

# Effects of Fruit and Vegetable Feeding Messages on Mothers and Fathers: Interactions Between Emotional State and Health Message Framing

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## Abstract

**Background** There is a pressing need to craft optimal public health messages promoting healthy feeding behaviors among parents. How these messages influence such feeding decisions are affected by multiple interactive factors including emotional states, message framing, and gender, but these factors have not been studied in the domain of parents' feeding of their children.

**Purpose** To evaluate the role of message framing, emotional state, and parent gender on feeding choices that parents make for their children.

**Methods** In 2016–2017, 190 parents (126 mothers) of 4- to 7-year-old children were randomly assigned to an anger or fear emotion induction and read either a gain- or loss-framed message about the importance of children's fruit and vegetable (FV) consumption prior to choosing foods for their child from a virtual reality buffet.

**Results** Mothers in an angry state who received a gain-framed message chose relatively more FV for their child in the virtual buffet,  $F(3, 180) = 4.77, p = .027$ . However,

fathers in this group did not feed more FV, but rather reported greater intention to improve future FV feeding,  $F(3, 180) = 4.91, p = .028$ .

**Conclusions** Providing gain-framed messages to parents, particularly mothers, in an anger state may be most effective for motivating healthy dietary choices for children.

**Clinical Trial information** [clinicaltrials.gov NCT02622035](https://clinicaltrials.gov/NCT02622035)

**Keywords** Child • Nutrition • Emotion • Message framing • Parent gender • Virtual reality

Early childhood is a critical period for the development of eating habits and behaviors. Among children 3–8 years old, an estimated 65% to 72% of daily calories are consumed in the home, highlighting the importance of parents' feeding decisions on children's food intake [1, 2]. Throughout this period, children transition from reliance on parental feeding to autonomous food choice. Thus, parents' feeding practices establish dietary patterns that track into adolescence and adulthood [3]. Indeed, parents are one of the most important influences on the development of children's eating behaviors [4, 5].

As such, there is a pressing need to understand the most effective public health communication strategies to promote healthy child feeding behaviors among parents, as well as the factors that influence and moderate messaging effects. Previous studies investigating factors that influence the effectiveness of public health messages have pointed to the importance of framing messages to highlight losses or gains associated with health choices, as well as the emotional state of the message recipient. There is also emerging evidence that these two factors may play important interactive roles [6–8]. However, the interactive effects of message framing and emotional state have not been studied in the crucial domain of

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parental proxy decision making related to child feeding. Thus, the goal of this study was to evaluate the interactive influences of health message framing and emotional state—as well as parent gender—on parents' food choices for their children.

### Message Framing and Parental Decision Making

The framing of health messages has consequences for how the messages are received and whether health behavior change occurs as a result [9]. Prospect theory suggests that people tend to be more sensitive to losses than gains [10]. Health researchers have capitalized on this to think about ways in which loss frames can be leveraged, and to identify moderators to understand when gain frames may actually be more powerful [11]. Indeed, gain-framed messages (which articulate what one will gain from doing the behavior, such as health or vitality) have been associated with more behavior change than loss-framed messages (which articulate what one will lose from not doing the behavior, such as developing a disease), when the behavior in question is preventive [12]. Although this framework and associated empirical findings present important implications for the impacts of framed health messages on parents' feeding decisions, studies have not yet investigated framing effects in this domain.

Research in other domains of parent decision making, however, indicates that there may be reason to hypothesize unique effects of gain- and loss-framed messages in the context of parental decision making about child feeding. In a recent study of parents' supportive behaviors for children's physical activity, researchers found no differential effect of gain- versus loss-framed messages on increasing these behaviors; the authors concluded that the advantages of the gain frame may not extend to the decisions made on behalf of one's child rather than the self [13]. Research in the domain of vaccine promotion similarly suggests that the influence of framing on proxy decision making may be different from the influence of framing on decision making for the self. A meta-analysis found that parents may be more likely to vaccinate children following loss-framed health messages, as opposed to the typical dominance of gain-framed messages for preventive behavior [14].

### Emotions and Parental Decision Making

Emerging evidence suggests that emotion is a fundamental determinant of self-focused health decisions [15]. However, there is limited research linking parents' emotions to their child-related food decision making. These few extant studies have linked parents' levels of positive affect to supportive feeding styles and encouragement

of child autonomy during feeding. Conversely, levels of negative affect have been linked to greater provision of unhealthy foods, greater perceived feeding problems, and more controlling feeding practices [16–20].

Yet rather than focusing exclusively on generalized negative or positive affect, emotion theorists highlight the importance of also examining the influence of specific emotional states on health decision making and behavior [15]. Discrete emotions exert distinct and important influences on cognitive processes such as risk perception and action tendencies, which have been linked to self-focused feeding behaviors and reactions to health messages [21–27]. Anger and fear are two specific emotions frequently studied due to their relevance to behavior change messages and health [28]. In addition, theoretically, in accordance with the Appraisal Tendency Framework, these emotions are associated with opposite action tendencies, which can facilitate differential health behaviors [29]. Individuals in an anger state, for example, tend to feel high levels of personal control and have approach-related action tendencies, whereas individuals in a fear state tend to feel low levels of control and have avoidance-related action tendencies. To date, we are aware of only one study linking parents' discrete emotions to child feeding practices; Faith and colleagues [30] reported that mothers who felt greater anger and frustration during feeding were more likely to pressure their child to eat. At present, no work has assessed the causal influence of discrete emotions on parents' actual food choices, or their responses to proxy-oriented health messages.

### Interactive Influences of Framing and Emotion

Evidence suggests that message framing and emotional state may operate interactively to influence health decisions and food choice. In a previous study by Gerend and Maner, individuals were induced to feel anger or fear, and then given gain- or loss-framed messages about the importance of fruit and vegetable consumption [7]. Here, a gain-framed message was more effective in increasing fruit and vegetable consumption for those in an angry state, whereas a loss-framed message was more effective for those in a fear state. These “matches” make sense given what is known about the characteristics of discrete emotions. An anger state is defined by a high sense of certainty and personal control, decreased risk perception, and increased reward seeking [22, 31]; these are good matches for gain-oriented messages. A fear state is defined by low perceived control and high perceived risk; these are good matches for loss-oriented messages [22, 32]. Indeed, in another study, participants completed an autonomy- or coercion-priming task, then received gain- or loss-framed health messages. Autonomy is related to

anger in its association with personal control, whereas coercion is related to fear in its association with low control. Those who received autonomy priming and gain-framed messages reported lower snack consumption and greater intention to avoid unhealthy snacks [8]. Taken together, the current evidence indicates that emotional states and framed messages may jointly operate to meaningfully influence health decisions, but these influences have not yet been studied in the domain of proxy decision making for children.

### Parent Gender

In crafting messages to encourage healthful child feeding, one final component to consider involves the gender of the message recipient. Fathers are underrepresented in child feeding research. A recent review of randomized controlled trials for obesity treatment and prevention reported that 92% of extant studies did not report on father involvement [33], despite the fact that fathers are consistently involved in feeding their young children, and can influence feeding in important ways. For example, a majority of fathers report being responsible at least half the time for organizing their child's meals and deciding what kinds of food the child will eat [34, 35], and fathers' feeding practices have been linked to their young children's eating behaviors [36]. Such findings underscore the importance of including fathers in research to improve child feeding. Nonetheless, there is a lack of research on whether and how fathers' approaches to child feeding may differ from those of mothers. Some studies have found that mothers and fathers significantly differ in their practices, most consistently reporting that fathers feel less responsible for child feeding than mothers [37–39], though others have found no differences [40]. The inconclusiveness of the current research makes it difficult to hypothesize potential effects of message framing and emotional state on fathers' feeding decisions. In all, current evidence indicates that fathers should be viewed as useful targets for health-promoting messages about child feeding, but knowledge about how to effectively tailor and communicate such messages to fathers is scarce.

### The Current Study

The goal of the current study is to evaluate the role of message framing, incidental emotional state, and parent gender on feeding choices that parents make for their children. We evaluated these choices using behavioral measurement in a virtual reality (VR)-based buffet restaurant. Given the mixed findings and lack of literature to draw from on proxy decisions in this domain, hypothesis generation was difficult. Therefore, we began with the hypothesis that patterns for proxy decision making in

this case would mirror those in the literature on self-related decisions. In particular, we hypothesized that induced emotion and message frames would interact such that participants would select more servings of fruits and vegetables for their child in the VR buffet when exposed to the following combinations: anger with gain frame, and fear with loss frame. We made no *a priori* hypotheses regarding the role of parent gender.

## Method

### Participants

Participants included 190 parents, 66% of whom were mothers ( $n = 126$ ), who had a biological child between 4 and 7 years old and with no major allergies or dietary-related health conditions (as reported by the participating parent). Once participants were deemed eligible, study staff identified an "index child" who met study criteria from among participants' biological children. It was required that the index child be living at home with the parent at least part of the time. In the case of multiple eligible children, the child with the most recent birthday was included. In the case of twins, the child named first by the parent was included. Exclusion criteria included prior participation in the study by another household member or co-parent of the index child, having a seizure disorder or epilepsy, high propensity for motion sickness, known pregnancy, poor uncorrected vision or hearing, and high sensitivity to the content of the anger video clip (i.e., sexual assault). Participants were recruited by online and newspaper advertisements, flyers, from databases of individuals interested in research, and by word of mouth. All participants gave informed consent for the study and were compensated \$60 for their participation. All study activities were approved by the institutional review board of the National Human Genome Research Institute.

### Design

Participants were randomly assigned (using a random number generator) to one of four conditions resulting from a  $2 \times 2$  factorial design, where the independent variables were experimentally induced incidental emotional state (anger vs. fear) and message framing (gain vs. loss). Participants were further stratified by gender (mothers vs. fathers) in subsequent analyses.

### Procedure

Participants were asked to consider only the index child during all study activities. Participants were consented online, filled out a baseline questionnaire online, and



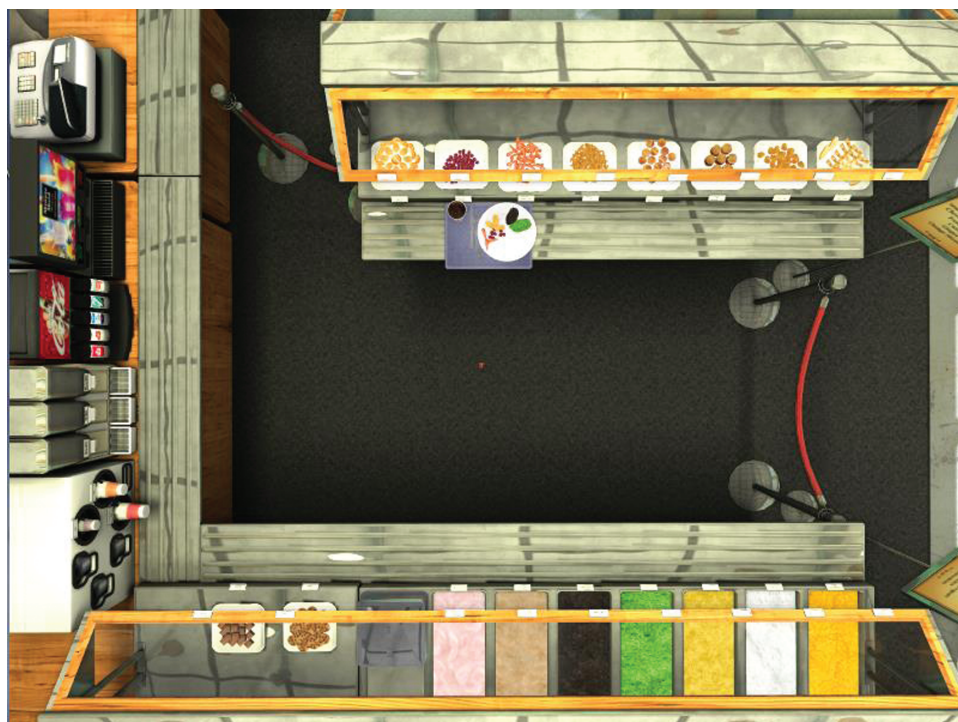
were then scheduled to come to the Immersive Virtual Environment Testing Area for an in-person study visit. The study was described as an assessment of the influence of new technologies in the context of child health, which was a concurrent aim of the study. Participants were told that they would perform a series of separate tasks, one after another. During the in-person visit, participants were re-consented and trained on how to use the VR buffet, and then they watched a computer-based film clip to induce either anger or fear. Anger was induced using a validated clip from the movie *Crash*, and fear was induced using a validated clip from the movie *The Ring* [41]. The clip from *Crash* deals with a White police officer sexually assaulting a woman of color in the presence of her husband. The clip from *The Ring* depicts a man watching a video that results in a creepy girl crawling out of his TV to attack him. These clips were chosen following pilot testing of four anger- and four fear-oriented emotion elicitation video clips described in the previous literature [41, 42] among a community sample of 10 adults (data not shown). This procedure induced incidental emotion, meaning emotion that is elicited outside of the context where its effect is evaluated. Incidental emotion is understood to influence outcomes similarly to integral emotion (emotion arising within context being evaluated) [43]. As such, emotion-related findings are believed to generalize to other contexts in which anger or fear influences parent behavior.

Following the emotion induction, participants completed a short “post-film” questionnaire to assess emotional state, that is, the effectiveness of the movie clips. They were then shown a PowerPoint presentation about child nutrition. Messages were focused on the health effects associated with feeding fruits and vegetables to children, and were modeled after materials used in Gerend and Maner’s 2011 study. Depending upon assigned condition, the material focused on either the advantages of consuming (gain frame) or disadvantages of not consuming (loss frame) enough fruits and vegetables for children. We adapted materials to adhere to recommended dietary guidelines for children ages 4–7 (portion sizes, serving sizes), and adapted the risks and benefits mentioned to be more applicable to children (e.g., referencing cancer risk “in the future” as opposed to the present). Following the presentation, participants filled out a short “post-framing” questionnaire, which served as a framing manipulation check. They then completed a session in the VR buffet during which their fruit and vegetable choices were assessed. Finally, participants completed a post-test questionnaire and were debriefed.

## Measures

### *The VR buffet*

Parents’ fruit and vegetable feeding behavior was assessed with a VR buffet (Fig. 1). The VR buffet allows



**Fig. 1.** Overhead view of virtual reality buffet. This view is for illustration purposes only; participants did not view the buffet from this vantage.

assessment of participants' behavior in a more controlled way than other approaches, as it is exactly the same for every participant and thus avoids extraneous variables that may function as confounders. At the same time, food choice measures in the VR buffet give precise information about amounts of each food chosen. The VR buffet has been used in previous research to demonstrate intervention effects [44, 45], and a recent study showed that this method produces valid assessments of parent feeding behavior in real feeding environments [46].

In the VR buffet, parents were instructed to select foods and a drink that would constitute a lunch plate for their child, from among a variety of choices meant to be palatable to children and to represent a range of nutrient and calorie densities. The primary outcome variable for this study was the number of servings of fruits and vegetables parents chose for their index child. Items on the buffet that counted as fruit or vegetables were carrots, green beans, black beans, corn, grapes, and orange slices. Fruits and vegetables available on the buffet were chosen with a number of considerations in mind. Briefly, they were chosen to be frequently served in child-oriented food service environments, to contribute to a range of nutrient- and calorie-density available in the buffet, and to be generally palatable to children.

For each food on the plate, we determined the proportion of a serving that was represented therein (e.g., if a parent placed five baby carrots on the child's plate, this would represent half a serving of vegetables). Data regarding serving sizes were drawn from MyPlate.gov [47, 48]. From there, we summed all proportions of servings together to arrive at the total servings of fruits and vegetables selected for the index child.

### Self-report measures

In the baseline questionnaire (completed by participants online before the lab visit), we assessed several demographic variables with respect to both the parent and the index child. We also assessed baseline intention to improve child feeding of fruits and vegetables using four items, each on a 1–7 Likert scale (e.g., "I intend to increase the amount of vegetables my child eats within the next 6 months," 1 = *strongly disagree*, 7 = *strongly agree*; Cronbach's alpha = .89). We also measured parents' perceived feeding responsibility with the three-item responsibility subscale of the Child Feeding Questionnaire, each item on a 1–5 Likert scale (e.g., "When your child is at home, how often are you responsible for feeding him/her?" 1 = *never*, 5 = *always*; Cronbach's alpha = .90).

Following the in-lab emotion induction procedure, in the "post-film" questionnaire, we assessed participants' self-reported emotional state using an instrument consisting of 18 emotions [49]. Participants reported the extent to which they currently felt each emotion using a

0–8 scale (0 = *not at all*, 8 = *extremely*). Following the provision of the framed fruit and vegetable information, in the "post-framing" questionnaire, we administered a manipulation check assessing participants' perception of the information's gain versus loss framing with a 7-point Likert scale ("Would you say that the presentation focused more on the risks of not eating enough fruits and vegetables or on the benefits of eating enough fruits and vegetables?" 1 = *risks*, 7 = *benefits*) [7].

In the post-test questionnaire administered after the virtual buffet task, we assessed self-efficacy for feeding the index child fruit and vegetables using seven items [50], each on a 1–7 scale (e.g., "I am confident I can give my child healthy foods," 1 = *not at all confident*, 7 = *very confident*; Cronbach's alpha = .89). Again, at post-test, we assessed intention to improve child feeding of fruits and vegetables using the same items from the baseline questionnaire (Cronbach's alpha = .91 at post-test).

### Data Analysis

Preliminary analyses involved testing for significant differences in demographic characteristics of our experimental groups to determine the need for covariates in our primary analyses. We also conducted two-way ANOVAs to assess the effectiveness of our manipulations, emotion induction and message framing, across experimental groups. Subsequently, to evaluate our primary hypothesis, we conducted a three-way ANOVA to test for main and interactive effects of message framing, emotional state, and parent gender on total servings of fruits and vegetables chosen in the buffet. We considered controlling for whether participants filled the virtual plate to capacity and thus received an error message, as this was related to choosing more fruits and vegetables. Including these "full plate warnings" as a covariate left results unchanged; it is not included in the final model. From there, we explored condition effects on intention to improve fruit and vegetable feeding and self-efficacy by conducting three-way ANCOVA and ANOVA. We also assessed correlations among our primary variables, stratified by participant gender. We performed an *a priori* power analysis based on Gerend and Maner [7]. In an attempt to increase our sample of fathers, we surpassed the original planned sample of  $N = 165$  until there were at least 15 fathers randomized to each experimental group.

## Results

### Participant Demographics

Participants did not significantly differ in terms of demographics or baseline characteristics between experimental conditions (see Table 1). Overall, fathers

**Table 1** Sample demographics and baseline assessments

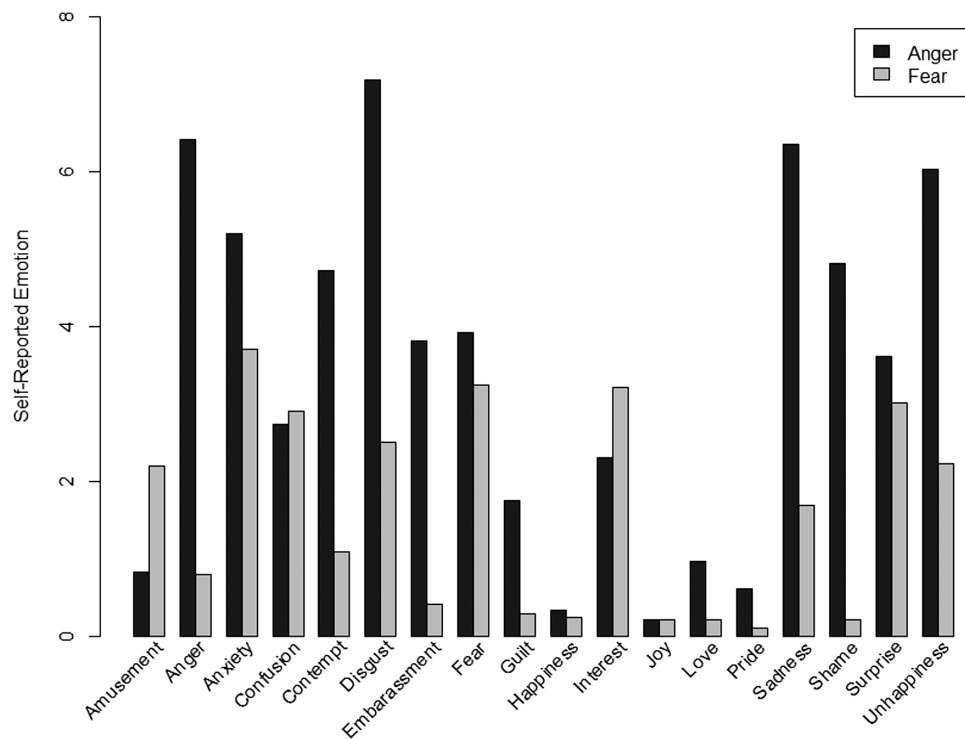
	Condition 1: Anger/gain ( <i>N</i> = 49)	Condition 2: Anger/loss ( <i>N</i> = 50)	Condition 3: Fear/gain ( <i>N</i> = 45)	Condition 4: Fear/loss ( <i>N</i> = 46)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Parent gender				
Male	15 (30.6)	18 (36)	15 (33)	16 (34.8)
Female	34 (69.4)	32 (64)	30 (67)	30 (65.2)
Index child gender				
Male	31 (63.3)	29 (58)	20 (44.4)	24 (52.2)
Female	18 (36.7)	21 (42)	25 (55.6)	22 (47.8)
Education level				
High school/some college	7 (14.3)	14 (28)	10 (22.2)	8 (17.4)
College graduate	18 (36.7)	12 (24)	10 (22.2)	13 (28.3)
Post graduate	24 (49)	24 (48)	25 (55.6)	25 (54.3)
Employment				
Employed full/part-time	40 (81.6)	38 (76)	39 (86.7)	40 (87)
Not employed	9 (18.4)	12 (24)	6 (13.3)	6 (13)
Race/ethnicity				
African American	10 (20.4)	16 (32.7)	9 (20)	14 (30.4)
Asian	1 (2)	10 (20.4)	6 (13.3)	5 (10.9)
Latino	7 (14.3)	3 (6.1)	4 (8.9)	4 (8.7)
White	24 (49)	17 (34.7)	25 (55.6)	22 (47.8)
Other	2 (4)	3 (6.1)	1 (2.2)	1 (2.2)
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
Parent age	38.24 (6.37)	37.46 (5.92)	38.44 (5.47)	36.67 (5.04)
Index child age	5.51 (1.16)	5.32 (1.15)	5.47 (1.18)	5.26 (1.12)
Parent BMI	25.32 (4.64)	29.14 (9.05)	28.85 (7.63)	27.55 (8.87)
Index child BMI	19.19 (8.94)	16.84 (3.64)	17.91 (5.37)	17.34 (5.94)
Feeding responsibility (range 1–5)	3.95 (0.80)	4.03 (0.84)	4.10 (0.68)	3.89 (0.79)
Intention to improve child's fruit and vegetable intake (baseline; range 1–7)	4.62 (1.28)	4.80 (1.45)	4.84 (1.36)	4.62 (1.43)

reported lower levels of feeding responsibility ( $M = 3.53$ ,  $SD = 0.79$ ) than mothers ( $M = 4.22$ ,  $SD = 0.66$ ),  $t = 6.02$ ,  $p < .01$ ,  $d = -0.95$ . In later analyses, we explored the role of perceived feeding responsibility as potentially underlying gender effects but did not find evidence of such a relationship (data not shown).

### Manipulation Assessments

Two-way ANOVA revealed a main effect of message frame such that, as anticipated, participants who received the gain-framed message perceived the information to be more focused on the benefits of feeding enough fruit and vegetables ( $M = 6.16$ ,  $SD = 1.33$ ), whereas those who received the loss-framed message found the information to be more focused on the risks of not feeding the child enough fruits and vegetables ( $M = 3.39$ ,  $SD = 2.01$ ),  $F(1, 184) = 359.6$ ,  $p < .01$ ,  $d = 1.63$ .

Participant reports of felt emotion following emotion inductions were more complex. A main effect of emotion induction emerged such that participants in the anger condition reported substantially higher levels of anger ( $M = 6.41$ ,  $SD = 1.67$ ) than the fear condition ( $M = 0.79$ ,  $SD = 1.51$ ),  $F(1, 184) = 1474.0$ ,  $p < .01$ ,  $d = 3.53$ . The anger group also indicated higher levels of disgust ( $M = 7.18$ ,  $SD = 1.30$ ) than the fear groups ( $M = 2.51$ ,  $SD = 2.58$ ; see Fig. 2). Participants who received the fear induction, however, did not report higher levels of fear ( $M = 3.24$ ,  $SD = 2.40$ ) than the anger conditions ( $M = 3.92$ ,  $SD = 2.87$ ),  $F(1, 184) = 22.0$ ,  $p = ns$ ,  $d = -0.26$ . Dominant emotions reported by the fear groups were fear, anxiety, interest, and surprise, although none of these reached particularly high levels. Comparing the two inductions, the fear groups reported higher levels of amusement and interest than the anger groups ( $ps < .01$ ). The anger



**Fig. 2.** Self-reported emotions in anger and fear induction groups

groups reported higher levels of all other emotions than the fear groups ( $ps < .01$ ), with the exception of excitement, confusion, happiness, joy, and surprise. Due to the unanticipated nature of the self-reported emotions associated with the fear induction, from this point forward, we will refer to this group as the “comparison,” or “not angry” group as opposed to the “fear” group. In addition, following previous reports [21, 42, 51], we conducted analyses controlling for self-report levels of disgust. Results were unchanged and models without disgust are reported here.

#### Servings of Fruit and Vegetables Chosen From the VR Buffet

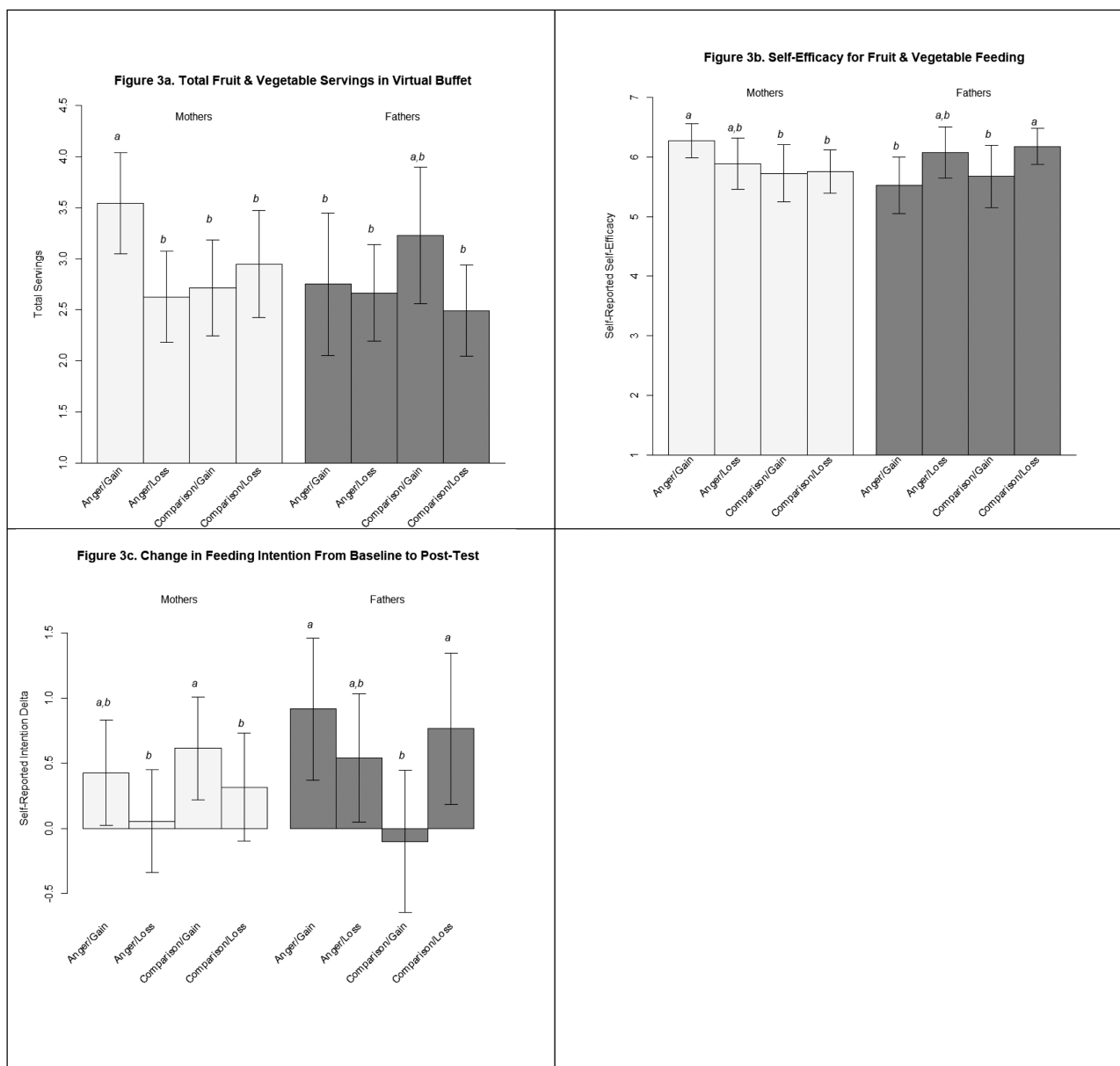
A three-way ANOVA was conducted to determine main and interactive effects of emotional state (angry vs. not), message framing (gain vs. loss), and parent gender (female vs. male). A significant main effect of message framing emerged,  $F(1, 180) = 4.14, p = .047, \eta_p^2 = 0.021$ , such that parents who received the gain-framed message chose more servings of fruits and vegetables in the virtual buffet. In addition, a significant three-way interaction emerged,  $F(1, 180) = 4.77, p = .027, \eta_p^2 = 0.027$ , such that among mothers, a combination of the anger induction and gain frame was associated with more servings of fruit and vegetables chosen than any other group of mothers, consistent with our hypothesis. This pattern was not observed among fathers (see Fig. 3A).

#### Self-Efficacy for Serving Fruit and Vegetables

A three-way ANOVA was conducted to test for main and interactive effects of parent gender, emotional state, and message framing on parent reports of self-efficacy to feed their child fruits and vegetables. There was a significant gender-by-message frame interaction,  $F(1, 181) = 4.85, p = .030, \eta_p^2 = 0.026$ , such that mothers who received the gain-framed message reported higher self-efficacy. Mothers in the anger/gain group reported the highest levels of self-efficacy, higher than either of the comparison conditions. Fathers in the anger/gain group, on the other hand, reported lower levels of self-efficacy, particularly as compared with the comparison/loss group (see Fig. 3B).

#### Intention to Improve Fruit and Vegetable Feeding

Intention to feed more fruit and vegetables to the index child increased among both mothers and fathers from baseline to post-test (mothers,  $t = 2.03, p = .04$ ; fathers,  $t = 2.17, p = .03$ ). A three-way ANCOVA was conducted to test for main and interactive effects of gender, emotional state, and message framing on post-test intention, controlling for baseline intention. There were no significant main effects. There was a significant three-way interaction,  $F(1, 180) = 4.91, p = .028, \eta_p^2 = 0.027$ , such that fathers who received the anger induction and gain-framed message reported greater increase in intention



**Fig. 3.** Graphs of outcomes by group for (A) servings of fruit and vegetables in the virtual buffet; (B) self-efficacy for feeding the child more fruits and vegetables; and (C) change in intention to improve fruit and vegetable feeding behavior from baseline to post-test. Groups labeled with the same letter are not significantly different from one another.

from baseline to post-test than the comparison/gain group. Fathers in the comparison condition who received a loss-framed message also showed relatively high increases, higher than the comparison/gain group as well. This pattern is consistent with the “match” hypothesis. Among mothers, this pattern was not observed (see Fig. 3C).

### Correlations Among Variables

Servings of fruits and vegetables chosen in the VR buffet were significantly correlated with self-efficacy for both

mothers ( $r = .34, p < .01$ ) and fathers ( $r = .29, p = .02$ ), whereas intention to improve fruit and vegetable feeding, at all timepoints, was uncorrelated with self-efficacy. Intention to improve fruit and vegetable feeding (baseline, post-test, and change between timepoints) was uncorrelated with servings of fruit and vegetables chosen in the VR buffet.

### Discussion

In the current study, we examined the interactive effects of message framing, emotional state, and parent gender



on mothers' and fathers' fruit and vegetable choices for their children. Our aim was to determine whether these important moderators would function similarly within the context of proxy parent feeding behavior, to their behavior within the context of self-focused decision making. Consistent with the self-focused literature, the anger/gain "match" was most effective; however, important gender differences were observed. Mothers in the anger/gain condition chose the most fruit and vegetable servings for their child in the VR buffet and reported the highest self-efficacy with regard to child feeding. Fathers in this anger/gain condition increased their intention to improve fruit and vegetable feeding the most (though not actual fruit and vegetable servings in the buffet), but also reported the lowest self-efficacy in this condition. In other words, an anger/gain combination translated to *actual* behavior change for mothers, but *intended* behavior change for fathers. We speculate that self-efficacy may have contributed to this differential outcome; however, we were unable to test this speculation due to sample size.

On the whole, our findings are at odds with the limited literature suggesting differential influences of message frames in parental proxy decision-making situations compared with self-directed decisions [13, 14]. Like encouragement of physical activity and vaccine provision, parental feeding of fruits and vegetables during childhood is sometimes regarded as a preventive behavior, and as such, one might expect to similarly see effects of message framing diverge from the self-oriented literature, as was shown in these previous studies. However, unlike the outcomes previously studied, fruit and vegetable feeding is a matter of degree as opposed to a choice between action and inaction. In addition, our work diverges from past studies in that we directly observed behavioral outcomes after the receipt of framed messages. In their 2017 study, Bassett-Gunter et al. [13] utilized self-report to measure parents' intentions and attitudes about encouraging children's physical activity; in their 2012 review, O'Keefe and Nan [14] did not distinguish between cognitive and behavioral outcomes in their analyses. Finally, our sample was comprised of a much larger proportion of fathers than in prior studies. These differences may have contributed to our contradictory findings. There may also be other moderators of message framing and emotional state effects yet to be identified, such as child gender or parent weight. However, our sample was not large enough to investigate these moderators alongside the influence of parent gender.

The current findings are in line with previous work regarding gender differences in response to emotion-induced action tendencies. For example, with regard to risk-taking, anger induces risky behavior in men but not women [52, 53]. As Ferrer and colleagues [52] suggest, this is presumably because there are social costs of aggressing and risk-taking for women but not men, and

an anger state facilitates high feelings of control in risky situations for men but not women. Indeed, both men and women decrease risk perceptions when they are angry, but only men act riskier, ostensibly because they are socially conditioned and rewarded for responding to transgression with action [52]. This suggests that although discrete emotions systematically change judgments and decision-making tendencies, these changes may only translate to action when social circumstances empower or reward such actions. In the domain of child feeding, mothers generally feel more control and are more experienced [39]; indeed, in our sample, mothers reported greater feeding responsibility than fathers. Thus, anger in this situation may facilitate increases in intention for everyone, but facilitate action tendencies only among women, who are more socially empowered and rewarded for making healthy food choices for their children.

Mothers in the anger/gain condition reported the highest self-efficacy among the mother groups, whereas fathers in this condition reported the lowest self-efficacy, providing further support for the differential role of action tendencies in our observed outcomes. In addition, self-efficacy was significantly correlated with fruit and vegetable choice for both mothers and fathers. Together, the evidence suggests a potential mediating role of self-efficacy. However, our sample size and study design did not allow for the implementation of a mediation model in the presence of three-way interactive effects. Whether similar gender effects would be observed for self-focused reactions is unknown; the study after which ours was modeled [7] did not report effects by gender as 77% of their sample was female.

Taken together, our findings present important implications for effective tailoring of parent-oriented public health messages. The current evidence indicates that the interactive influences of message framing and emotional state may be similar for self- and proxy-oriented behaviors, at least in the domain of fruit and vegetable choice. As in the case for the self-oriented literature, administering a gain-frame message to parents in an anger state appears to be most efficacious. This is not to suggest that practitioners should make parents angry before or in the course of delivering health messages. Rather, the current work suggests the possibility for capitalizing on emotion that may already exist in the context of child feeding. For example, in communication contexts where parents are already likely to be angry (e.g., while learning about children's health risk, or about how the food industry prioritizes profit over health), accompanying gain frame messages may be the best choice for inducing feeding changes. In addition, because anger likely influences parental reactions through associated tendencies toward agency and control, these processes can also be considered as potential, direct intervention targets.

In addition, the current evidence reiterates the necessity of including fathers in future research and considering parent gender when crafting public-health messages. Gender differences are clearly present with regard to involvement in child feeding, as well as cognitive factors such as action tendencies and self-efficacy, all of which are important determinants of whether a message will elicit the intended behavior.

Limitations of the current study also merit consideration. First, the fear induction manipulation did not operate as intended. We speculate that participants may have exhibited reactance to our attempt to induce fear using what has become a prototypical horror movie in the United States, or that we may have selected a popular and well-viewed film that is less fear-inducing during a second viewing because its ability to induce fear depends upon surprise. Although this movie clip was validated in previous work [41], and performed well in our pilot test, the current manipulation failure suggests the importance of sample and study context in the effectiveness of emotion inductions. However, while the film was not fear-inducing, it also induced significantly less anger than the anger induction, and therefore serves as an effective comparison. Furthermore, though this group serves as a comparison, there is not a true control group in the study and as such, it is not known how each group would compare with parents who received no emotion induction and no information.

Additional limitations include that the current sample was relatively educated, and thus may have already been aware of the importance of fruit and vegetable feeding for young children [54], which could have reduced the impact of the health message. Relatedly, most of our sample was employed full-time, and thus may have lower levels of responsibility for child feeding. The racial and ethnic diversity of the sample was adequate, however, with nearly half the sample identifying as non-White. With regard to study design, self-efficacy was measured *after* the VR buffet task, meaning that the potential mediating role of self-efficacy on feeding behavior could not be tested. Finally, only a limited number of fruits and vegetables could be included in the VR buffet. The fruits and vegetables included from the buffet were chosen based on school and daycare foodservice menus rather than restaurant menus, and the particular items chosen may not have been palatable to all children. We balanced popularity with other considerations relevant to design of the virtual buffet including ease of 3D modeling.

In all, the current work provides evidence that important moderators of persuasive health message effects may work similarly for child-focused behaviors as they do for self-focused behaviors, at least under certain circumstances. Boundary conditions for these relationships will need to be established. Future research and intervention

work will benefit from exploring the intermediary roles of cognitive and emotional factors to further disentangle the differential effects of child-oriented health messages on mothers and fathers, and understand how to most effectively motivate all parents to make better dietary choices for their children. A shift in this direction could have substantial public health impact.

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#### Compliance With Ethical Standards

**Authors' Statement of Conflict of Interest and Adherence to Ethical Standards** The authors have no conflicts of interest to report. They have adhered to ethical standards.

**Authors' Contributions** All authors were involved in the preparation of this manuscript and read and approved the final version.

**Ethical Approval** The authors have complied with all human subjects requirements; the study reported here was approved by the National Human Genome Research Institute Institutional Review Board.

**Informed Consent** Informed consent was obtained from all participants.

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