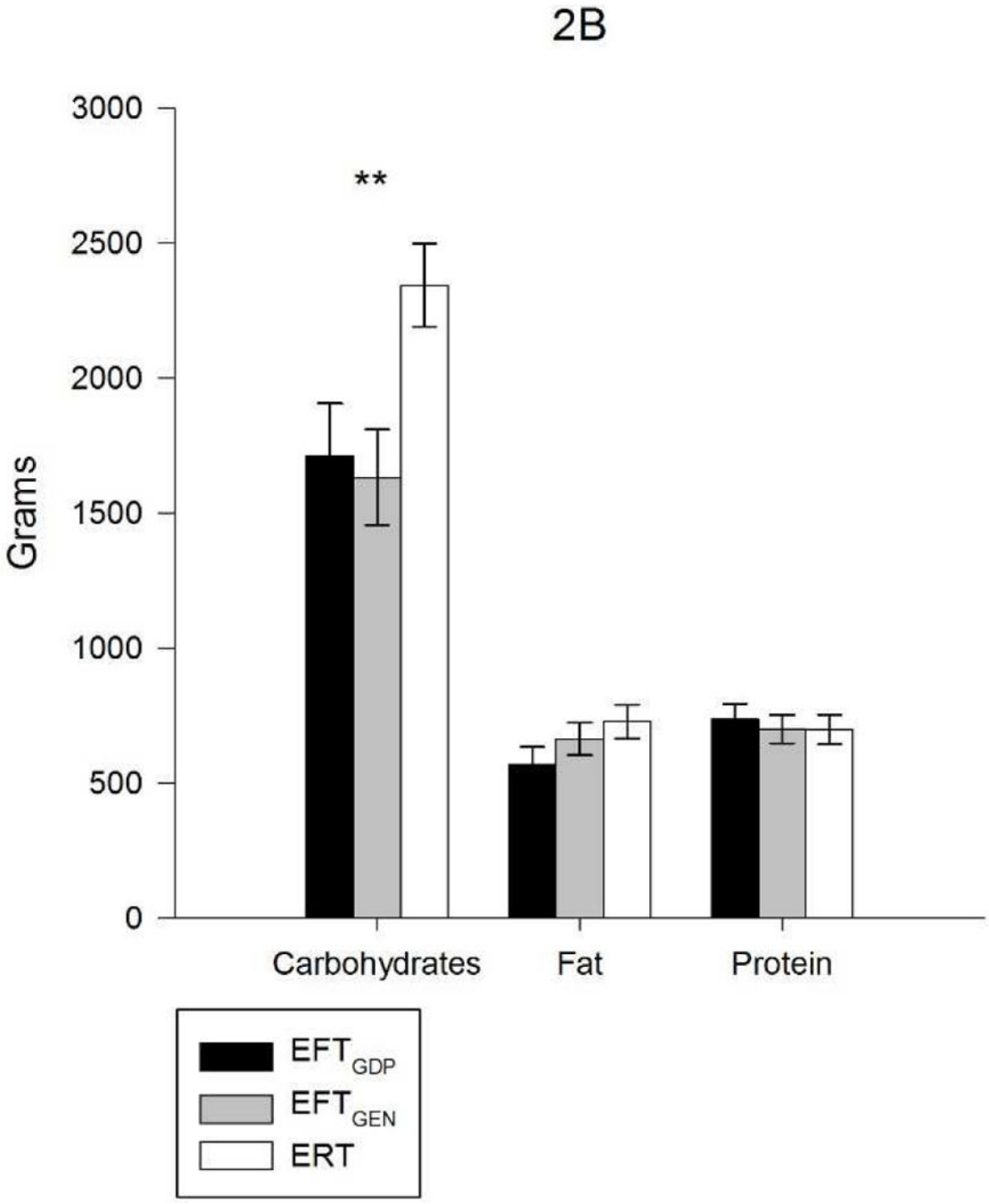

Figure 2B.

Grams of macronutrients purchased (mean ± SE) for one week of groceries per person in the family. Participants randomized to the EFT_{GDP} group and EFT_{GEN} group purchased fewer grams of carbohydrates ($p = .006$), but not grams of fat ($p = .16$) or protein ($p = .77$) than the ERT group. * p ≤ .05 ** p ≤ .01 *** p ≤.001

Table 1.

Study 1 Participant Characteristics.

	EFT Health Goal n = 13	**Savings Goal n = 11**	**p-value**
Age (Mean ± SE, years)[b]	37.5 ± 2.2	45.3 ± 2.4	**.03**
Income (Mean ± SE, $)[b]	68077 ± 12464	76363 ± 13550	.66
Education (Mean ± SE, years)[b]	15.0 ± 0.7	15.5 ± 0.7	.68
Body Mass Index (Mean ± SE)[p]	31.5 ± 1.7	33. 2 ± 1.9	.52
Family Size (Mean ± SE, people)[b]	3.3 ± 0.3	3.9 ± 0.3	.20
Race (n, %)[b]			.39
White	6(46.15%)	7 (63.64%)	
Non-white	7(53.85%)	4 (36.36%)	
Imagery measures (Mean ± SE)[p]			
Frequency	3.9 ± 0.2	3.8 ± 0.3	.77
Vividness	4.3 ± 0.3	3.4 ± 0.3	**.04**
Task spending (Mean ± SE, $)[p]	49.27 ± 0.3	49.99 ± 0.3	.11
Measures of satiety (Mean ± SE)[b]			
Hunger	3.6 ± 0.3	3.1 ± 0.4	.30
Fullness	1.6 ± 0.3	1.6 ± 0.3	.96
Eating factors (Mean ± SE)[p]			
Disinhibition	6.5 ± 0.9	6.1 ± 1.0	.78
Restraint	9.8 ± 1.3	10.2 ± 1.4	.83
Hunger	3.8 ± 0.9	4.7 ± 1.0	.48
Dietary Habits (Mean ± SD)[p]			
Freq. of meals outside the home	2.0 ± 0.2	2.2 ± 0.2	.46
Fruit and vegetable consumption	13.2 ± 0.7	13.0 ± 0.8	.88

*$*indicates United States dollar values

*b*indicates a baseline measure

*p*indicates a post-intervention measure;

“Task spending” is a measure of how much participants spent on one week of groceries per member of the household during the experimental task

Table 2.

Study 2 Participant Characteristics.

	EFT Health Goal n = 10	**EFT General n = 12**	**ERT Games n = 11**	**p**
Age (Mean ± SE, years)[b]	43.1 ± 2.8	40.3 ± 2.6	40.9 ± 2.7	.74
Income (Mean ± SE, $)[b]	75325 ± 13974	95625 ± 12757	67205 ± 13324	.30
Education (Mean ± SE, years)[b]	15.2 ± 0.8	17.2 ± 0.7	15.8 ± 0.8	.18
Body Mass Index (Mean ± SE)[p]	30.2 ± 2.1	33.0 ± 1.9	34.0 ± 2.0	.40
Family Size (Mean ± SE, people)[b]	3.8 ± 0.3	4.1 ± 0.3	4.5 ± 0.3	.39
Race (n, %)[b]				.51
White	8 (80.00%)	10 (83.33%)	7 (63.64%)	
Non-white	2 (20.00%)	2 (16.67%)	4 (36.36%)	
Imagery measures (Mean ± SE)[p]				
Frequency	3.9 ± 0.3	2.7 ± 0.3	2.7 ± 0.3	**.01**
Vividness	3.7 ± 0.4	3.2 ± 0.4	2.8 ± 0.4	.26
Task spending (Mean ± SE, $)[p]	49.43 ± 1.1	46.52 ± 1.1	49.15 ± 1.1	.13
Satiety (Mean ± SE)[b]				
Hunger	3.8 ± 0.3	3.7 ± 0.2	3.9 ± 0.3	.79
Fullness	1.5 ± 0.3	1.5 ± 0.3	1.6 ± 0.3	.99
Eating factors (Mean ± SE)[p]				
Disinhibition	8.0 ± 1.2	6.6 ± 1.1	8.2 ± 1.1	.55
Restraint	9.3 ± 1.4	9.1 ± 1.3	10.0 ± 1.4	.90
Hunger	6.0 ± 1.2	5.0 ± 1.1	6.8 ± 1.1	.49
Dietary Habits (Mean ± SD)[p]				
Freq. of meals outside the home	1.9 ± 0.2	1.8 ± 0.2	2.0 ± 0.2	.78
Fruit and vegetable consumption	12.9 ± 0.8	13.8 ± 0.7	13.3 ± 0.7	.71

*$*indicates United States dollar values

*b*indicates a baseline measure

*p*indicates a post intervention measure;

"Task spending" is a measure of how much participants spent on one week of groceries per member of the household during the experimental task