Generalization Processes in the Evaluative Conditioning of Foods

DISSERTATION

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By

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Abstract

Evaluative conditioning (EC), the pairing of objects (conditioned stimuli, CS) with positively and negatively valenced unconditioned stimuli (US) in order to induce attitude change, has been demonstrated to be a viable method of changing attitudes towards foods and corresponding eating behaviors. Positively conditioning healthy foods and negatively conditioning unhealthy foods should result in healthier food preferences. Of current interest is the extent to which EC can generalize beyond the conditioned foods to entire dimensions underlying food judgment, particularly health and taste. The current research includes three EC experiments using the Video Surveillance paradigm (Jones, Fazio, & Olson, 2009) and three experiments using physical push-pull movements as US. Four healthy CS foods were paired with positive US and four unhealthy CS foods were paired with negative US. Participants then reported eating intentions for a variety of foods, including non-CS foods. Initial experiments demonstrated that conditioning a few exemplar food items through either method increased sensitivity to health and decreased sensitivity to taste when judging a variety of additional foods. Additional experiments using both methods replicated the generalization effect with regard to health sensitivity, but only when a task that preceded the EC procedure promoted, rather than interfered with, categorization of the CS foods by health. A push-pull experiment demonstrated that using specific food as CS produced effects comparable to those obtained when conditioning higher level categories, such as fruits and vegetables. We also demonstrated that the eating likelihood measure prospectively predicts healthiness of eating behavior outside of the lab. This research shows that EC can generalize to an entire dimension underlying food judgment and that this effect is facilitated by accessibility of the health dimension at the time of exposure to the EC pairings.

This dissertation is dedicated to my family, for their love and support.

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Fields of Study

Major Field: Psychology

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Chapter 1: General Introduction

One of social psychology's longest-running areas of research is that of attitude formation and change, examining how people form their personal likes and dislikes. How do people form these preferences and what can we do to shift pre-existing evaluations? These questions have been addressed via many approaches, leading to the development of extensive literatures on persuasion (Petty & Cacioppo, 1996), normative influences (Cialdini & Trost, 1998), and cognitive dissonance processes (Cooper, 2007), among others. The approach we will be focusing on in the present work is evaluative conditioning (EC), which pairs a conditioned stimulus (CS) with an unconditioned stimulus (US) that evokes a positive or negative evaluation (see Jones, Olson, & Fazio, 2010; Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010; and Walther, Weil, & Dusing, 2011 for reviews). After the CS is repeatedly paired with US, the valence originally associated with the US becomes associated with the CS. EC is most often used to establish positive or negative attitudes towards neutral or novel stimuli, but it can also shift people's pre-existing evaluations of objects (Gibson, 2008; Lebens et al., 2011).

Recently, our understanding of EC has progressed substantially. Attitude formation or change via EC can occur through multiple mechanisms (Jones et al., 2010; Walther, et al., 2011), depending on particular experimental paradigms. One mechanism is signal-learning or propositional learning, which requires explicitly learning that the CS predicts the US occurrence (e.g., Lovibond & Shanks, 2002; Pleyers, Corneille, Luminet, & Yzerbyt, 2007). According to these types of theories, contingency awareness, i.e., knowledge of the CS-US relations, is necessary for CS attitude acquisition or change (but also see Walther & Nanengast, 2006). Other models of EC's underlying mechanisms maintain that contingency awareness is not necessary for successful EC (Baeyens, Eelen, & van den Bergh, 1990), instead focusing on implicit (Jones, Fazio, & Olson, 2009) and purely associative processes (Hütter & Sweldens, 2013). Some researchers have incorporated both associative and propositional mechanisms into a single dual-process model (Hu, Gawronski, & Balas, 2017). While there is much debate about whether propositional or implicit processes are responsible for mediating EC effects (e.g., Bar-Anan, De Houwer, & Nosek, 2010; Hütter, Sweldens, Stahl, Unkelbach, & Klauer, 2012; Pleyers, et al., 2007; Stahl & Unkelbach, 2009), for the purposes of this body of work and in the context of our particular experimental paradigms, we will focus on implicit mechanisms.

Generalization

One relatively understudied area of EC research concerns the generalization of EC effects, which is important for better understanding EC's underlying psychological processes and applying it to real-world contexts such as interventions for diet or prejudice reduction (Olson & Fazio, 2006). EC would have very little utility if resulting attitude change effects were limited to the exact CS (Unkelbach, Stahl, & Förderer, 2012). Interestingly, Unkelbach and colleagues (2012) found a complete *lack* of generalization in one experiment — EC effects emerged only for the exact CS and not when they were modified. They found that EC did not produce an effect on CS faces that had been altered by the addition of eyeglasses and/or beards. One key aspect to note is that these stimuli were specific faces rather than broader social categories or abstract concepts (e.g., words), which may have contributed to this limitation.

Unlike Unkelbach and colleagues, other researchers have found evidence for EC generalization effects on CS-linked stimuli. Walther (2002) found an attitude spreading effect, such that EC affects attitudes towards both a previously neutral target person and other persons who had been associated with that target. Till and Priluck (2000) found generalization of conditioning of brands to similar products and brand names. Another demonstration of generalization was the finding that EC effects on face stimuli transferred to evaluations of composites made from the CS faces, such that composites made from positively conditioned faces were judged to be more trustworthy than those made from negatively conditioned faces (Koscor & Bereczkei 2017).

Another approach to generalization effects focused on different targets of EC. Hütter, Kutzner, and Fiedler (2014) examined the competing effects of EC on specific CS (what they termed as “evaluative identity conditioning,” e.g., a specific face) versus EC of cues indicating an exemplar’s membership to a particular category (“evaluative cue conditioning,” e.g., gender). To illustrate, positive conditioning of a specific female face exemplar would compete with negative conditioning of the category of “female”. They found that evaluative cue conditioning is stronger than evaluative identity conditioning; that is, cue (category) conditioning overrides competing identity (exemplar) conditioning. Hütter and colleagues also argued that EC effects targeting a shared cue should transfer valence irrespective of overall similarity to the CS. For example, they speculate that EC effects should be evident all female faces equally, regardless of their similarity to conditioned female faces. However, they did not experimentally test this proposition. Their approach addressed a very specific question about competing types of conditioning, rather than focusing on the extent to which EC effects can spread from CS to similar attitude objects. Their work suggests, however, that EC's effects can manifest in a broad context across multiple similar attitude objects and need not be limited to very specific CS-US configurations; general patterns of EC across categories of stimuli matter more than specific singular US-CS pairings.

While these studies have examined various aspects of EC generalization, we offer a different perspective and focus on whether EC of several exemplars results in attitude change effects across an entire category of attitude objects. The classical conditioning literature provides some insight about what processes might underlie generalization, particularly semantic generalization (Feather, 1965). Stimulus generalization gradients in classical conditioning demonstrate that conditioned responses are stronger for stimuli very similar to the original CS, weakening considerably in response to more dissimilar stimuli (Siegel, 1967). Razran (1949) asserts that there is a qualitative, crude gradient, i.e. a similarity-dissimilarity scale, along which people place new objects in relation to the original CS. Feather (1965) presents a theoretical argument that generalization effects require participants to categorize generalization stimuli as being similar to the CS and belonging to the same category.

The attitude objects we use as generalization stimuli, foods, are naturally associated rather than experimentally associated with the CS (in contrast to Walther, 2002) and vary in the degree of their similarity to the positive and negative CS in a multidimensional space (i.e., healthiness and tastiness, among other qualities). We would expect EC effects to generalize to items that are similar to the CS as indicated by their proximity in this multidimensional space. Furthermore, the resemblance between the generalization stimuli and the CS lies in their similarity along a specific abstract conceptual dimension (e.g., healthiness) rather than similarity of physical attributes.

We chose to use foods as the attitude objects of interest because they vary in the degree to which they are perceived as healthy and tasty, among other dimensions. These qualities allowed us to use a large variety of items that naturally vary in their resemblance to one another along these two dimensions. We decided to positively condition healthy foods and negatively condition unhealthy foods, which would provide information on basic generalization processes as well as potentially inform applied contexts, particularly healthy eating interventions that aim to address one of today's most serious public health issues.

Applications of Evaluative Conditioning in the Health Domain

Obesity rates in the United States and many other countries have been steadily climbing, with an alarming 34.9% (78.6 million) of American adults currently qualifying as obese (Ogden, Carroll, Kit, & Flegal, 2014), putting them at high risk for cardiovascular disease, diabetes, and many other medical conditions. While various factors play a role in poor health outcomes, one is clearly the overconsumption of unhealthy, calorie-dense foods. Researchers have investigated a variety of experimental interventions to reduce unhealthy food consumption and to increase healthy food consumption (Adriaanse, Vinkers, De Ridder, Hox, & De Wit 2011; Armitage, 2004; Michie, Abraham, Whittington, & McAteer, 2009; Stadler, Oettingen, & Gollwitzer, 2010). Because attitudes can influence behavior (e.g., Ajzen, 1991), attitude change may be a good method to encourage people to make healthier food choices.

Evaluative conditioning has been one approach to nudge people's attitudes regarding healthy and unhealthy foods, with the ultimate goal of helping them choose to eat healthier foods. Food EC with this goal in mind pairs healthy food that is to be positively conditioned (CS+) with positive stimuli (US+) and/or unhealthy food that is to be negatively conditioned (CS-) with negative stimuli (US-). The resulting attitude change promotes choosing the healthy food over the unhealthy food. Pairing negative stimuli such as images of obese bodies or poor health outcomes (e.g., heart surgery) with foods changed explicitly measured evaluations (Dwyer, Jarratt, & Dick, 2007; Lascelles, Field, & Davey, 2003), as well as implicitly measured evaluations and behaviors regarding the foods (Hensels & Baines, 2016; Hollands, Prestwich, & Marteau, 2011; Lebens et al., 2011). Lebens and colleagues (2011) found that conditioning high-fat snack foods with negatively valenced body shapes and fruits with positively valenced body shapes led to more negative implicitly measured attitudes towards those high-fat foods. Positively conditioning apples and bananas led to higher likelihood of choosing those fruits over granola bar, compared to negatively conditioning the same fruits and a control condition (Walsh & Kiviniemi, 2013).

Despite these results, past food EC research has an important shortcoming. These studies have focused only on measuring attitudes towards the specific CS foods involved in the EC procedure, potentially limiting the scope of their effects and ignoring whether EC can change attitudes toward the many other foods people would encounter in everyday life. Might EC of a few food exemplars affect people's attitudes and likelihood of eating a large variety of foods? The present experiments examined whether EC effects can generalize beyond the CS to other foods and serve to elucidate the underlying mechanism for such generalization. We were also interested in exploring potential boundary conditions and whether individual differences may play a role as well.

Chapter 2: Introduction to the Generalization of Evaluative Conditioning via the Video Surveillance Paradigm

The present set of studies draws from the implicit learning perspective and the Implicit Misattribution Model in particular (Jones et al., 2009), which posits that EC can occur when people implicitly misattribute the attitude that actually emanates from the US as coming from the CS. The greater the potential source confusability, or likelihood of mistaking the CS as the source of the evaluation, the more likely EC will occur. Various features of the “Video Surveillance” EC procedure are critical to facilitating implicit misattribution (Jones et al., 2009; Olson & Fazio, 2001). Participants are tasked with searching for and responding to specific targets that appear unpredictably in a non-rhythmic stream of visual stimuli. These targets, which are objects similar to the CS (i.e., food exemplars), provide a plausible reason for the appearance of the CS-US trials. CS-US trials, disguised as “distractors,” appear infrequently throughout the procedure interspersed among filler stimuli trials. Overall, the task and its design features serve to avoid drawing participants’ attention to the CS-US pairings. The CS and US always appear simultaneously, which is necessary for implicit misattribution to occur (Hütter & Sweldens, 2013). The procedure uses multiple US for each CS and each US appears only once, also minimizing the potential for contingency awareness (Stahl & Unkelbach, 2009; Sweldens, Van Osselaer, & Janiszewski, 2010).

The implicit misattribution model informs design features in the Video Surveillance procedure that encourage source confusion. Essentially, any feature that makes the source of the original attitude (the US) less clear or prominent can encourage misattribution to the CS, inducing attitude formation or change in accordance with the valence of the paired US. For example, Jones et al. (2009) found that alternately flashing the CS and US on the screen during a pairing trial produced stronger EC effects than when they remained constant, due to manipulating eye gaze shifts that promoted source confusion. The eye gaze shifts cause participants to rapidly split their attention between the two stimuli, making the actual source of their evaluative reaction less clear. Furthermore, using mildly evocative stimuli as US (e.g., “commendable,” a picture of a waterfall), encourages more source confusion than using strongly evocative stimuli (e.g., “awesome,” a picture of puppies) as US because the valence is less clearly evoked from the mildly evocative stimuli compared to the strongly evocative stimuli. The Video Surveillance paradigm has been used to establish attitudes towards novel cartoon stimuli (Jones et al., 2009; Olson & Fazio, 2001), reduce implicit bias towards African Americans (Olson & Fazio, 2006), and affect food choice behavior (Walsh & Kiviniemi, 2013).

The first experiment in this set tested whether applying the Video Surveillance paradigm to a few healthy and unhealthy foods could effectively shift eating likelihood ratings towards those foods as well as a variety of other foods ranging in healthiness and tastiness. Four healthy foods, in word form, repeatedly appeared with positive words and images while four unhealthy foods repeatedly appeared with negative words and images.

We predicted that EC effects on the CS foods would generalize to other similarly healthy and unhealthy foods, resulting in participants' reporting greater likelihood of eating healthy food and reduced likelihood of eating unhealthy food. Essentially, this overall pattern would manifest as a greater sensitivity to healthiness considerations when making food judgments.

Chapter 3: Experiments 1 - 3

Experiment 1

Methods

Participants. 168 undergraduates (98 women) participated for partial course credit.

Procedure. This experiment used the Video Surveillance procedure developed by Olson and Fazio (2001) and revised by Jones et al. (2009). Participants were told that the study was supposedly about attention and rapid responding. They were to be vigilant for two target foods, *chicken pot pie* and *crackers*, responding when they appeared on the screen by hitting the space bar as quickly as possible. The targets, in picture or word form, and additional foods that were supposedly "distractor" stimuli were presented in a non-rhythmical fashion either singly or paired with other stimuli. Key CS-US pairs were unobtrusively embedded in this visual stream. The CS, selected from a pre-tested set (Young & Fazio, 2013), were foods normatively rated as either high in taste and low in health or low in taste and high in health, i.e., foods towards which a typical person might feel ambivalent. Four healthy/untasty CS+ foods appeared in word form (*grapefruit*, *cauliflower*, *shredded wheat*, *yogurt*) paired with US+ (e.g., "commendable," a picture of a waterfall); four unhealthy/tasty CS- food words (*pizza, fried chicken, cheeseburger*, *cheesecake*) appeared with US- (e.g., "inferior," a picture of bees; see Table 14 for the complete list of US). Each of the healthy (unhealthy) CS words appeared 5 times during the task, with a different US+ (US-) each time, for a total of 20 positive conditioning trials and 20 negative conditioning trials. Participants were randomly assigned to either the EC condition with CS-US pairings or a control condition in which CS and US appeared equally often but unpaired with any other stimuli.

Each trial of the Video Surveillance procedure lasted 1500 ms. During conditioning trials, the CS and US stimuli flashed back and forth, each appearing briefly in an alternating fashion. Both appeared simultaneously for 300 ms, then the first stimulus would disappear for 50 ms then reappear. 175 ms later, the second stimulus would disappear for 50 ms then reappear. This sequence repeated; the resulting effect was that the stimuli appeared to flash quickly back and forth. As noted previously, the flashing promotes eye gaze shifts between the CS and US, which Jones et al. (2009) found to enhance source confusion and encourage implicit misattribution of the evaluation evoked by the US to the CS. Some stimulus pairs in filler trials also sporadically flashed so that the CS-US trials did not stand out in the procedure.

Measures. Following the EC procedure, participants rated the likelihood that they would eat an offered serving of each of 42 foods from -5 to +5 (very unlikely to very likely), including the 8 CS foods and 34 novel foods that they had not seen during EC. Normative ratings of the perceived healthiness and tastiness of each food were available from Young and Fazio (2013); see Table 13. For exploratory purposes, participants completed several subscales of the Food Choice Questionnaire (FCQ, Steptoe, Pollard, & Wardle, 1995), which measures the extent to which participant consider various factors when deciding what to eat, such as sensory appeal, weight control, and health. Participants then completed questions assessing their contingency awareness, i.e., how aware they were of the CS-US pairings.

Contingency Awareness. After completing the dependent measures, participants answered three questions assessing their contingency awareness. The questions began as more general and progressively increased in specificity. Two independent raters coded participants' free responses to the questions and judged whether they seemed to be correctly aware of systematic food CS-US pairings. Participants were judged to be contingency-aware if both raters agreed that they expressed awareness of the pairings in response to the first and/or second questions ("Did you notice anything out of the ordinary in the way the words and pictures were presented during "surveillance"?" and "Did you notice anything systematic about how particular words and images appeared together?"). The third question was "Did you notice anything about the words and images that appeared with certain foods?"

Results

Contingency Awareness. Five participants (6%) met the criterion of contingency awareness, as judged by both raters. When the criterion was relaxed to even a single coder having made a judgment of contingency awareness, 9 participants (10%) were excluded. Which criterion was employed was of no consequence with respect to the statistical significance of the results. Excluding the few participants who reported contingency awareness did not change the statistical significance of the key results, with the exception of one generalization finding that achieved a marginal level of significance following such exclusion (see below).

Conditioned Stimuli. Eating intention ratings for the 4 healthy and 4 unhealthy CS foods were averaged and subjected to a mixed-design analysis of variance with CS type (healthy, unhealthy) as a within-subjects factor and condition (control, EC) as a between-subjects factor. The analysis revealed a significant main effect of CS type, $F(1, 166) = 65.95$, $MSE = 4.79$, $p < .001$, and a significant interaction between CS type and condition, $F(1,166) = 6.26$, $MSE = 4.79$, $p = .01$. Control participants preferred unhealthy/tasty CS- ($M = 2.64$, $SD = 1.96$) over the healthy/untasty CS+ ($M = 0.11$, $SD = 2.08$). Among EC participants, this preference for unhealthy/tasty CS- ($M = 2.04$, $SD = 2.40$) over healthy/untasty CS+ ($M = 0.70$, $SD = 1.87$) was significantly smaller. A simple effects analysis revealed that EC participants rated healthy CS+ ($M = 0.70$, $SD = 1.87$) marginally higher than control participants did ($M = 0.11$, $SD = 2.08$), $F(1,166) = 3.86$, $MSE = 3.90$, $p = .05$. EC participants ($M = 2.05$, $SD = 2.40$) also tended to rate unhealthy CS- foods lower than did control participants ($M = 2.64$, $SD = 1.96$), $F(1,166) = 3.08$, $MSE = 4.84$, $p = .08$.

Generalization. Participants' eating intentions regarding the 34 non-CS foods, the generalization measure, were examined in relation to the foods' normatively perceived healthiness and tastiness. We used two statistical approaches to calculate sensitivity to healthiness and tastiness. The first approach involved calculating within-subject correlation scores for each participant, correlating 1) their eating intention ratings with the normative healthiness ratings for each non-CS food and 2) their eating intention ratings with the normative tastiness ratings for each non-CS food. These scores will be referred to as the healthiness sensitivity index and the tastiness sensitivity index, respectively. After transforming the scores via Fisher's r-to-z formula, the experimental conditions were compared.

The sensitivity indices were subjected to a mixed-design analysis of variance with index type (healthiness, tastiness) as a within-subjects factor and condition (control, EC) as a between-subjects factor. The analysis revealed a significant main effect of index type, $F(1, 166) = 49.22$, $MSE = 6.92$, $p < .001$, and a significant interaction between index type and condition, $F(1,166) = 4.70$, $MSE = .66$, $p = .03$. A simple effects analysis revealed that EC led participants to have marginally higher healthiness sensitivity index scores ($M = .16$, $SD = .39$) than those in the control condition ($M = .05$, $SD = .30$), $F(1,166) = 3.39$, $p = .07$. EC also led participants to have lower tastiness sensitivity index scores ($M = .35$, $SD = .26$) than those in the control condition ($M = .43$, $SD = .26$), $F(1,166) = 3.77$, $p = .05$. Essentially, the difference between the tastiness and healthiness sensitivity scores was reduced in the EC condition ($M = .20$, $SE = .06$) compared to the control condition ($M = .38$, $SE = .06$) (Figure 1).

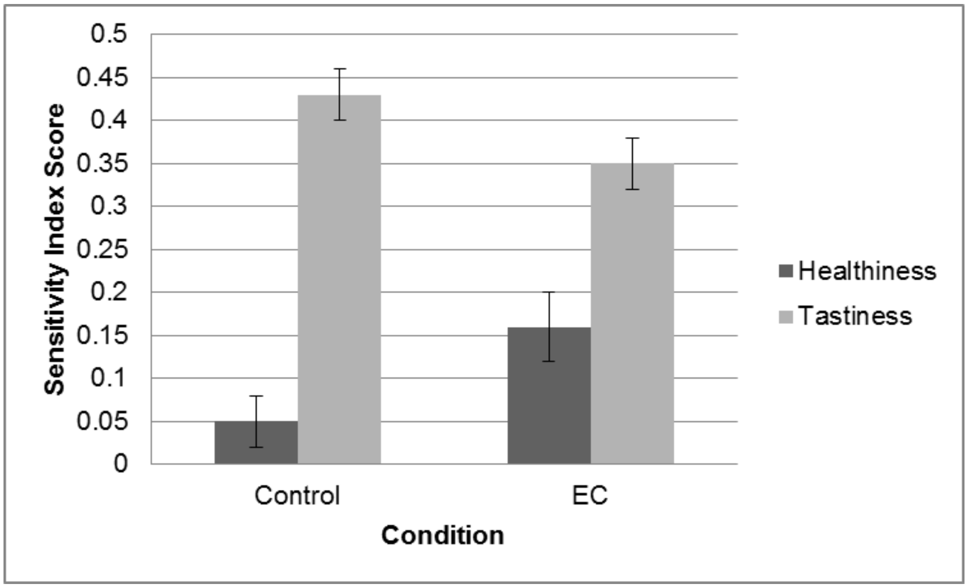

Figure 1. Healthiness and tastiness sensitivity index scores. Error bars indicate standard errors.

The second approach we took to analyzing generalization effects was through multi-level modeling, which is more precise because it accounts for both normative healthiness and tastiness within a single model and accounts for more variance. Eating intention ratings were participant-centered for ease of interpretation, as we were interested in comparing the extent to which normative healthiness and tastiness predicted eating likelihood, our operationalization of sensitivity, rather than focusing on absolute values of eating likelihood ratings. Hierarchical linear modeling (HLM) was used to examine how sensitive participants were to the health and taste dimensions when rating eating intentions. The two-level HLM analyses involved 5712 observations (168 participants) nested in 34 foods. The model predicted a participant's likelihood of eating a serving from dummy-coded condition (control = 0, EC = 1) at level 1 as a fixed effect, and food healthiness and tastiness (entered grand-mean centered) at level 2 as fixed effects. The intercept was entered as a random effect; random effects estimates were kept in the model only if they reached $p < 0.200$ level of significance, as per Nezlek's recommendation (2011).[1] Robust standard errors were assumed.

The analysis at level 1 (pseudo $R^2 = 0.12$) showed that EC did not have a significant main effect on eating intentions ($\gamma_{10} = 0.00$, $t(5675) = 0.00$, $p = 1.00$). At level 2 (pseudo $R^2 = 0.78$), participants' eating intentions for the 34 non-CS foods were significantly predicted by both tastiness ($\gamma_{01} = 0.77$, $t(31) = 13.56$, $p < .001$) and healthiness ($\gamma_{02} = 0.10$, $t(31) = 4.65$, $p < .001$), indicating that they were sensitive to both dimensions, although more so to tastiness. Significant cross-level interactions between condition and normative tastiness and between condition and normative healthiness showed that EC participants' ratings corresponded to tastiness less ($\gamma_{11} = -0.12$, $t(5675) = 2.32$, $p = .02$) and healthiness more ($\gamma_{12} = 0.10$, $t(5675) = 5.28$, p < .001), compared to control participants (Figures 2 & 3). When contingency-aware participants were excluded (both raters agreeing on contingency awareness item 1 and/or item 2), the condition x tastiness term attained a marginal level of statistical significance, $\gamma_{11} = -0.12$, $t(5505) = 1.95$, $p = .05$, though the condition x healthiness term remained significant, $\gamma_{12} = 0.10$, $t(5505) = 5.00$, p < .001. Thus, EC led participants to be less sensitive to taste and more

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[1] The level 1 and level 2 equations are as follows:
Level 1: Eating likelihood$_{ij} = \beta_{0j} + \beta_{1j}$(Condition) + r_{ij}
Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$(Tastiness) + γ_{02}(Healthiness) + u_{0j}
$\beta_{1j} = \gamma_{10} + \gamma_{11}$(Tastiness) + γ_{12}(Healthiness)
r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} is the effect of condition on intentions at mean levels of tastiness and healthiness. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{12} represent the interactions between normative tastiness with condition and normative healthiness with condition. See Table 2 for details.

sensitive to health in their eating intentions. To our knowledge, this is the first EC study to demonstrate generalization from specific CS to entire dimensions underlying a class of attitude objects.

Ratings of Health Importance. Participants also had completed the health, weight control, and sensory appeal subscales of the Food Choice Questionnaire (FCQ), which assesses importance of various factors in everyday food choice. Although no effects were observed on the weight control and sensory appeal subscales, EC did increase scores on the FCQ health subscale. EC led participants to endorse the importance of health considerations in their food choices significantly more (*M* = 2.95, *SD* = 0.71) than control participants did (*M* = 2.74, *SD* = 0.67), *t*(166) = 2.01, *p* < .05; *d* = 0.30.

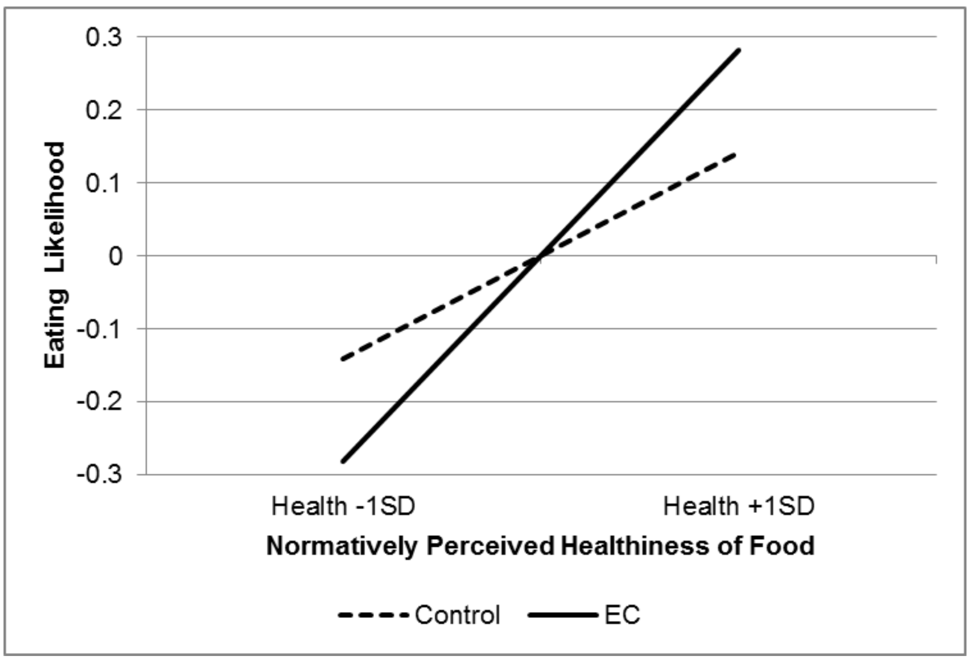

Figure 2. Predicted eating intentions regarding foods of varying healthiness among participants in Experiment 1, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

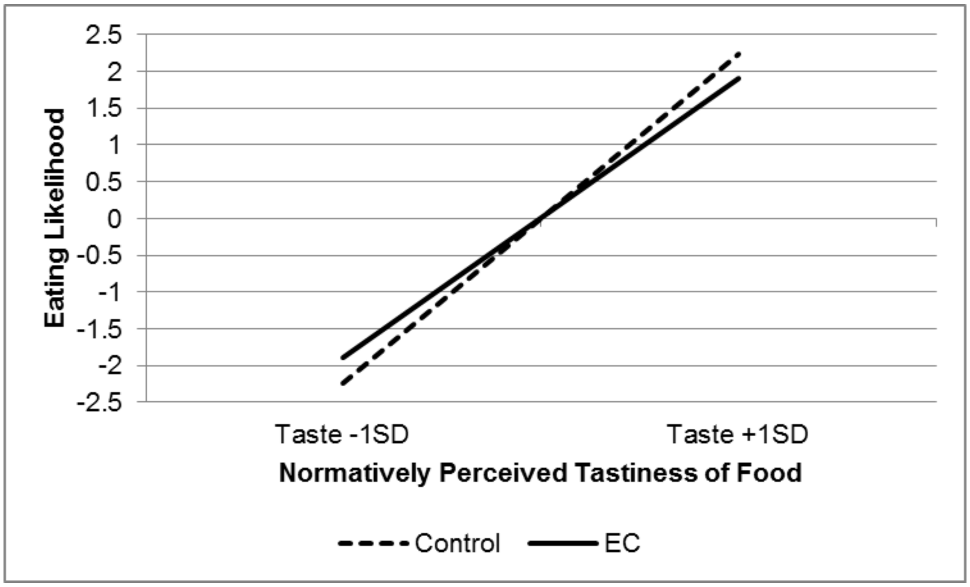

Figure 3. Predicted eating intentions regarding foods of varying tastiness among participants in Experiment 1, based on HLM coefficient terms. Eating likelihood scores are participant-centered.

Discussion

Altogether, the results indicated that EC via the Video Surveillance paradigm can change eating intentions towards the conditioned foods and, more importantly, shift people's sensitivity towards the tastiness and healthiness dimensions when rating a variety of foods that had not been conditioned nor even presented during the EC procedure. Participants' eating intentions in the EC condition were less favorable towards unhealthy foods overall. Furthermore, participants who had undergone EC reported on an explicit measure that they cared more about health in their food choices than those in the control condition. Should these changes in eating intentions translate into changes in eating behavior, it is possible that participants would make healthier food choices following EC.

More generally, we demonstrated that EC can shift attitudes not only towards specific CS, but can generalize to entire dimensions underlying judgment of similar attitude objects. To our knowledge, this is the first experiment demonstrating wide-ranging generalization of EC effects to attitude objects that naturally resemble the CS on various dimensions. Furthermore, given our use of words to represent the CS objects instead of pictures, this generalization suggests spreading effects of EC based on resemblance along both the health and taste dimensions, beyond shared physical qualities demonstrated in previous research (Hütter et al., 2014; Till & Priluck, 2000).

Experiment 2

Why might the effects of EC in Experiment 1 have generalized beyond the specific CS foods from the surveillance procedure? In particular, why did EC decrease sensitivity to food tastiness and increase sensitivity to food healthiness when participants were expressing their eating intentions regarding a wide array of foods not paired with the US? A likely possibility is that some participants may have implicitly categorized the CS foods by health, construing each CS+ as “healthy food” and each CS- as “unhealthy food.” Each pairing of US+ with “healthy food” and US- with “unhealthy food” would therefore shift attitudes towards the entire categories of healthy and unhealthy foods, promoting EC generalization, i.e., a corresponding shift with respect to other foods that also belonged to these categories. This idea would be consistent with Feather’s (1965) proposal that generalization effects require participants to construe generalization stimuli as belonging to the same category as the CS. Any such changes would manifest themselves as less sensitivity to taste and greater sensitivity to healthiness.

People’s likelihood of categorizing foods by healthiness may vary as a function, not only of an individual’s chronic accessibility of healthiness, but also of the acute accessibility of healthiness. Thus, promoting the construal of the CS in terms of healthiness may facilitate generalization. Each CS+ presentation would represent a pairing of the category “healthy food” with positivity, and vice versa with each CS-presentation. Moreover, as predicted by the Implicit Misattribution Model (Jones et al., 2009), when a tasty but unhealthy CS- food (e.g., pizza) is paired with a US-, source confusability should be greater if the food is thought of as unhealthy rather than tasty. Such a construal more easily allows for misattribution of the negativity evoked by the US- to the CS-. Thus, construing food by health in this paradigm should enhance source confusion and promote implicit misattribution, leading to stronger EC and more generalization.

To test this reasoning, Experiment 2 included a task designed to create a mindset among the participants in one condition that would encourage categorization of the foods presented during the surveillance procedure in terms of their healthiness. Participants in a control condition were induced to categorize the foods in an entirely irrelevant and relatively neutral fashion, by mealtime, i.e., whether the food was typically eaten for breakfast or dinner. The intent was to prime participants with either a healthiness or a mealtime mindset during the EC task. The hypothesis for this second experiment was that generalization would be more likely to occur after EC when categorization by health is promoted rather than discouraged.

Methods

Participants. 117 undergraduate students (73 women) participated for course credit.

Procedure. The essential design of the Video Surveillance procedure was the same as in Experiment 1. Participants had the task of searching for two food targets in a stream of stimuli and viewed the same CS-US pairs throughout the procedure, with healthy CS+ paired with US+ and unhealthy CS- paired with US-. For this experiment, EC participants had the additional simultaneous task of keeping a running mental tally of the number of healthy and unhealthy foods, while control condition participants kept a tally of the number of breakfast and dinner foods that appeared in each of five blocks. These tallies included all non-targets, i.e. filler trials and CS-US trials, that belonged to the respective health/mealtime categories. Participants reported their respective tally numbers for healthy and unhealthy (breakfast and dinner) foods at the end of each block before restarting at a count of 0 with the next block.

Measures. Following Video Surveillance, participants completed the eating intention measure, the three FCQ subscales, and post-experimental contingency awareness questions.

Results

Conditioned Stimuli. No participants met criteria for expressing contingency awareness. Eating intention ratings for each of the 4 healthy CS and 4 unhealthy CS foods were averaged to create composite healthy and unhealthy CS scores. Overall, participants preferred unhealthy CS (M = 2.27, SD = 2.45) to healthy CS (M = 0.74, SD = 2.13). A mixed-design analysis of variance (ANOVA) was conducted with CS food type (healthy, unhealthy) as a within-subjects factor, and task type (health, mealtime) and EC (control, EC) as between-subjects factors. A significant main effect of CS food type, $F(1, 113) = 24.37$, $p < .001$, $\eta^2 = .177$, was obtained. There were no significant interactions between CS food type and task, between food type and EC, nor among CS food type, task, and EC, *Fs* < 1, *p* > .05). No significant condition differences nor interactions were found for the FCQ subscales.

Table 1

Conditioned stimuli eating likelihood ratings.

		EC Condition	
Task	**CS Type**	**Control** *M* (*SE*)	**EC** *M* (*SE*)
Meal	Healthy	2.13 (.38)	2.08 (.34)
	Unhealthy	3.54 (.46)	3.25 (.45)
Health	Healthy	1.42 (.37)	1.36 (.35)
	Unhealthy	3.28 (.44)	3.01 (.47)

Generalization. Participants' eating intentions regarding the 34 non-CS foods, the generalization measure, were examined in relation to the foods' normatively perceived healthiness and tastiness. We calculated two within-subject correlation scores for each participant for healthiness and tastiness, a healthiness sensitivity index and a tastiness sensitivity index. The scores were transformed using Fisher's r-to-Z formula prior to comparing them across conditions. A mixed 2 x 2 x 2 ANOVA, with task type and EC as between-subject factors and index type as a within-subject factor, revealed a trending three-way interaction between task, EC, and index type, *F*(1,113) = 2.13, *MSE* = .35, *p* = .15 (Figure 4). The tastiness and healthiness sensitivity scores were not significantly different from each other in the health/EC condition, (difference score *M* = .10, *SE* = .11), *F*(1,113) = .53, *p* = .47 or the mealtime/control condition (*M* = .16, *SE* = .11), *p* = .14, but were marginally different in the mealtime/EC condition (*M* = .19, *SE* =

.11), p = .07, and were significantly different in the health/control condition (M = .38, SE = .11), p < .001. This pattern suggested that the health/EC condition most successfully reduced the predominance of taste sensitivity over health sensitivity in influencing eating likelihood judgments. Simple effects analyses within the healthiness mindset conditions showed that EC led participants to have significantly higher healthiness sensitivity index scores (M = .22, SE = 0.07) than those in the control condition (M = .01, SE = 0.07), F(1,113) = 4.32, p = .04. In the mealtime condition, there was no such difference in health sensitivity index scores between the EC (M = .13, SE = .07) and control conditions (M =.19, SE = .07), F(1,113) = 0.50, p = .48. There were no significant differences in the taste sensitivity scores between EC and control conditions in either of the mealtime and health task conditions, all difference score Ms < .07, ps > .48.

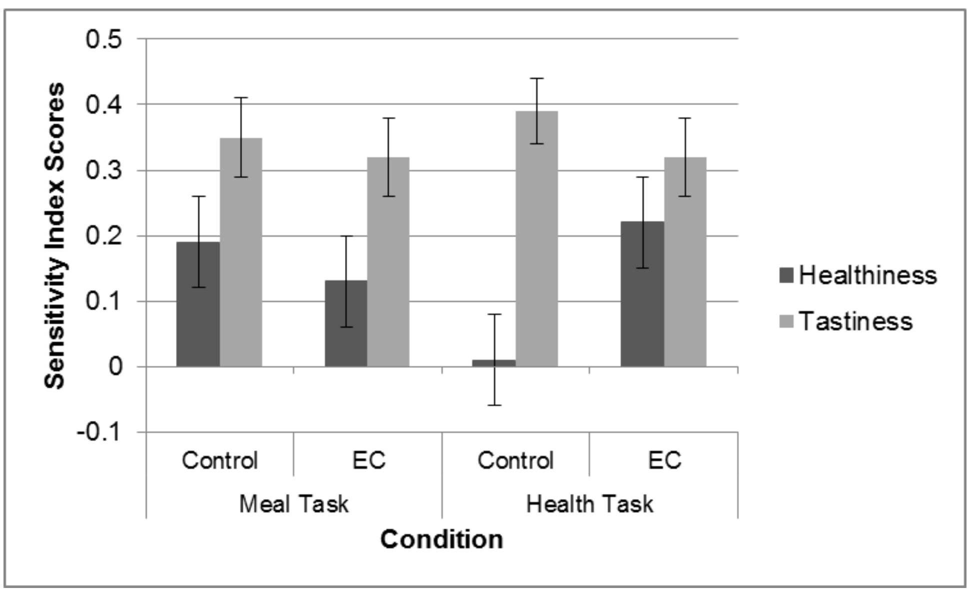

Figure 4. Healthiness and tastiness sensitivity index scores in Experiment 2.

Hierarchical linear modeling was used to examine the extent to which participants used the health and taste dimensions in their eating intentions towards the 34 non-CS foods. Robust standard errors were assumed. Participants' eating intentions were compared to previously collected data on normative perceived healthiness and tastiness of the respective foods. The two-level HLM analyses involved 3978 observations (based on 117 participants) nested in 34 foods (mean eating likelihood rating across the 3978 observations = 2.29, *SD* = 0.10). The model predicted a participant's likelihood of eating a serving from condition (EC, control), task (health, mealtime), and the interaction between condition and task at level 1, as well as food healthiness and tastiness (entered grand-mean centered) at level 2.[2]

HLM analyses demonstrated that participants used both tastiness ($\gamma = 0.57$, $t(31) = 12.27$, $p < .001$) and healthiness ($\gamma = 0.21$, $t(31) = 4.73$, $p < .001$) to discriminate among foods. Participants who had tallied food by health unexpectedly used the health dimension less than those who had tallied food by mealtime ($\gamma = -0.12$, $t(3935) = 2.46$, $p = .01$), but these two groups did not differ in their use of taste dimension ($\gamma = 0.10$, $t(3935) = 1.22$, $p = .23$). EC also did not affect use of taste ($\gamma = 0.01$, $t(3935) = 0.06$, $p =$

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[2] The level 1 and level 2 equations are as follows:
Level 1: $\text{Eating likelihood}_{ij} = \beta_{0j} + \beta_{1j}(\text{Task Type}) + \beta_{2j}(\text{EC}) + \beta_{3j}(\text{Task Type x EC}) + r_{ij}$
Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Tastiness}) + \gamma_{02}(\text{Healthiness}) + u_{0j}$
$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Tastiness}) + \gamma_{12}(\text{Healthiness})$
$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{Tastiness}) + \gamma_{22}(\text{Healthiness})$
$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{Tastiness}) + \gamma_{32}(\text{Healthiness})$
r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} and γ_{20} are the effects of task type and EC on intentions at mean levels of tastiness and healthiness. γ_{30} represents the interaction between task type and EC. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{21} represent the interactions between normative tastiness and task type. Coefficients γ_{12} and γ_{22} represent the interactions between normative healthiness and EC. Coefficients γ_{31} and γ_{32} represent 3-way interactions between task type, EC, and healthiness and tastiness, respectively. See Table 3 for details.

.90) or health (γ = -0.04, t(3935) = 0.98, p = .33). However, there was a significant task x EC x health interaction, such that there was a greater difference in use of health between EC participants and control participants who had been in the health tally condition than between EC and control participants who had been in the mealtime tally condition (γ = 0.15, t(3935) = 3.12, p = .002) (Figures 5 & 6). The task x EC x taste interaction term was not significant (γ = -0.13, t(3935) = 1.42, p = .15.

Using HLM to comparing the two mealtime task conditions directly to each other, there were no significant interactions between EC and normatively perceived taste (γ = -0.03, t(1969) = 1.40, p = .16) nor health (γ = -0.02, t(1969) = 1.49, p = .14) ratings. When comparing the two health task conditions directly, there was a significant interaction between EC and normatively perceived health ratings, such that EC led to greater use of health compared to the control (γ = 0.06, t(1935) = 3.95, $p < .001$), with no difference in use of taste (γ = -0.03, t(1935) = 0.89, p = .37).

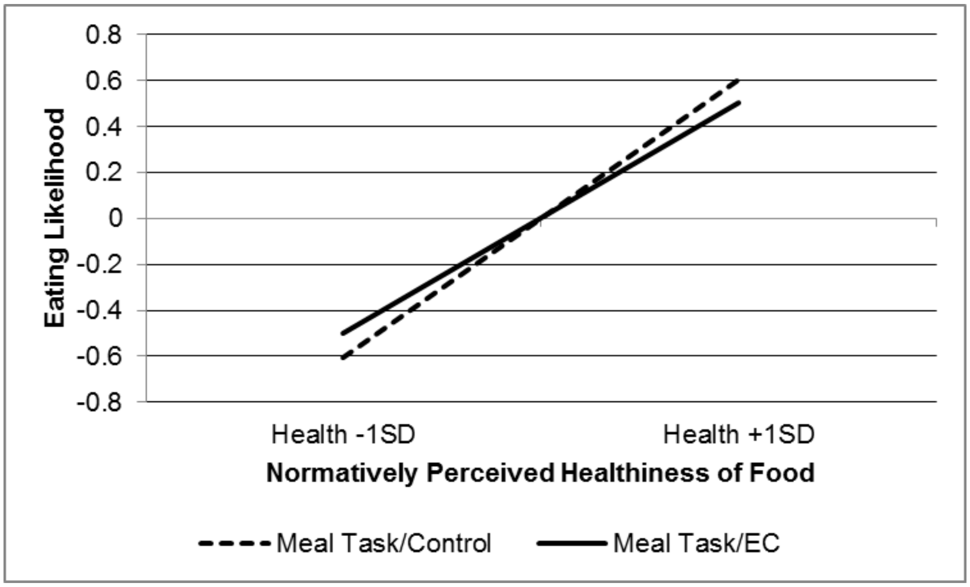

Figure 5. Predicted eating intentions regarding foods of varying healthiness among mealtime tally task participants in Experiment 2, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

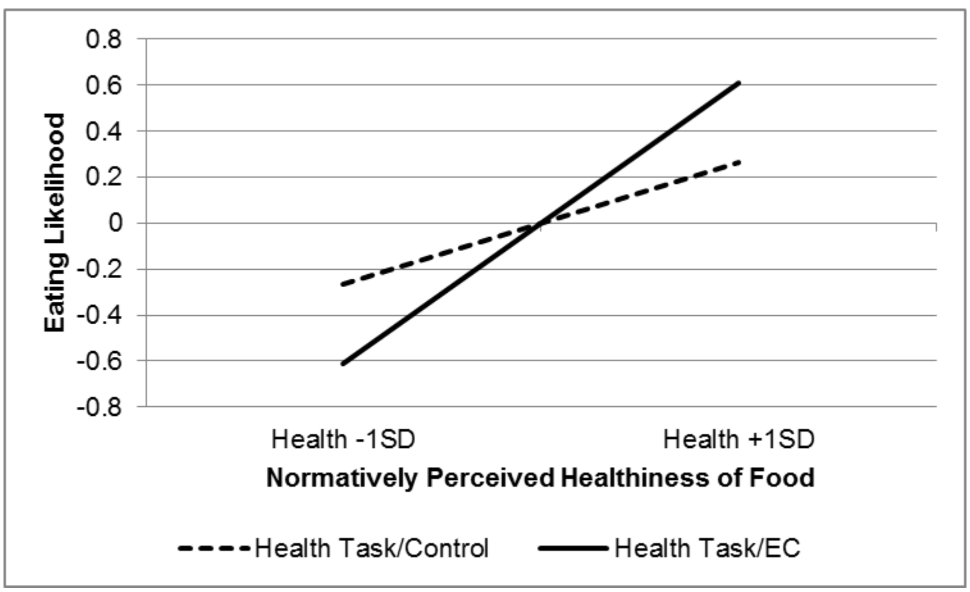

Figure 6. Predicted eating intentions regarding foods of varying healthiness among health tally task participants in Experiment 2, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

Discussion

Experiment 2 replicated the effects from Experiment 1, such that EC led to generalization with increased use of health in eating intentions, but only when participants tallied healthy and unhealthy foods during the surveillance procedure. Interfering with the use and salience of the health dimension by assigning participants to tally foods by mealtime rather than health eliminated this generalization effect. Thus, categorizing CS foods by health was necessary for EC effects to generalize to different foods through increased use of the health dimension in eating intentions.

Surprisingly, given the generalization findings, there were no significant effects of EC on ratings of the CS+ and CS- themselves. This may have occurred for a number of reasons, most likely insufficient power . The generalization data include far more observations for each participant (34 food ratings) compared to the CS data alone (8 food ratings). Interestingly, this study also did not replicate the finding from Study 1 showing that EC could increase participants' reported importance of health in food choices. Still, the health generalization effect replicated, which was the primary effect of interest.

Experiment 3

We wanted to replicate Experiment 2 using a slightly different approach that might be less burdensome to participants and reduce potential distraction from the EC pairings, which could interfere with the EC procedure itself (Field & Moore, 2005). Therefore, we tested whether priming a particular mindset (health or mealtime) *prior* to EC could result in similar effects. Previous work has used conceptually similar tasks to manipulate dimension accessibility prior to EC (Olson, Kendrick, & Fazio, 2009). Priming of this sort is a classic and often-used method of influencing people's interpretations of stimuli appearing in subsequent tasks (e.g., Higgins, Rholes, & Jones, 1977). Priming a dimension prior to a subsequent task could lead to a carryover effect, such that the health (or mealtime) dimension was still active and would affect participants' construal of food items during and after EC. Thus, instead of using a tallying task during EC, we gave participants a categorization task to perform just before proceeding to the Video Surveillance task.

Methods

Participants. 92 undergraduate students (30 women) participated for partial course credit.

Procedure. As part of a 2 x 2 (task x EC) design, participants first completed a task in which they pressed keys ("e" and "i" for left and right sides of the computer screen, respectively) to quickly categorize each of 54 foods, one at a time. In the mealtime task conditions, participants categorized foods by whether they were breakfast or dinner foods. In the health task conditions, participants categorized foods as healthy or unhealthy. Food items appeared as verbal labels (e.g., *banana*, *corndog*) in random order and included foods that would later appear as healthy CS+ and unhealthy CS-, as well as a set of fillers, none of which were the foods in the dependent measure. Participants then completed Video Surveillance and the same eating intention measures as in previous experiments, as well as the same contingency awareness items.

Results

Contingency Awareness. Two independent raters coded participants' free responses to the contingency awareness questions and judged whether they seemed to be correctly aware of systematic food CS-US pairings. Participants were judged to be contingency-aware if both raters agreed that they expressed awareness of the pairings in response to the first and/or second questions ("Did you notice anything out of the ordinary in the way the words and pictures were presented during "surveillance"?" and "Did you notice anything systematic about how particular words and images appeared together?"). Only three participants (6%) met the criterion of both raters agreeing that they expressed contingency awareness in response to at least one of the first two questions. Using a less conservative cutoff of at least one coder judging a participant to be aware, a total of 5 participants met this criterion (11%). Excluding these 5 participants resulted in the same pattern of results for the CS foods; the 3-way food type x task type x EC interaction became marginally significant, $F(1,82) = 3.85$, $MSE = 16.34$, $p = .053$.

The generalization effects detailed below remained unchanged in their statistical significance when these participants were excluded.

Conditioned Stimuli. We used a mixed-design ANOVA to analyze CS eating intentions with CS food type (healthy, unhealthy) as a within-subjects factor and task type (mealtime, healthiness) and EC (control, EC) as between-subjects factors. This analysis revealed a marginally significant 3-way interaction among food type, task type, and EC, $F(1,88) = 2.86$, $MSE = 14.99$, $p = .10$ (see Figure 7). The preference for unhealthy CS over healthy CS was significantly smaller for EC participants (compared to control participants) if they had categorized foods by health, $F(1,88) = 4.22$, $MSE = 10.49$, $p = .04$, but not if they had categorized foods by mealtime, $F(1,88) = 0.101$, $MSE = 10.49$, $p = .75$. A simple effects analysis revealed that participants in the health task/EC condition had significantly lower eating intentions for unhealthy CS foods ($M = 1.19$, $SD = 2.77$) than those in the health task/control condition ($M = 2.50$, $SD = 1.83$), $F(1,88) = 4.25$, $MSE = 4.58$, $p = .04$. Also, the same participants in the health task/EC condition had lower eating intentions ($M = 1.19$, $SD = 2.77$) for unhealthy CS foods compared to those in the mealtime task/EC condition ($M = 2.43$, $SD = 1.88$), $F(1,88) = 3.96$, $MSE = 4.58$, $p = .05$. All other simple effect comparisons of intentions between conditions were nonsignificant, *p*s > .05.

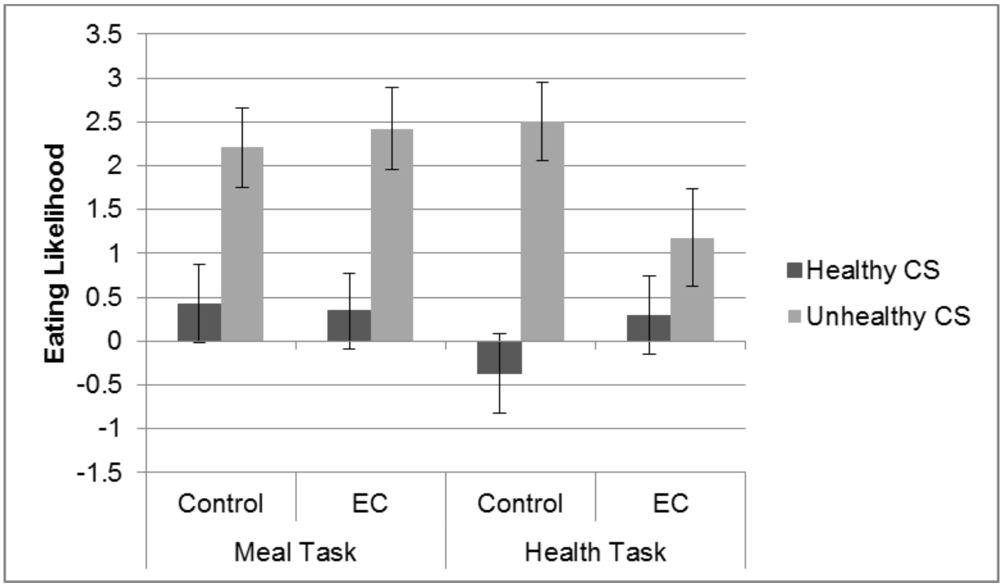

Figure 7. Eating intentions for CS foods in Experiment 3. Error bars indicate standard errors.

Generalization. Participants' eating intentions regarding the 34 non-CS foods, the generalization measure, were examined in relation to the foods' normatively perceived healthiness and tastiness. We calculated two within-subject correlation scores for each participant for healthiness and tastiness, a healthiness sensitivity index and a tastiness sensitivity index. The scores were transformed using Fisher's r-to-Z formula prior to comparing them across conditions. A mixed 2 x 2 x 2 ANOVA, with task type and EC as between-subject factors and index type as a within-subject factor, revealed a marginally significant three-way interaction between task, EC, and index type, $F(1,88) = 3.74$, $MSE = .60$, $p = .06$ (Figure 8). The differences between the tastiness and healthiness sensitivity scores were significant in all conditions, all Fs > 14.5, ps < .001, except for the health task/EC condition, $F(1,88) = .53$, $p = .47$. Simple effects analyses within the healthiness mindset conditions showed that EC led participants to have significantly higher healthiness sensitivity index scores (*M* = .24, *SD* = 0.49) than those in the control condition (*M* = -.07, *SD* = 0.37), *F*(1,88) = 7.05, *p* = .009. In the mealtime condition, there was no such difference in health sensitivity index scores between the EC (*M* = -.13, *SD* = .33) and control conditions (*M* = -.03, *SD* = .36), *F*(1,88) = 0.89, *p* = .35. There were no significant effects of EC, task, nor their interaction for tastiness sensitivity scores (all *p*s > .30). Overall, EC increased participants' sensitivity towards health over taste, but only after engaging in the health task.

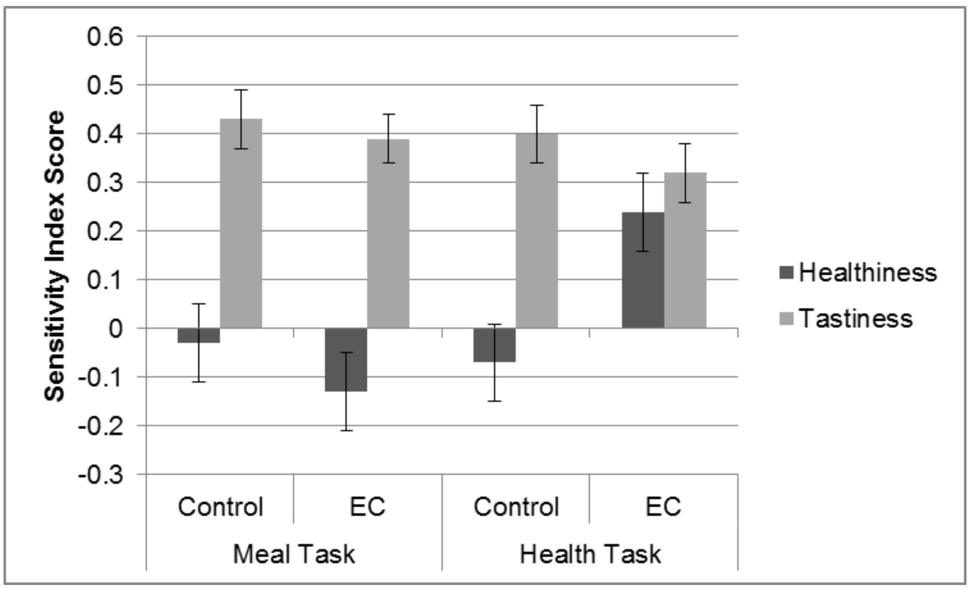

Figure 8. Healthiness and tastiness sensitivity index scores in Experiment 3. Error bars refer to standard errors.

HLM was used to examine more precisely how eating intentions regarding the non-CS foods related to the foods' normatively perceived tastiness and healthiness.[3] The

[3] The level 1 and level 2 equations are as follows:
Level 1: Eating likelihood$_{ij}$ = β_{0j} + β_{1j}(Task Type) + β_{2j}(EC) + β_{3j}(Task Type x EC) + r_{ij}

two-level HLM analyses involved 3128 observations (92 participants) nested in 34 foods. Task types did not significantly differ when it came to the relationship between normative healthiness and eating intentions (γ_{12} = -0.06, t(3085) = 1.31, p = .19). Neither EC, task type, nor their interaction significantly affected the relationship between tastiness and eating intentions (all ps > .05). At level 2, participants' eating intentions were significantly predicted by tastiness (γ_{01} = 0.65, t(31) = 10.44, p < .001) and marginally predicted by healthiness (γ_{02} = 0.06, t(31) = 1.98, p = .06).

Most importantly, and as predicted, there was a significant 3-way task x EC x healthiness interaction (γ_{32} = 0.44, t(3085) = 7.20, p < .001; see Figure 9). To decompose this interaction, health task and mealtime task participants were analyzed in two separate HLMs, each with only EC as a level 1 variable (as in Experiment 1). As expected, EC significantly increased correspondence between eating intentions and healthiness, relative to the control, for those who had categorized foods by health, γ_{12} = 0.30, t(1493) = 7.66, p < .001 (see Table 5 in the Appendix). No such effect of EC was apparent for in the mealtime categorization condition; in fact, EC unexpectedly reduced correspondence between intentions and healthiness compared to the control condition (γ_{12} = -0.14, t(1561)

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Tastiness}) + \gamma_{02}(\text{Healthiness}) + u_{0j}$
$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Tastiness}) + \gamma_{12}(\text{Healthiness})$
$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{Tastiness}) + \gamma_{22}(\text{Healthiness})$
$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{Tastiness}) + \gamma_{32}(\text{Healthiness})$
r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} and γ_{20} are the effects of task type and EC on intentions at mean levels of tastiness and healthiness. γ_{30} represents the interaction between task type and EC. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{21} represent the interactions between normative tastiness and task type. Coefficients γ_{12} and γ_{22} represent the interactions between normative healthiness and EC. Coefficients γ_{31} and γ_{32} represent 3-way interactions between task type, EC, and healthiness and tastiness, respectively. See Table 4 for details.

= 3.71, *p* < .001) (see Table 6 in the Appendix). Overall, the HLM analyses were consistent with the within-subject healthiness correlation score analyses.

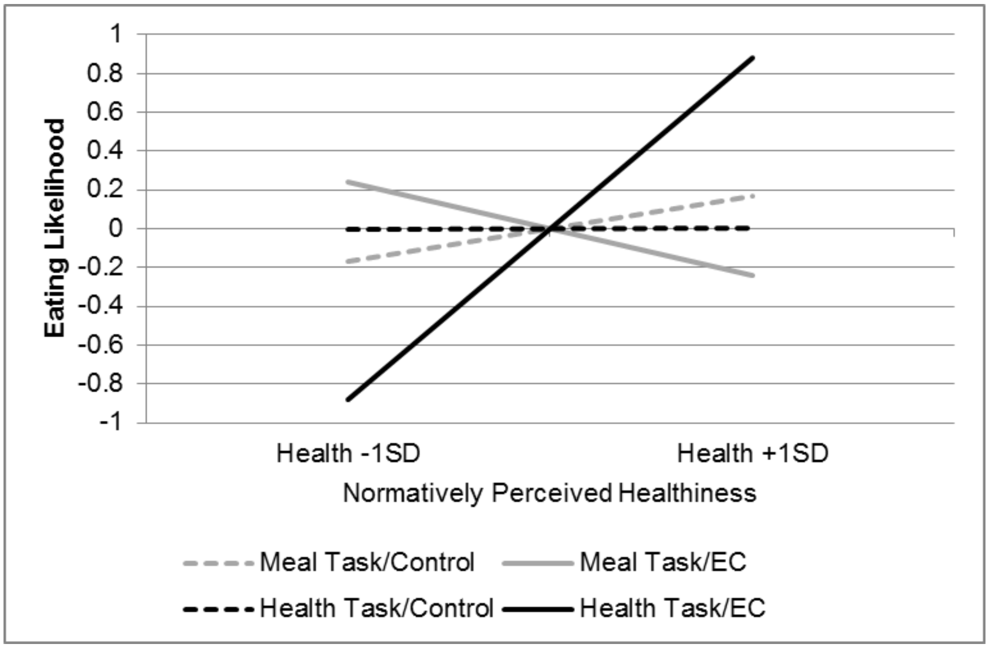

Figure 9. Predicted eating intentions regarding foods of varying healthiness among participants in Experiment 3, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

Ratings of Health Importance. Also of interest was whether task, EC, and their interaction affected the extent to which participants explicitly reported health to be important in their food choices. For the FCQ health subscale, a 2 (task type) x 2 (EC) between-subjects ANOVA found no main effects of task nor EC, *F*s < 0.50, *p* > .05, η^2 < .010. There was, however, a significant interaction between task type and EC, *F*(1,88) = 5.69, *MSE* = .62, *p* = .02. There was a nonsignificant trend of less health importance for control participants who performed the health task (*M* = 2.58, *SD* = 0.86) compared to control participants who had performed the mealtime task (*M* = 2.96, *SD* = .70), *F*(1,88)

= 2.63, *MSE* = 0.621, *p* = .11. Participants in the health task/EC condition reported marginally higher health importance (*M* = 2.86, *SD* = 0.86)) compared to those in the mealtime task/EC condition (*M* = 2.45, *SD* = 0.72), *F*(1,88) = 3.08, *MSE* = 0.621, *p* = .08.

Discussion

This experiment replicated the healthiness generalization effects of EC from Experiment 2 by demonstrating that priming a healthiness mindset facilitates the effect while priming an alternative mindset interferes with it. Priming a healthiness mindset also facilitated the EC effect on the CS, while priming the alternative mindset appeared to inhibit it, which is consistent with the Implicit Misattribution Model. According to the Implicit Misattribution Model, increased source confusability facilitates EC effects. For example, when participants viewed unhealthy/tasty foods through the lens of their (lack of) health value, the negative attitude emanating from the US- should have been more easily misattributed to the CS- foods, compared to when they were construed in terms of the mealtimes during which they would appear. In other words, when the more negative attributes of the CS- were made salient, compared to relatively neutral ones, EC in the negative direction would be more likely to succeed. Furthermore, in the healthiness mindset condition, there was an effect of EC on only healthiness sensitivity but not tastiness sensitivity, providing further evidence that participants' implicit categorization of CS foods as healthy or unhealthy foods during EC is the primary mechanism of generalization. There was also some evidence indicating that participants who had undergone EC after being in a healthiness mindset self-reported greater consideration of health in their food choice.

With regard to the unexpected reversal in the mealtime conditions, such that EC decreased sensitivity to health relative to control, careful examination of the specific CS and DV foods suggests that this effect may have stemmed from an unintentional covariation between the foods' typical mealtime and healthiness. The healthy CS included two breakfast foods, whereas the unhealthy CS included four dinner foods. Thus, EC may have led some participants to generalize positivity to breakfast foods and negativity to dinnertime foods. Given that many of the healthiest foods in the stimulus set were vegetables, which are not typically associated with breakfast, any such tendencies that could have led to the expression of eating intentions that imply less sensitivity to health.

Chapter 4: General Discussion of Experiments 1 – 3

Evaluative conditioning is a classic phenomenon that has been demonstrated many, many times. What these studies contribute to the vast existing literature is that EC effects can generalize to entire dimensions underlying evaluative judgment and corresponding behavioral intentions, provided that those relevant dimensions are salient and form a basis for construal of the CS during the conditioning procedure. Salience of such dimensions may vary on an individual basis or be experimentally manipulated. The current research demonstrates that the carryover effect of a preceding task that primes a particular mindset leads to such generalization, while priming a competing mindset eliminates the effect.

The Implicit Misattribution Model suggests that source confusion was the likely mechanism for EC to affect CS food eating intentions (Jones et al., 2009). The EC procedure included various presentation factors such as flashing the CS-US pairs, moderately evocative US, and US that were generally unrelated to food so as to promote valence transfer in the absence of contingency awareness (Jones et al., 2009). As for generalization effects, if participants had construed each CS+ as "healthy food" and each CS- as "unhealthy food," each US-CS pair essentially also conditioned the entire corresponding food category, which would explain the effects on other foods belonging to those categories. Even more relevant to the likelihood of implicit misattribution, source confusion was likely enhanced when a tasty but unhealthy food was construed in terms of its unhealthiness while being paired with a negative US and, similarly, when a less tasty but healthy food was construed as healthy while being presented with a positive US. Presumably, construing an unhealthy but tasty food in terms of its health value shifts its evaluation to be more negative, increasing the likelihood of source confusability when it is paired with a negative US. Experiments 2 and 3 in particular support this mechanism, as we found neither effects of EC on the CS food nor beneficial generalization effects when participants had been induced to categorize the CS as breakfast or dinner foods instead of healthy or unhealthy foods.

In Experiment 1 and Experiment 3, EC influenced the extent to which health considerations were self-reported as important for food choices. This could have occurred as a result of participants' self-perception of their preferences during the eating intentions task, through direct generalization processes from the pairings of "healthy food" with US+ and "unhealthy food" with US-, or likely a combination of both processes. Additional research will be necessary to elucidate this precise mechanism.

In the EC literature, some assert that contingency awareness is necessary for EC effects to occur (e.g., Pleyers et al., 2007) and others argue that it is not required (e.g., Hütter et al., 2012; Jones et al., 2010). Although the debate remains unresolved, it is clear that the role of contingency awareness varies as a function of the conditioning procedure and its underlying mechanism (Sweldens, Corneille, & Yzerbyt, 2014). One solution for reconciling discrepant findings in the literature is that there are multiple possible mechanisms underlying EC effects.

In the present studies, removing contingency-aware participants did not meaningfully change our crucial findings. While some (e.g., Pleyers et al., 2007) have criticized the funneled debriefing method used to identify contingency-aware participants in the present experiments, others have shown the measure to correspond well with recognition memory for the CS-US pairings (see Jones et al., 2009, footnote 4), which is yet another commonly-used method (Baeyens, Eelen, Crombez, van den Bergh, 1992; Hütter & Sweldens, 2013; Stahl & Unkelbach, 2009). Moreover, the use of a sophisticated multinomial processing model to analyze recognition memory data has yielded very clear evidence of EC effects in a simultaneous CS-US presentation paradigm in the absence of contingency awareness (Hütter et al., 2012; Hütter & Sweldens, 2013). Simultaneous pairing promotes implicit misattribution and is fundamental to the EC procedure employed presently (Hütter & Sweldens, 2013). Indeed, a contingency awareness account for the results of Experiments 2 and 3 would have to argue that health task participants had higher rates of contingency awareness than those who had completed the mealtime task in order to explain the effects. No participants in Experiment 2 met exclusion criteria for contingency awareness. In Experiment 3, the few reports of contingency awareness were not more numerous in the health task condition. Within the EC condition, 3 out of 24 (13%) mealtime task participants and 2 out of 21 (10%) health task participants were coded as contingency aware by at least one rater. Thus, our results were not dependent on contingency awareness.

Overall, we have demonstrated that EC effects can generalize to an array of related objects in a multidimensional space. What dimension is relevant or cognitively active at the time determines the pattern of generalization. Generalization along a particular dimension is most likely to occur when the conditioned objects are construed in relation to broader categories related to that particular multidimensional space. This construal process can occur without explicit prompting (possibly depending on individual differences), or can also be manipulated prior to or during conditioning. Our findings have important implications for the understanding of evaluative conditioning and attitude generalization, as well as how implicit cognitive processes can interact with EC and generalization processes.

Implications for Application

Positive EC of healthy foods and negative EC of unhealthy foods clearly could become valuable interventions or supplementary treatments for people struggling to eat healthily and lose weight. More importantly, undergoing EC with just a few exemplars of healthy and unhealthy CS foods could extend much further to influence how participants construe a large array of food options. Though previous studies have demonstrated direct effects of EC on attitudes and behaviors on the CS foods themselves (Dwyer et al., 2007; Hollands et al., 2011; Lascelles et al., 2003; Lebens et al., 2011; Walsh & Kiviniemi, 2014), this set of studies is the first to show generalization effects beyond the CS foods alone. Experiments 2 and 3 establish important boundary conditions for when this procedure would be more or less effective and, by doing so, illuminates the likely mechanism responsible for generalization. Participants need to construe the CS foods in terms of their health value at the time of EC, rather than by some other means of judgment or categorization, in order for the effects to generalize and be functional and meaningful. In the real world, people encounter a nearly infinite array of food choices, more than could possibly be conditioned. Demonstrating the potential reach of EC effects is vital for the further development of the method as a viable diet intervention.

One potential limitation of this research involves the specific mode of presentation of the food stimuli. Verbal labels for CS foods, rather than images, were used in part to encourage greater generalization, as words describe many varieties of a food (i.e., all types of fried chicken) without depicting a more specific example (i.e., a particular order of fried chicken from a particular fast food chain). The word format likely also encouraged at least some participants to construe the foods more abstractly in terms of their health goals rather than their hedonic taste goals, making it easier to think of healthy foods as positive and unhealthy foods as negative (Carnevale, Fujita, Han, & Amit, 2015; Fujita & Carnevale, 2012). These more abstract construals and corresponding evaluations of the foods may have encouraged more implicit misattribution as well, as it would be more plausible to participants that negativity could come from “greasy unhealthy food” rather than “tasty comfort food.” More research would need to clarify whether visual representations of CS foods would show the same EC effects, albeit to a possibly weaker extent. Similarly, the eating likelihood DV presented participants with verbal labels rather than pictures. In practice, EC as implemented in the current studies may be especially effective when people decide what to order at a restaurant using a menu containing only written descriptions of the available items, rather than when they see photos of the food options.

Future research should also examine whether EC-mediated eating intention shifts would translate into changing actual behaviors towards food, whether that is through consumption, willingness to pay for various food products, food diaries following the study, or other behavioral measures. Evidence from the literature of attitude-behavior consistency (Ajzen, 1991) and behavioral intentions (Webb & Sheeran, 2006) suggest promise, particularly because of the specificity of the eating intention measure that was used in the present work (Ajzen & Fishbein, 1977; Heberlein & Black, 1976). In order to be a meaningful intervention, however, effects need to last beyond a single study session. Previous EC work that has demonstrated lasting effects suggests potential for such success (Houben, Schoenmakers, & Wiers, 2010; Olson & Fazio, 2006).

Chapter 5: Introduction to the Generalization of Evaluative Conditioning via Approach-Avoidance Training

Another approach to attitude change is approach-avoidance training, which we consider to be a form of evaluative conditioning. Given people's natural adaptive tendencies to approach things that are good and avoid things are bad, we generally have positive associations with "approach" and negative associations with "avoid" (Chen & Bargh, 1999). Thus, we can think of approach and avoidance actions as forms of positive US and negative US, respectively (Laham, Kashima, Dix, Wheeler, & Levis, 2014). Cacioppo, Priester, and Berntson (1993) demonstrated that when arm flexion (i.e., pulling up on a bar) was associated with a visual stimulus, participants evaluated the stimulus more positively. When arm extension (i.e., pushing down on a bar) was associated with a stimulus, people evaluated it more negatively. Arm flexion typically occurs to bring objects towards oneself, while arm extension pushes them away. The researchers proposed that the actions of arm flexion and extension are inherently associated with positivity and negativity, respectively. However, subsequent research, as will be noted shortly, has revealed that a more nuanced perspective is more appropriate.

One often-used method of training participants to approach and avoid stimuli involves pushing or pulling a computer joystick when specific images or words appear on a screen. Different instructions can frame a pushing action to mean either approach --

moving oneself towards an object-- or avoid -- moving an object away from oneself (Markman & Brendl, 2005; Seibt, Neumann, Nussinson, & Strack, 2007; van Dantzig, Pecher, & Zwaan, 2008). In other words, the joystick movement can be attached to either the actor or the object, giving the exact same action opposite meanings. Thus, the physical actions in and of themselves do not automatically imply a particular valence; rather, the symbolic and context-dependent meanings of the actions imply positivity or negativity. Each variation of the joystick paradigm makes the meaning of the push and pull actions clear through detailed instructions to participants and various design features such as perspective lines or zooming effects, which may be necessary to achieve attitude change effects (Laham et al., 2014).

Researchers have shown that approach-avoid training with joystick movements can establish attitudes towards novel objects, such as faces (Woud, Becker, & Rinck, 2008; Woud, Maas, Becker, & Rinck, 2013) and animals (Huijding, Muris, Lester, Field, & Joosse, 2011). Priester, Cacioppo, and Petty (1996) found an important boundary condition in their push-pull paradigm: motor movement conditioning is more effective for novel non-words than for similarly neutral familiar words that have more associations in memory. Nonetheless, experiments have demonstrated that approach-avoid training can still change attitudes towards familiar objects and categories. Researchers have used this technique to reduce pre-existing negative bias against insects and spiders (Jones, Vilensky, Vasey, & Fazio, 2013), African Americans (Kawakami, Phills, Steele, & Dovidio, 2007; Phills, Kawakami, Tabi, Nadolny, & Inzlict, 2011), and math (Kawakami, Steele, Cifa, Phills, & Dovidio, 2008), among other attitude objects. These effects have been found on a variety of outcome measures, such as self-report questionnaires, implicit association tests (Kawakami et al., 2007; Phills et al., 2011; Woud et al., 2013), and behavior (Kawakami et al., 2013; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2013).

Applications of Approach-Avoidance Training

Various researchers have focused on using joystick-based avoidance training to reduce potentially harmful consumption behaviors, particularly through an approach-bias-reduction mechanism (Kakoschke, Kemps, & Tiggeman, 2017a). Approach bias refers to the facilitation of an approach action when it is directed toward an appetitive stimulus in comparison to an avoidance action directed toward that same stimulus. For example, people respond more quickly when approaching appealing food than when avoiding it. Neumann & Strack (2000) also found the converse, such that approach (avoidance) movements facilitate the processing of positive (negative) information. Based on these findings, avoidance training paradigms repeatedly pair avoidance with stimuli to reduce approach bias and shift evaluations to be less positive.

Several common appetitive stimuli have been targets of avoidance training. Wiers and colleagues have used avoidance training to reduce approach biases towards alcohol in problem drinkers (Wiers, Rinck, Kordst, Houben, & Strack, 2010, but see also Lindgren et al., 2015) and reduce relapse in alcohol-dependent inpatients (Wiers et al., 2013). There is also promising evidence that avoidance training can change smokers' biases towards cigarettes and reduce smoking behavior (Kong et al., 2015; Machulska, Zlomuzica, Rinck, Assion, & Margraf, 2015). Related to the current work, unhealthy food has also been a target of interest for avoidance training. Researchers have trained participants to avoid chocolate, resulting in reduced approach biases (Dickson, Kavanagh, & MacLeod, 2016; Kemps, Tiggemann, Martin, & Elliott, 2013), reduced cravings (Kemps et al., 2013), and reduced consumption of chocolate during a subsequent taste test (Schumacher, Kemps, & Tiggeman, 2016). Kakoschke, Kemps, and Tiggeman (2017b) found that unhealthy food avoidance training led participants to be more likely to choose a healthy snack food over an unhealthy one, compared to a control condition. Becker, Jostmann, Wiers, and Holland (2014), however, failed to find an effect of approach avoidance training on food attitudes and eating behavior. These mixed findings regarding food push-pull training suggest that additional research needs to clarify relevant boundary conditions. In general, according to Kakoschke and colleagues' meta-analysis (2017a), avoidance training successfully modifies attitudes and behavior when the relevant approach bias is indeed successfully reduced.

The Present Research

The main research question for the following set of experiments we conducted was whether push-pull conditioning can generalize beyond CS along category-relevant dimensions to related attitude objects, similar to our findings using the Video Surveillance paradigm. Specifically, we used the same set of food stimuli from Young and Fazio (2013), which vary in their perceived healthiness and tastiness, to examine this possibility. We were also interested in examining potential underlying mechanisms and boundary conditions for such a generalization effect and exploring how individual differences might moderate any effects.

Given the high likelihood of experimental demand in many of the paradigms that use supraliminal presentations of CS (e.g., experiment 1 of Kawakami et al., 2007, all studies in Kakoschke et al., 2017), we chose to use subliminal presentations of CS instead (Jones et al., 2013; experiment 2 of Kawakami et al., 2007; but see also Van Dessel, De Houwer, Roets, & Gast, 2016). Subliminal presentations show visual stimuli for such brief durations (on the scale of milliseconds) that a vast majority of people cannot accurately report what they saw. Some people report that they are unable to see any signs of the subliminal stimuli, some report seeing an image flash but not being able to identify the content, and very few can clearly see and accurately identify the content. While a subliminal presentation approach would almost surely produce a weaker effect compared to supraliminal presentations, a key advantage is the increased confidence that any observed attitude change effects are due strictly to the systematic pairing of approach and avoidance movements with the CS rather than participants consciously noticing the pairings and adjusting their responses and behaviors accordingly. We opted to use word CS instead of picture CS, as words are easier to mask than images and are more abstract in nature (Rim et al., 2014), potentially facilitating broader effects.

The rich literature on semantic priming demonstrates that people can process the meaning of subliminally-presented words, at least on some level (Abrams, Klinger, & Greenwald, 2002; Greenwald, Draine, & Abrams, 1996; Ortells, Vellido, Daza, & Noguera, 2006; Shaffer & LaBerge, 1979). A typical priming task would involve a lexical decision task, during which a subliminal semantically-related prime presented immediately before a target stimulus facilitates faster reaction times compared to either presenting no prime or an unrelated prime. One account that explains priming effects is automatic spreading activation, such that a prime activates a particular mental semantic network, leading to activation of related nodes (Collins & Loftus, 1975; Kiefer, 2002). This activation of related nodes facilitates faster responses to related targets. Based on the ability of subliminal words to rapidly activate related concepts, it is possible that push-pull training effects could similarly spread to concepts and stimuli closely related to the CS, such as healthy and unhealthy foods more generally.

Chapter 6: Experiments 4 - 6

Experiment 4

For Experiment 4, we were interested in testing whether subliminal push-pull training could shift eating likelihood ratings towards 4 healthy and 4 unhealthy CS foods, as well as whether any effects would generalize to other foods that vary in their resemblance to the CS with regard to the dimensions of perceived healthiness and tastiness. Thus, we used the same food stimuli as in the video surveillance experiments: *cauliflower*, *zucchini*, *shredded wheat*, and grapefruit for healthy CS+ and *pizza*, *cheeseburger*, *cheesecake*, and *fried chicken* for unhealthy CS-. We hypothesized that push-pull training would decrease the relative preference for unhealthy over healthy foods and that the effect would generalize to other foods, such that participants would show greater sensitivity to health considerations in their eating likelihood ratings.

Methods

Participants. 56 undergraduates (34 women) participated in exchange for partial course credit.

Procedure. For this experiment, we adapted the push-pull procedure with subliminal CS presentations developed by Jones et al. (2013). Participants learned that they were ostensibly participating in a computer-based task that used body movements to better focus cognitive resources and attention. They read instructions to explicitly adopt the perspective of moving the joystick forward to symbolize moving themselves towards the screen, while pulling it back to mean moving themselves away from the screen (as opposed to moving an object on the screen away or towards themselves). Participants were also instructed to move the computer keyboard aside and to place the joystick in front of the center of the monitor, further enhancing the perceptual experience of moving toward and away from it. Their assigned task was to look for the words “TOWARD” and “AWAY,” responding by moving the joystick forward and backward, respectively, as quickly as possible. These conditioning trials appeared at unpredictable intervals, interspersed with blank screens and filler trials displaying random alphanumeric characters. To enhance the perspective of moving toward and away, we included perspective lines in the background (Markman & Brendl, 2005).

We used Sony 16-inch CRT monitors set to a 480 x 600 screen resolution and a 120 mHz refresh rate. During approach conditioning trials, the word “TOWARD!!” appeared for 66 ms, followed immediately by a healthy CS food word appearing for 26 ms (2 screen refreshment cycles), a mask consisting of a string of randomized alphanumeric characters for 66 ms (5 refreshment cycles), and the appearance of the word “TOWARD!!” again until the participant responded by pushing the joystick toward the screen. Similarly, during avoidance conditioning trials, the word “AWAY!!” appeared for 66 ms, followed by an unhealthy CS food word for 26 ms, a mask consisting of a string of randomized alphanumeric characters for 66 ms, then “AWAY!!” again until the participant pulled the joystick away from the screen. There were 15 trials for each of the 8 CS words, for a total of 60 approach trials and 60 avoid trials. To ensure that participants were paying adequate attention to the screen, slow response times longer than 2000 ms triggered a "Please respond faster!" notification. In the control condition, the same "APPROACH!!" and "AVOID!!" prompts appeared, but with subliminal presentations of random alphanumeric characters instead of CS food words. To control for exposure to the food words in the control condition, the healthy and unhealthy CS words each appeared for 26 ms (2 screen refreshment cycles) at random points throughout the procedure, but not adjacent to trials of approach nor avoid prompts.

Following the approach-avoid task, participants completed Young and Fazio's eating intentions measure, rating the likelihood that they would eat each of 42 foods if offered on a scale from -5 to +5. Participants then completed individual difference measures related to eating behavior, including the Food Choice Questionnaire. To assess stimuli and contingency awareness, participants completed a funneled questionnaire asking whether 1) they noticed anything out of the ordinary in the way the words were presented, 2) whether they saw any words flashing very quickly and if so, to describe them in detail, and 3) whether they noticed any particular patterns with regard to images flashing, words, and how they were supposed to respond. They then read a debriefing statement revealing the true purpose of the experiment and were thanked for their participation.

Results

Awareness. 6 participants (11%) were judged by both raters to have reported seeing the subliminal food stimuli on the basis of the first awareness question. This number increased to 14 participants (25%) when responses to the second question were taken into consideration. 6 participants (11%) were judged to be contingency aware of the relationship between push-pull movements and food stimuli based on their responses to the third question. Excluding stimuli and contingency aware participants by various criteria sometimes meaningfully changed the results; all such instances are noted below.

Conditioned Stimuli. Participants' eating likelihood ratings were subjected to a mixed-design ANOVA with CS food type as a within-subjects factor and condition as a between-subjects factor. Participants rated unhealthy CS foods (M = 2.79, SD = 2.24) significantly more positively than healthy CS foods (M = 0.54, SD = 2.41), $F(1,54)$ = 24.44, MSE = 12.06, $p < .001$. There was no significant interaction between CS food type and condition, indicating that EC did not reduce preference of unhealthy CS over healthy CS, $F(1,54)$ = 1.11, MSE = 6.03, p = .30. Simple effects showed that participants' eating likelihood ratings for healthy CS foods in the EC condition (M = 0.56, SD = 2.76) did not significantly differ from those in the control condition (M = 0.52, SD = 1.94), F(1,54) = .003, p = .96. There was, however, a trend in the expected direction such that EC participants reported lower eating intentions for the unhealthy CS foods (M = 2.37, SD = 2.77) than control participants did (M = 3.32, SD = 1.19), but this pattern did not reach statistical significance, $F(1.54)$ = 2.56, p = .12. Removing aware participants by each of the three criteria weakened this trend, though the patterns of unhealthy CS ratings remained directionally consistent.

Generalization. To assess individual differences in generalization, we calculated within-subject correlation scores between all 42 foods and their normative healthiness and tastiness ratings to generate a health sensitivity index and a taste sensitivity index for each participant. These correlation scores were transformed using Fisher's r-to-Z formula prior to analysis. The sensitivity indices were subjected to a mixed-design ANOVA with index type (healthiness, tastiness) as a within-subjects factor and condition (control, EC) as a between-subjects factor. The analysis revealed a significant main effect of index type, $F(1, 54) = 28.22$, $MSE = 0.18$, $p < .001$, and a significant interaction between index type and condition, $F(1,54) = 4.75$, $MSE = 0.18$, $p = .03$, such that EC led to a reduction in the difference between the tastiness and healthiness sensitivity indices (Figure 10). Simple effect comparisons revealed that EC participants had marginally higher scores on the health sensitivity index ($M = .08$, $SE = .07$) compared to control participants ($M = -.11$, $SE = .07$), $F(1,54) = 4.00$, $p = .051$. EC participants ($M = .33$, $SE = .05$) also had marginally lower scores on the tastiness sensitivity index compared to control participants ($M = .49$, $SE = .06$), $F(1,54) = 3.73$, $p = .06$.

After removing participants who expressed stimulus awareness in response to the second question, which excluded the greatest number of participants, EC participants still showed a marginally significant two-way interaction between index type and condition, $F(1,40) = 3.44$, $MSE = .18$, $p = .07$. Removal of contingency-aware participants resulted in a trending two-way interaction between index type and condition, $F(1,48) = 2.33$, $MSE = .13$, $p = .13$.

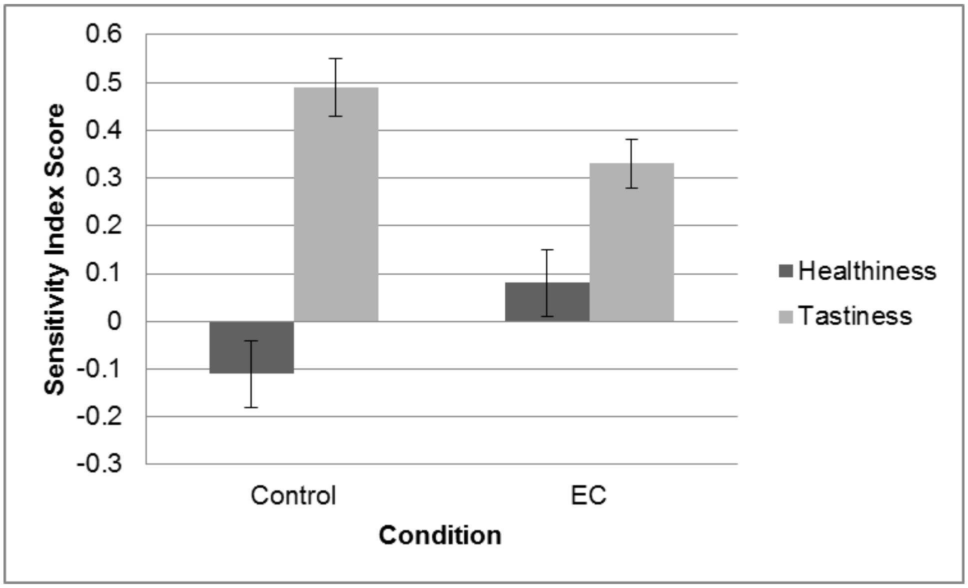

Figure 10. Healthiness and tastiness sensitivity scores. Error bars refer to standard errors.

We also used an HLM approach to examine generalization effects to all 42 foods. Eating likelihood ratings were participant-centered. The two-level HLM analyses involved 2352 observations (based on 56 participants), nested in 42 foods. Condition was entered at level 1 as a fixed effect, and normative tastiness and healthiness ratings were entered as fixed effects, both grand-mean-centered, at level 2.[4] Normative tastiness ratings significantly predicted the eating likelihood for a given food, $\gamma_{01} = 0.78$; $t(39) = 16.4$, $p < .001$, while healthiness did not, $\gamma_{02} = -0.006$; $t(39) = .18$, $p = .86$. There was a

[4] The level 1 and level 2 equations are as follows:

Level 1: Eating likelihood$_{ij} = \beta_{0j} + \beta_{1j}(\text{Condition}) + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Tastiness}) + \gamma_{02}(\text{Healthiness}) + u_{0j}$

$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Tastiness}) + \gamma_{12}(\text{Healthiness})$

r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} is the effect of condition on intentions at mean levels of tastiness and healthiness. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{12} represent the interactions between normative tastiness with condition and normative healthiness with condition. See Table 7 in the Appendix for details.

significant cross-level interaction between EC and normative healthiness ratings, γ_{12} = 0.13, $t(2307) = 4.23$, $p < .001$, such that participants in the EC condition showed higher correspondence with healthiness ratings in their eating likelihood ratings compared to participants in the control condition (Figure 11). There was also a significant cross-level interaction between EC and normative tastiness ratings, $\gamma_{11} = -0.14$, $t(2307) = 2.11$, p = 0.04, indicating that EC reduced participants' correspondence to normative tastiness ratings in their eating likelihood ratings compared to control (Figure 12).

When participants who were expressed stimuli awareness during the first question (as agreed upon by both raters) were removed from the analysis, the cross-level interaction between EC and normative healthiness ratings remained significant, $p = .004$, while the cross-level interaction between EC and normative tastiness dropped to non-significance, $p = .35$. The results were similar when removing aware participants as judged by their responses to the second question, with the cross-level interaction between EC and normative healthiness ratings remained significant, $p = .009$, and the cross-level interaction between EC and normative tastiness dropping to trending, $p = .13$. Removing contingency aware participants resulted in a marginally significant interaction between EC and normative healthiness, $p = .07$, and a nonsignificant interaction between EC and normative tastiness, $p = .20$.

There were no significant effects of EC on any of the FCQ measures, indicating that participants were not self-reporting any differences in their consideration of health in food judgments or eating motivations.

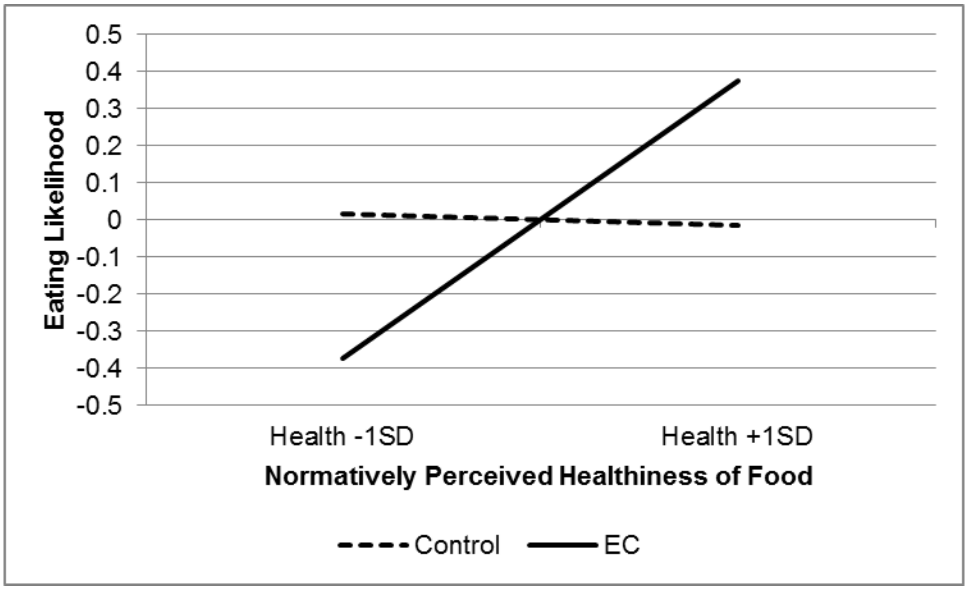

Figure 11. Predicted eating intentions regarding foods of varying healthiness among participants in Experiment 4, based on HLM coefficient terms. Eating likelihood scores are participant-centered.

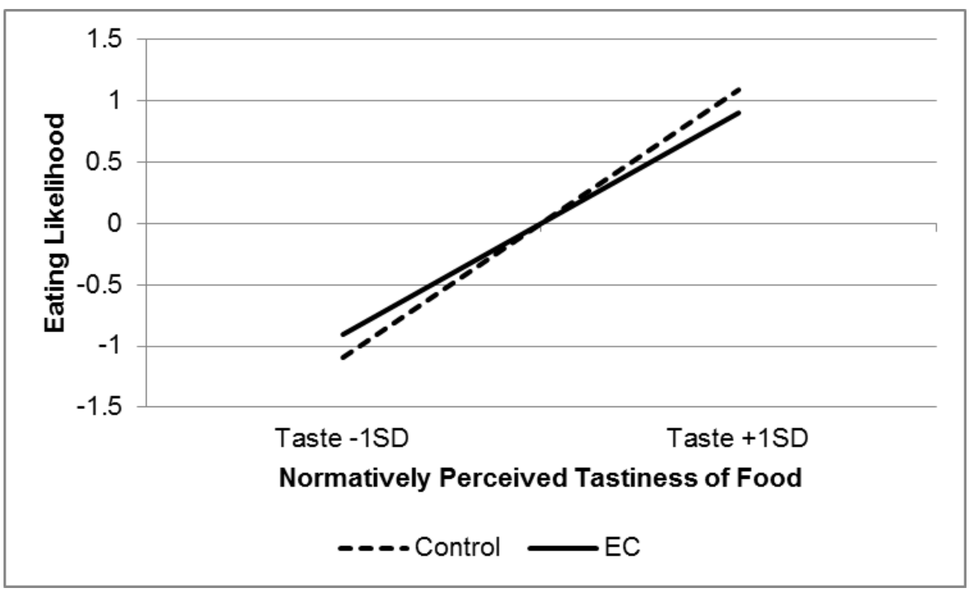

Figure 12. Predicted eating intentions regarding foods of varying tastiness among participants in Experiment 4, based on HLM coefficient terms. Eating likelihood scores are participant-centered.

Moderation by Weight Control Concern. As an exploratory analysis, we were interested in whether weight control importance, as measured by the FCQ weight control subscale, may have moderated any of the observed effects. We regressed the CS difference score on condition, Z-scored weight control, and their interaction. For the CS difference score, there was a marginally significant interaction between condition and weight control, $B = 1.70$, $t(52) = 1.85$, $p = .07$, indicating that EC was more effective in reducing the preference of unhealthy CS over healthy CS in participants who were higher in weight control concern. The simple effect of EC was significant for participants at +1 SD on the FCQ weight control subscale, $B = 2.73$, $t(52) = 2.12$, $p = .04$, but not those at the mean, $B = 1.04$, $t(52) = 1.13$, $p = .26$, nor at -1 SD, $B = -0.66$, $t(52)$ - .51, $p = .61$. The interaction dropped to nonsignificance when excluding stimuli aware participants by either criterion, but the pattern was unchanged when excluding only contingency aware participants, $B = 1.96$, $t(46) = 2.36$, $p = .02$. The conditional effect of EC on participants at +1SD on the FCQ weight control scale was still present, $B = 2.32$, $t(46) = 1.98$, $p = .05$.

To assess weight control concern's role in moderating generalization effects, weight control (Z-scored) as well as the interaction between condition and weight control were added to the HLM model at level 1 (see Table 8 in the Appendix).Weight control FCQ scores did not significant predict the use of taste, $\gamma_{21} = -0.01$, $t(2301) = .27$, $p = .79$, nor health, $\gamma_{22} = 0.03$, $t(2301) = 0.02$, $p = .13$ in eating likelihood ratings. The two-way interaction between EC and normative healthiness remained significant, $\gamma_{12} = 0.13$, $t(2301) = 3.94$, $p = < .001$, though the interaction between EC and normative tastiness became marginally significant, γ_{11} = -0.12, *t*(2301) = 1.73, *p* = .08. We found a significant cross-level three-way interaction between condition, weight control, and normative healthiness, γ_{31} = 0.07, *t*(2301) = 2.20, *p* = .02, indicating that participants who had high weight control FCQ scores became more sensitive to healthiness considerations in their eating likelihood ratings following EC, while participants lower in weight control importance were less affected (Figure 13). This interaction dropped to non-significance when removing stimuli aware participants from question 1, but remained significant when dropping participants from question 2 and 3.There was also a significant three-way interaction between condition, weight control, and normative tastiness, γ_{31} = -0.18, *t*(2301) = 3.21, *p* = .001, indicating that participants higher in weight control importance scores became less sensitive to tastiness considerations following EC. This interaction remained significant when excluding contingency-aware participants or stimuli-aware participants based on the first question. It dropped to nonsignificance when excluding stimuli-aware participants based on the second question.

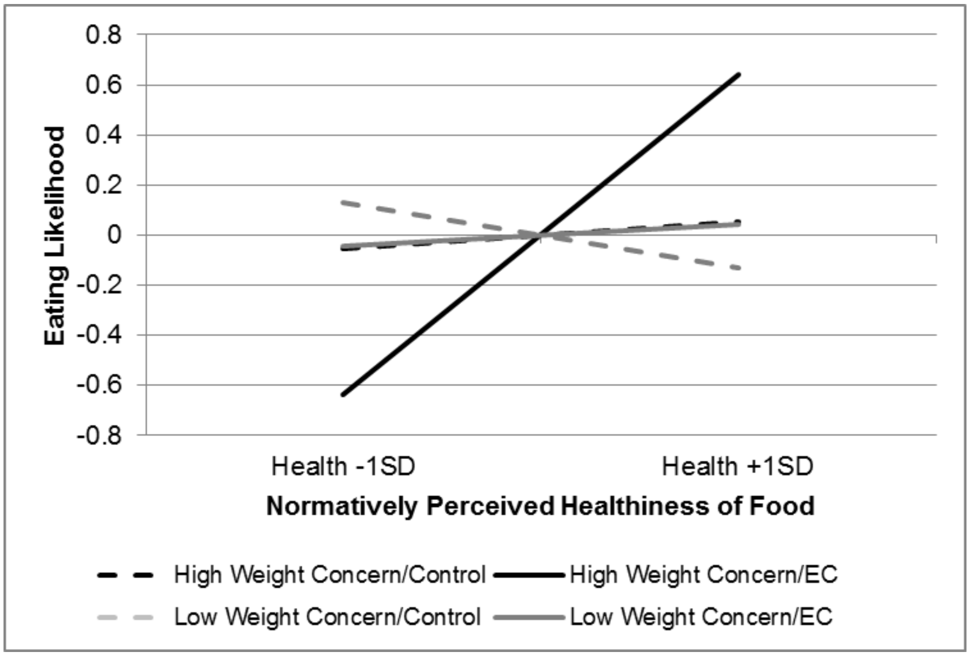

Figure 13. Predicted eating intentions regarding foods of varying healthiness among participants high and low in weight control concern in Experiment 4, based on HLM coefficient terms. Eating likelihood scores are participant-centered.

Discussion

We demonstrated that subliminal push-pull EC with healthy and unhealthy foods can lead people to become more sensitive to healthiness concerns in their eating likelihood judgments. While there was not a statistically significant effect of EC on the CS foods themselves in general, participants' ratings of the unhealthy foods trended in the expected direction. One reason for the discrepancy between the CS effects and the generalization effects could be that the generalization analyses, particularly HLM, have greater statistical power to detect relatively small effects given the considerably larger number of observations included in these analyses.

Furthermore, there was some evidence that weight control importance moderated both EC and subsequent generalization effects, such that EC was particularly effective in participants with greater concern for weight control in their food choices. Participants with such concerns could be more likely to automatically construe foods they encounter, even subliminally, as healthy or unhealthy, because consuming those foods would be beneficial or harmful to their diets, respectively. Given this tendency, generalization along the healthiness dimension would have been particularly facilitated for these participants, as a CS food's healthy or unhealthy nature would likely have been automatically activated in conjunction with the push-pull movements. To contrast, participants with low concern for weight control would be less likely to automatically construe foods by their healthiness, and therefore be less likely to generalize their attitudes and eating intentions based on the healthiness dimension.

Given the small number of participants who had expressed contingency awareness and the fact that the results did not meaningfully change when excluding them, our generalization effects did not appear to depend on participants' awareness of the relation between their approach-avoidance movements and the specific CS. However, one important limitation of this experiment was that a fairly high proportion of participants (11-25%, depending on which criterion was employed) reported being able to see occasional food-related words, though they were presented at a supposedly subliminal duration of time. Excluding stimuli-aware participants by either criterion tended to affect the analyses, in part because so many participants were removed, reducing statistical power. Thus, in the subsequent follow-up experiments, we sought to minimize the visibility of the CS by shortening the presentation time. We also sought to increase the sample size to lessen the impact of excluding stimuli-aware participants on the analyses.

Experiment 5

Given the finding in Experiment 4 that positively conditioning several healthy food exemplars and negatively conditioning several unhealthy food exemplars with push-pull training produced generalization effects, we were interested in what cognitive processes might underlie this finding. Could specific examples of foods be so tightly and automatically associated with their respective categories that presenting “cheeseburger” is not so different from presenting “unhealthy food?” If specific exemplars are strongly associated with their superordinate categories, then we might expect similar generalization effects when using the categories directly as CS, as exemplars and categories could be functionally interchangeable.

To examine this possibility, we tested whether directly conditioning healthy and unhealthy food categories, such as *fruit* and *junk food*, would replicate the generalization effects we found with specific exemplars as CS. One possibility was that exemplar and category conditioning would lead to similar generalization effects. If this were the case, we might expect EC to be especially effective in producing generalization effects for participants who are high in weight control concerns, who would be more likely to automatically categorize foods as being healthy or unhealthy as well as judge them by their health merit. Weight control concern could enhance both the initial EC effect, by providing a chronic motivation to evaluate unhealthy foods negatively, and the generalization effect, as dieters could be more likely to group foods together by their healthiness rather than some other quality. For example, dieters, compared to people unconcerned with weight control, may perceive other unhealthy foods as more similar to pizza and cheesecake. The other possibility was that category conditioning would produce even stronger generalization effects because categories are inherently more general and EC effects would spread to even more items.

Methods

Participants. 242 undergraduate students (122 women) participated for partial course credit.

Procedure. For this experiment, we used the same push-pull conditioning procedure as in Experiment 4. One key change we made was reducing the CS exposure duration from 26 ms (2 screen refreshment cycles) to 13 ms (1 refreshment cycle) to lessen the potential for participants to consciously perceive the displayed words. Participants were randomly assigned to one of three conditions: exemplar EC, category EC, or control. The exemplar EC condition used the same four healthy and four unhealthy food stimuli as in Experiment 4. In the category EC condition, we replaced the specific food CS with the categories of *fruits* and *vegetables* paired with push actions and *snack food* and *junk food* paired with pull actions. Thus, in the category EC condition, each CS food category appeared 30 times, for a total of 120 trials. The control condition displayed random alphanumeric strings with the approach and avoid prompts instead of showing either type of CS.

We wanted to equate exposure to the CS words across the two EC conditions. In the exemplar EC condition, the food category words appeared at random intervals, unassociated with joystick movements, for a total of 120 trials. Conversely, in the category EC condition, the specific exemplar foods appeared at random intervals, not associated with joystick movements, for 120 trials. In the control condition, both the category words and exemplars appeared subliminally at random intervals, not associated with joystick movements.

Following the push-pull procedure, participants completed the eating likelihood measure, the FCQ, and the funneled questionnaire to assess stimuli and contingency awareness. They were debriefed regarding the true purpose of the study and thanked for their participation.

Results

Awareness. Four participants (2%) were judged by both raters to be aware of the flashed food words after the first question. Thirteen participants (6%) were judged to be aware by the second question. Only one participant (0.4%) was judged to be aware of the relationship between push-pull movements and food stimuli. Excluding aware participants by any of these criteria did not change the significance of any of the following analyses, except where noted below with respect to the HLM analysis of generalization moderated by weight control.

Conditioned Stimuli. We first subjected the healthy and unhealthy CS (the 8 original exemplar foods) eating likelihood ratings to a mixed-design ANOVA with healthy and unhealthy CS as the repeated measures and condition as the between-subject variables. There was a significant effect only for CS food type, $F(1,239) = 81.85$, $p < .001$, such that unhealthy CS foods were favored over healthy CS foods. There was no significant food type by condition interaction, $F(2,239) = 0.59$, $MSE = 4.91$, $p = .56$. Although the mean differences between the healthy and unhealthy CS ratings were in the expected direction, with control participants having greater preference for unhealthy CS (M = -2.04, SD = 2.69), followed by exemplar EC participants (M = -1.91, SD = 3.33) and category EC participants (M = -1.53, SD = 3.30), the differences were small.

Generalization. We calculated within-subject correlations between participants' eating likelihood ratings and normative health and taste ratings to produce a health sensitivity index and a taste sensitivity index. A mixed-design ANOVA with index type as the within-subject factor and condition as the between-subject factor showed only a significant effect of index type, $F(1,237) = 130.02$, $MSE = .171$, $p < .001$. Simple effects analyses showed that the mean difference score of the control group (M = -.47, SE = .07) was trending towards being greater than that of the category EC group (M = -.42, SE = .06), p = .10, and exemplar EC group (M = -.40, SE = .07), p = .17) (Figure 14). The means were in the expected direction, such that participants in the category EC condition (M = -0.2, SD = .38) and the exemplar EC condition (M = -.01, SD = .39) had higher healthy sensitivity scores than participants in the control condition (M = -.08, SD = .32).

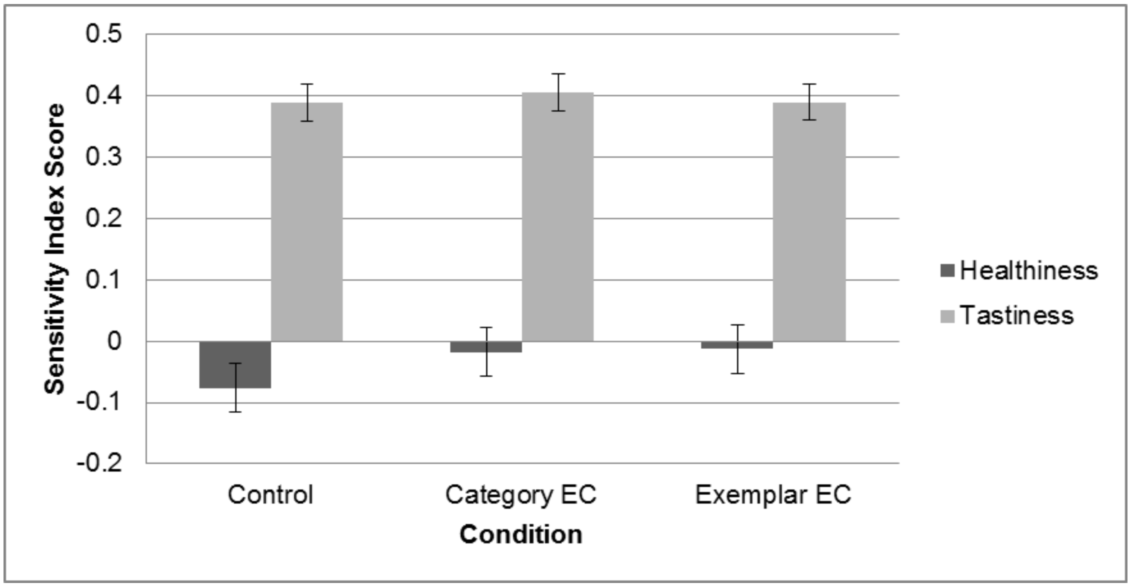

Figure 14. Healthiness and tastiness sensitivity index scores for Experiment 5. Error bars refer to standard errors.

We next conducted a generalization analysis using an HLM approach, which is more sensitive than the sensitivity indices, controls for normative healthiness and tastiness simultaneously, and models more variance. Conditions were dummy coded such that the first dummy variable compared the category EC condition to the control condition and the second dummy variable compared the exemplar EC condition to the control condition.[5] Overall, normative tastiness predicted participants' eating likelihood

[5] The level 1 and level 2 equations are as follows:
Level 1: Eating likelihood$_{ij}$ = $\beta_{0j} + \beta_{1j}$(Dummy 1Condition) + β_{2j} (Dummy 2 Condition) + r_{ij}
Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$(Tastiness) + γ_{02}(Healthiness) + u_{0j}
$\beta_{1j} = \gamma_{10} + \gamma_{11}$(Tastiness) + γ_{12}(Healthiness)
$\beta_{2j} = \gamma_{20} + \gamma_{21}$(Tastiness) + γ_{22}(Healthiness)
r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} and γ_{20} are the effects of condition (category and exemplar) on intentions at mean levels of tastiness and healthiness. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{21} represent the interactions between normative tastiness and condition. Coefficients γ_{12} and γ_{22} represent the interactions between normative healthiness and condition. See Table 9 in the Appendix for details.

ratings, γ_{01} = 0.69, *t*(39) = 7.85, *p* < .001, while normative healthiness did not, γ_{02} = 0.03, *t*(39) = 0.85, *p* = .40. When focusing on the cross-level interactions to assess generalization effects on eating likelihood ratings, the analysis demonstrated that participants in the exemplar EC condition had significantly higher sensitivity to health compared to those in the control condition, γ_{21} = 0.07, *t*(10116) = 2.52, *p* = .01. Similarly, participants in the category EC condition also showed significantly higher sensitivity to health compared to those in the control condition, γ_{12} = 0.07, *t*(10116) = 4.1, *p* < .001 (Figure 15).

We repeated the HLM analysis with a different dummy coding scheme with the category EC condition as a reference, to compare the exemplar EC and category EC conditions directly to each other. We did not find a significant cross-level effect in this second model, γ_{12} = -0.005, *t*(10116) = .19, *p* = .85, indicating that the two EC conditions were equivalent in their generalization effects on healthiness.

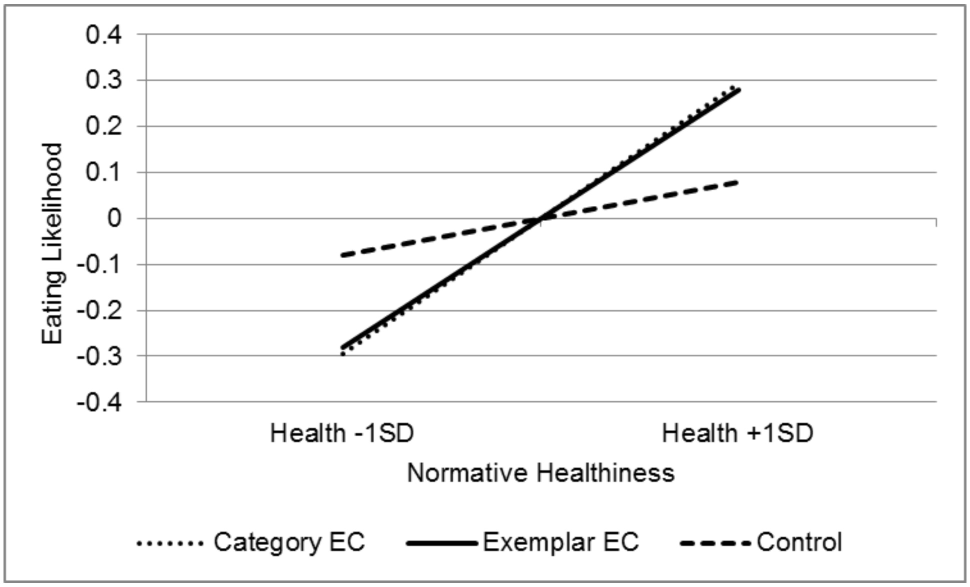

Figure 15. Predicted eating intentions regarding foods of varying healthiness among participants in Experiment 5, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

Moderation by Weight Control Concern. We were also interested in whether FCQ weight control would moderate the effects of EC on CS and generalization. There was no significant difference in FCQ weight control between the three conditions, omnibus $F(2,178) = 1.88$, $p = .16$, though the control participants had slightly lower scores ($M = 2.17$, $SD = .85$) than the category EC ($M = 2.41$, $SD = .87$) and exemplar EC ($M = 2.46$, $SD = .92$) conditions. First, we subjected the CS difference score to a hierarchical linear regression, with dummy coded conditions (with control as the reference category) entered at step 1, Z-scored weight control entered at step 2, and the interaction terms for condition x FCQ weight control entered at step 3. There was a trending interaction between FCQ weight control and the dummy variable representing exemplar EC condition when examining the difference between healthy and unhealthy

CS, B = 0.76, $t(236) = 1.51$, $p = .13$, such that participants with higher weight control concerns had a reduced preference of unhealthy CS over healthy CS following exemplar EC.

We also subjected the unhealthy CS ratings to the same linear regression. There was a marginally significant interaction between the dummy variable representing the exemplar EC condition and weight control, B = -0.60, $t(236) = 1.73$, $p = .09$. Specifically, there was a trend such that participants in the exemplar EC condition with higher weight control importance (+1 SD) rated the unhealthy CS more negatively compared to control participants, B = -0.75, $t(236) = 1.48$, $p = .14$, but not for participants at mean levels of weight control, B = -0.16, $t(236) = 0.46$, $p = .65$, nor for those at -1 SD, B = 0.44, $t(236) = 0.95$, $p = .35$. However, there was no evidence that exemplar EC had an effect on ratings of healthy CS foods, even when taking into account weight control as a potential moderator. The dummy variable representing category EC did not have any significant interactions with weight control when predicting either type of CS rating, nor their difference score.

In the HLM, we added terms at level 1 for Z-scored FCQ weight control and the interactions between weight control and each of the two dummy coded conditions to test for potential moderation.[6] Overall, normative tastiness predicted eating likelihood ratings,

[6] The level 1 and level 2 equations are as follows:

Level 1: Eating likelihood$_{ij} = \beta_{0j} + \beta_{1j}$(Dummy 1Condition) + β_{2j}(Dummy 2 Condition) + β_{3j}(ZWeightControl) +
β_{4j}(Dummy1*ZWeightControl) + β_{5j}(Dummy2*ZWeightControl) + r_{ij}

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$(Tastiness) + γ_{02}(Healthiness) + u_{0j}
$\beta_{1j} = \gamma_{10} + \gamma_{11}$(Tastiness) + γ_{12}(Healthiness)
$\beta_{2j} = \gamma_{20} + \gamma_{21}$(Tastiness) + γ_{22}(Healthiness)
$\beta_{3j} = \gamma_{30} + \gamma_{31}$(Tastiness) + γ_{32}(Healthiness)

$\gamma_{01} = 0.70$, $t(39) = 8.22$, $p < .001$, but normative healthiness did not, $\gamma_{02} = 0.04$, $t(39) = 1.22$, $p = .23$. Weight control significantly predicted correspondence with normative healthiness, $\gamma_{12} = 0.06$, $t(39) = 4.23$, $p < .001$ and marginally predicted correspondence with normative tastiness, $\gamma_{11} = 0.06$, $t(39) = 1.91$, $p = .06$. There were two significant three-way interactions that emerged between both of the dummy-coded EC conditions, weight control, and normative healthiness ratings (Figures 16 & 17). The interaction between the dummy coded category EC condition, weight control, and normative healthiness, $\gamma_{42} = 0.05$, $t(10107) = 2.79$, $p = .005$, indicated that category EC was particularly effective in producing generalization for participants who expressed higher concern for weight control in their food choices. Similarly, the interaction between dummy coded exemplar EC condition, weight control and healthiness, $\gamma_{52} = 0.05$, $t(10107) = 2.08$, $p = .04$, indicated that the exemplar EC generalization effect was stronger in participants with higher weight control concerns. These statistical effects held when excluding participants who expressed stimuli awareness in response to question 1 or those who expressed contingency awareness in response to question 3. However, the effects dropped to below significance when excluding the 6% of participants who

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$$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{Tastiness}) + \gamma_{42}(\text{Healthiness})$$
$$\beta_{5j} = \gamma_{50} + \gamma_{51}(\text{Tastiness}) + \gamma_{52}(\text{Healthiness})$$

r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} and γ_{20} are the effects of condition (category and exemplar) on intentions at mean levels of tastiness and healthiness. γ_{30} represents the effect of weight control on intentions at main levels of tastiness and healthiness, and γ_{40} and γ_{50} are the interaction terms between weight control and each of the dummy conditions. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{21} represent the interactions between normative tastiness and condition. Coefficients γ_{12} and γ_{22} represent the interactions between normative healthiness and condition. Coefficients γ_{31} and γ_{32} represent interactions between weight control and healthiness and tastiness, respectively. Coefficients γ_{41} and γ_{42} represent interactions between category EC, weight control, and healthiness and tastiness. Coefficients γ_{51} and γ_{52} represent interactions between exemplar EC, weight control, and healthiness and tastiness. See Table 10 in the Appendix for details.

expressed awareness in response to question 2.[7] There was no significant three-way interaction for either of the EC variables with weight control and tastiness.

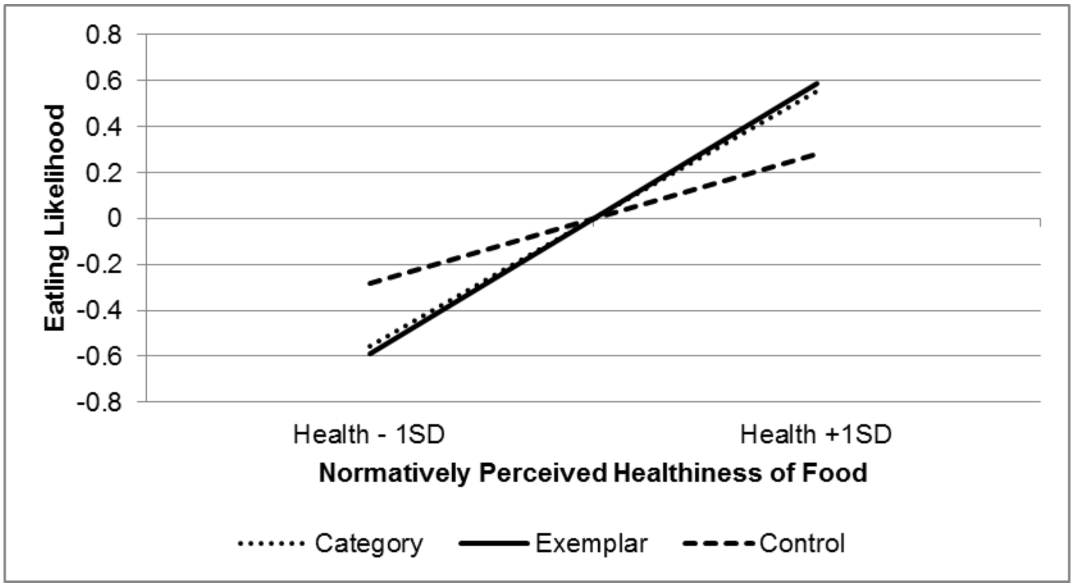

Figure 16. Predicted eating intentions regarding foods of varying healthiness among participants at +1SD in FCQ weight control in Experiment 5, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

[7] Excluding participants who expressed stimuli awareness in response to question 2, the 3-way interaction between category EC, weight control, and normative healthiness was not significant, $\gamma_{42} = 0.014$, $t(9561) = 0.60$, $p = .546$. The three-way interaction between exemplar EC, weight control, and normative healthiness was marginally significant, $\gamma_{52} = 0.04$, $t(9561) = 1.83$, $p = .07$. This was the only analysis in this experiment for which statistical significance was affected by the exclusion of stimuli-aware participants.

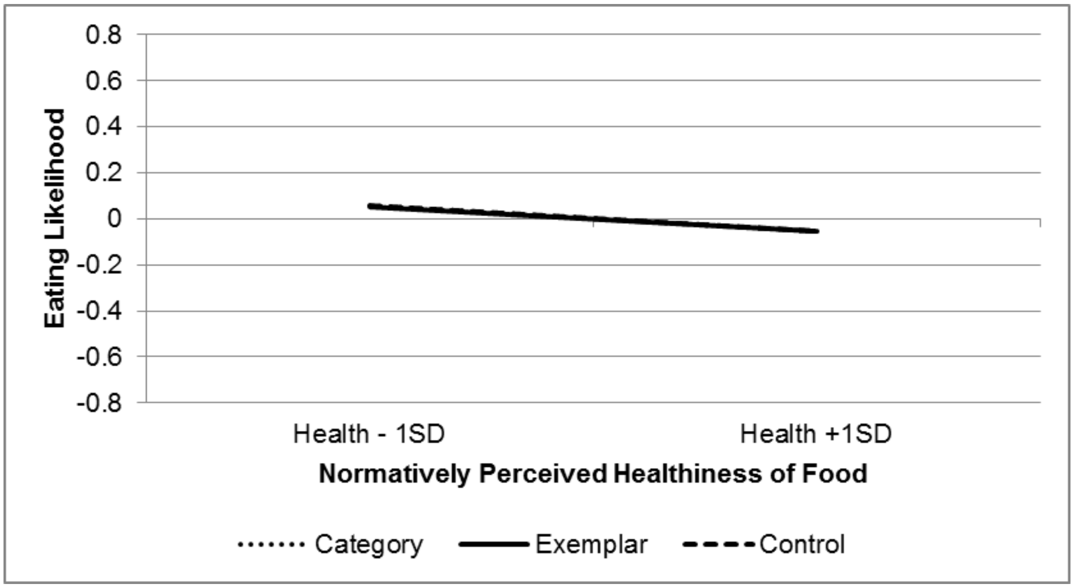

Figure 17. Predicted eating intentions regarding foods of varying healthiness among participants at -1SD in FCQ weight control in Experiment 5, based on HLM coefficient terms. Eating likelihood ratings are participant-centered. All lines are overlapping.

Discussion

The finding that subliminal push-pull EC produced comparable generalization effects using either specific food exemplars or categories as CS suggests that food exemplars can automatically activate superordinate categories, even when they have been displayed for only subliminal durations. These results are consistent with the possibility that exposure to a specific CS exemplar also primes its corresponding category, effectively conditioning the higher-order category at the same time.

Furthermore, we found that the generalization effects were stronger for people who have greater weight control concerns, who would likely have stronger, more automatic associations between specific foods and whether they are healthy or unhealthy.

Having such associations should facilitate a generalization effect along the health dimension because foods are chronically mentally organized and interpreted in the context of that quality. People with low weight control concerns may interpret and construe foods along other dimensions, reducing the likelihood of generalization of EC effects by similarities in healthiness.

By reducing the stimulus presentation time from 26 ms (2 refreshment cycles) to 13 ms (1 refreshment cycle), the frequency of participants who reported being able to see food words declined substantially, from 25% in Experiment 4 to 6% in the present experiment. Importantly, excluding participants by any of the three criteria did not meaningfully affect the significance of our primary generalization findings, reiterating that participants need not express contingency awareness or even stimulus awareness to show generalization effects from push-pull EC. Excluding participants made the moderation by weight control findings more tentative, but the general patterns of moderation appear to be consistent with those from Experiment 4.

Experiment 6

Given the consistent finding that push-pull EC produced generalization effects along the health dimension particularly among those high in weight control concern, we were interested in whether priming participants with different categorization mindsets would enhance or interfere with the effect. We decided to experimentally manipulate individuals' construals of the food stimuli, by priming mindsets using the approach from Video Surveillance Experiment 3. We expected that inducing a healthiness mindset would replicate or enhance the generalization effect, while inducing a competing mealtime mindset would interfere with it, because the healthiness dimension would not be as readily accessible and become less likely to form a basis for categorizing foods. When another dimension is active, there would be little reason to expect a generalization effect based on the dimension of healthiness.

Methods

Participants. 165 undergraduate students (109 women), mean age 18.76 (SD = 1.86), participated for partial course credit.

Procedure. Participants were randomly assigned to one of four conditions in a 2 (health task vs. mealtime task) x 2 (EC vs. control) between-subjects design. First, they had the task of quickly categorizing a series of food words (54 trials) into one of two categories, using different keys for each. Participants categorized foods as healthy or unhealthy in the health task conditions or by whether they would more likely to be eaten during breakfast or dinner in the mealtime conditions. These categorization foods included the CS food words, but no other foods from the 42-item eating likelihood questionnaire. Participants then completed the push-pull joystick conditioning task as outlined in Experiment 4, with the modification of 13 ms (1 refreshment cycle) CS presentations. Following the push-pull task, participants completed the eating likelihood questionnaire, the FCQ, and the funneled awareness questions. They were debriefed and thanked for their participation.

Results

Awareness. Three participants (2%) met criteria for food stimuli awareness for the first question, while a total of 14 participants (9%) met criteria for awareness for the second question. Six participants (4%) expressed contingency awareness of the relationship between movements and healthy/unhealthy words. Excluding aware participants by any of these criteria did not change the significance of the results for any of the analyses.

Conditioned Stimuli. We subjected the CS eating likelihood ratings to a mixed ANOVA, with 2 (health vs. mealtime task) x 2 (EC vs. control) between-subject factors and CS type as a within-subjects factor. The only factor that significantly predicted ratings was CS food type, $F(1,161) = 30.51$, $p < .001$, with participants preferring unhealthy CS ($M = 1.85$, $SD = 2.41$) over healthy CS ($M = 0.38$, $SD = 2.10$). The effects of EC condition, task condition, and their interaction were not significant. The differences between healthy and unhealthy CS ratings were directionally consistent with our hypothesis, with the health task/EC condition having the smallest preference of unhealthy CS over healthy CS (*M* = -.12, *SD* = 4.03), followed by the mealtime/EC condition (*M* = -1.39, *SD* = 3.75), the health task/control condition (*M* = -1.66, *SD* = 3.33), and the mealtime/control condition (*M* = -2.01, *SD* = 3.10).

Generalization. We expected to find that the generalization effect would be strongest when participants had categorized foods by healthiness and undergone EC during the push-pull task. We calculated within-subject correlations between participants' eating likelihood ratings and normative health and taste ratings to produce a health sensitivity index and a taste sensitivity index. The sensitivity indices were subjected to a 2 x 2 x 2 mixed-design ANOVA with task type (mealtime, health) and condition (control, EC) as between-subjects factors and index type (healthiness, tastiness) as a within-subjects factor. The analysis showed a significant main effect of index type, $F(1, 161) = 44.99$, $MSE = .21$, $p < .001$, but no other significant main effects, interactions, nor simple effects. Although there was no indication of an interaction, $F(1,161) = .20$, $MSE = .21$, $p = .66$, the sensitivity index difference scores were in the expected direction. Participants in the health task/EC condition had the smallest difference between taste and health sensitivity scores (*M* = .23, *SE* = .10), compared to the mealtime task/control condition (*M* = .40, *SE* = .11), mealtime task/EC condition (*M* = .38, *SE* = .10), and health task/control condition (*M* = .34, *SE* = .10).

In the HLM generalization analysis[8], which was better powered to detect effects, normative tastiness ratings significantly predicted eating likelihood ratings, $\gamma_{01} = 0.81$,

[8] The level 1 and level 2 equations are as follows:

$t(39) = 10.02$, $p < .001$, as did normative healthiness ratings, $\gamma_{02} = 0.14$, $t(39) = 3.71$, $p < .001$. We expected to find that the generalization effect would be strongest when participants had categorized foods by healthiness and undergone EC during the push-pull task. Indeed, the HLM analysis showed a significant 3-way interaction between task, EC, and normative healthiness ratings, $\gamma_{32} = 0.11$, $t(6879) = 3.41$, $p < .001$ (Figure 18). This result indicated that health sensitivity, represented by the slope of predicting eating likelihood ratings by food healthiness, was steepest for participants in the healthiness task/EC condition compared to the other three conditions. There was no 3-way interaction between task, EC, and normative tastiness ratings, $\gamma_{31} = 0.01$, $t(6879) = 0.07$, $p = .92$.

Level 1: Eating likelihood$_{ij} = \beta_{0j} + \beta_{1j}$(Task Type) + β_{2j}(EC) + β_{3j}(Task Type x EC) + r_{ij}
Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$(Tastiness) + γ_{02}(Healthiness) + u_{0j}
$\beta_{1j} = \gamma_{10} + \gamma_{11}$(Tastiness) + γ_{12}(Healthiness)
$\beta_{2j} = \gamma_{20} + \gamma_{21}$(Tastiness) + γ_{22}(Healthiness)
$\beta_{3j} = \gamma_{30} + \gamma_{31}$(Tastiness) + γ_{32}(Healthiness)
r_{ij} represents the error associated with level 1, u_{0j} represents the intercept error, γ_{00} is the average intercept, and γ_{10} and γ_{20} are the effects of task type and EC on intentions at mean levels of tastiness and healthiness. γ_{30} represents the interaction between task type and EC. Coefficients γ_{01} and γ_{02} represent main effects of normative tastiness and healthiness on food ratings. Coefficients γ_{11} and γ_{21} represent the interactions between normative tastiness and task type. Coefficients γ_{12} and γ_{22} represent the interactions between normative healthiness and EC. Coefficients γ_{31} and γ_{32} represent 3-way interactions between task type, EC, and healthiness and tastiness, respectively. See Table 11 for details.

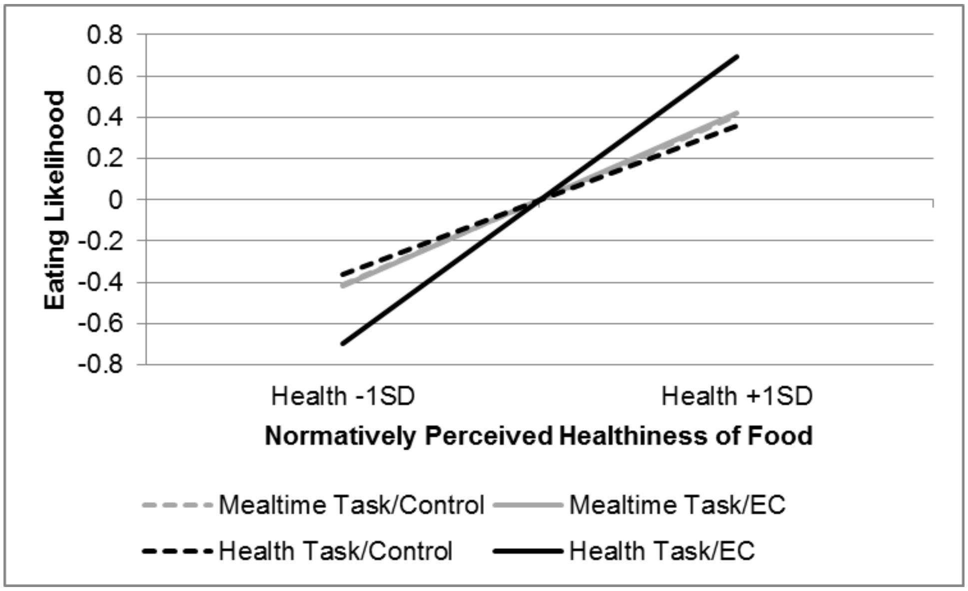

Figure 18. Predicted eating intentions regarding foods of varying healthiness among all participants in Experiment 6, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

Moderation by Weight Control Concern. We were interested in whether FCQ weight control would moderate the generalization effect as assessed through HLM (Table 12 in the Appendix). FCQ weight control did not differ between conditions, $F(3,161) = .348$, $p = .79$. At the mean level of all other variables, weight control positively predicted the correspondence between normative healthiness and eating likelihood, $\gamma_{32} = 0.05$, $t(6867) = 1.94$, $p = .05$. The three-way interaction between task, EC, and normative healthiness remained significant, $\gamma_{42} = 0.08$, $t(6867) = 2.42$, $p = .02$. The HLM analysis with weight control added in as a level 1 variable showed a significant four-way interaction between task, EC, weight control, and healthiness, $\gamma_{72} = -0.11$, $t(6867) = 3.84$, $p < .001$, which indicated that the health task/EC condition, in comparison to the other conditions, led to higher health sensitivity, but primarily for participants with low concern for weight control (Figures 19 & 20). It appeared that participants who had high weight concern were not substantially affected by the experimental manipulations, being sensitive to healthiness in all conditions. The health task/EC condition appeared to be most effective in producing a generalization effect for people typically unconcerned about weight control, which was an unexpected contrast from previous findings. Parallel to that finding, there was also a significant four-way interaction between task, EC, weight control, and tastiness, $\gamma_{71} = 0.21$, $t(6867) = 3.25$, $p = .001$, indicating that tastiness sensitivity was reduced in the health task/EC condition for participants with low concern for weight control (Figures 21 & 22). It appeared that participants with higher weight control concern were higher in health sensitivity in the health task condition compared to the mealtime condition, regardless of EC condition, $\gamma_{52} = 0.11$, $t(6867) = 4.69$, $p < .001$.

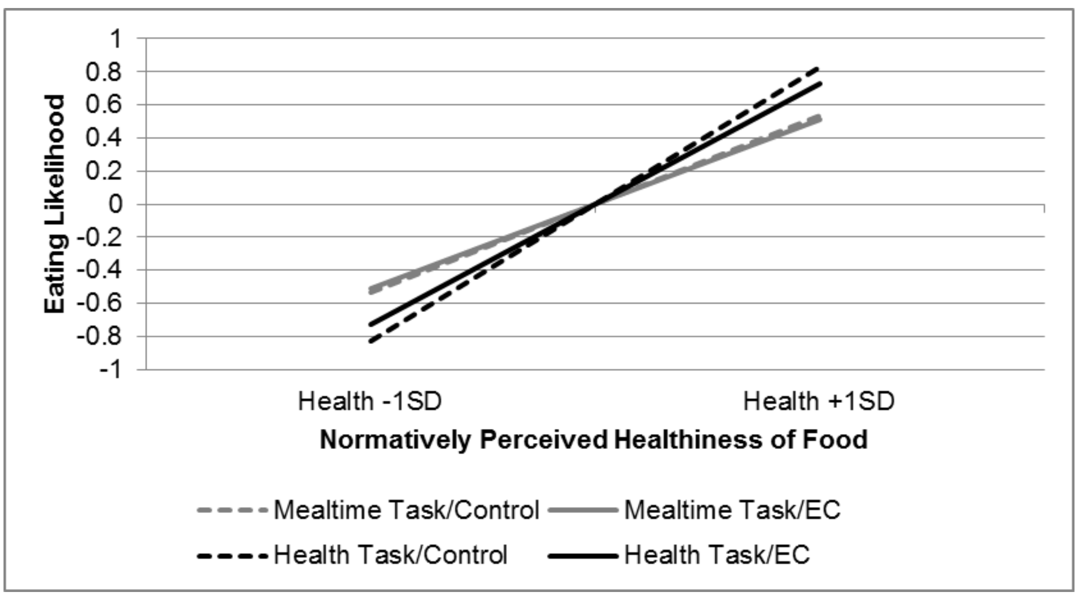

Figure 19. Predicted eating intentions regarding foods of varying healthiness among participants at +1SD in FCQ weight control in Experiment 6, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

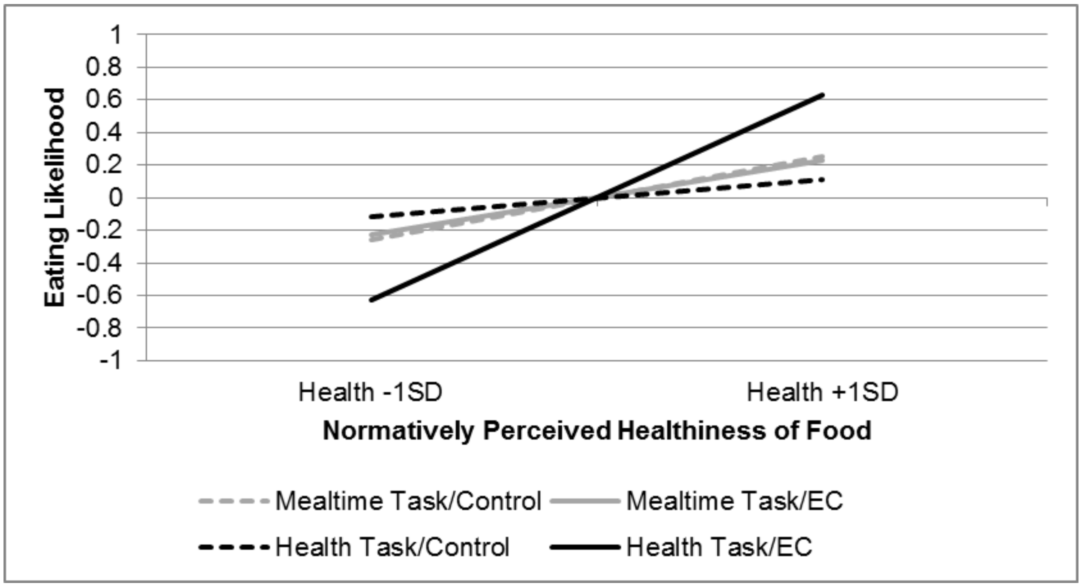

Figure 20. Predicted eating intentions regarding foods of varying healthiness among participants at -1SD in FCQ weight control in Experiment 6, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

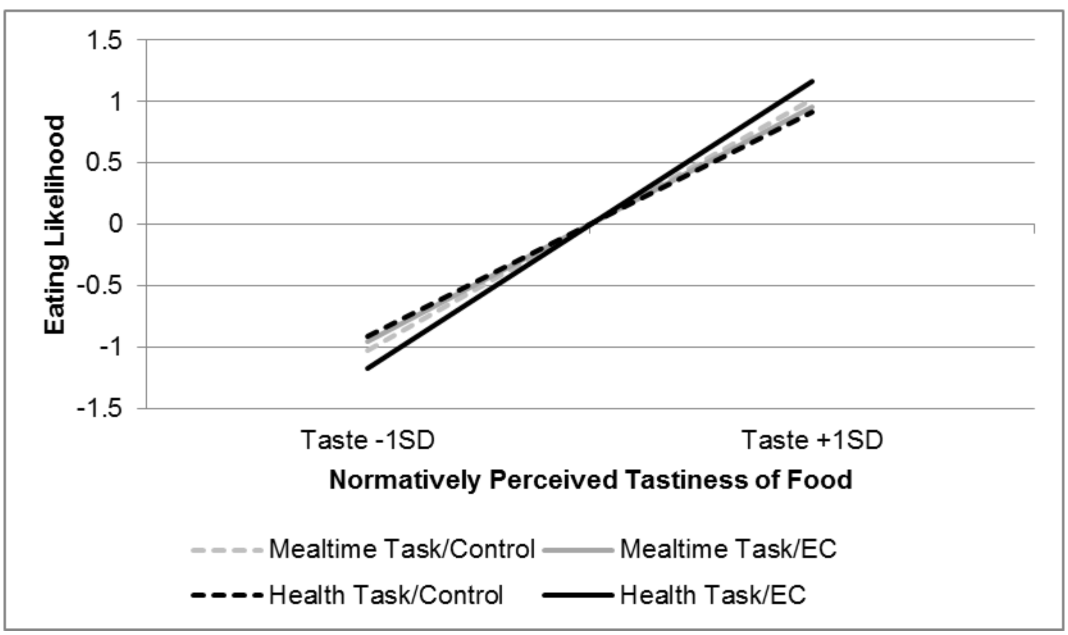

Figure 21. Predicting eating intentions regarding foods of varying tastiness among participants at +1SD in FCQ weight control in Experiment 6, based on HLM coefficient terms. Eating likelihood ratings are participant-centered.

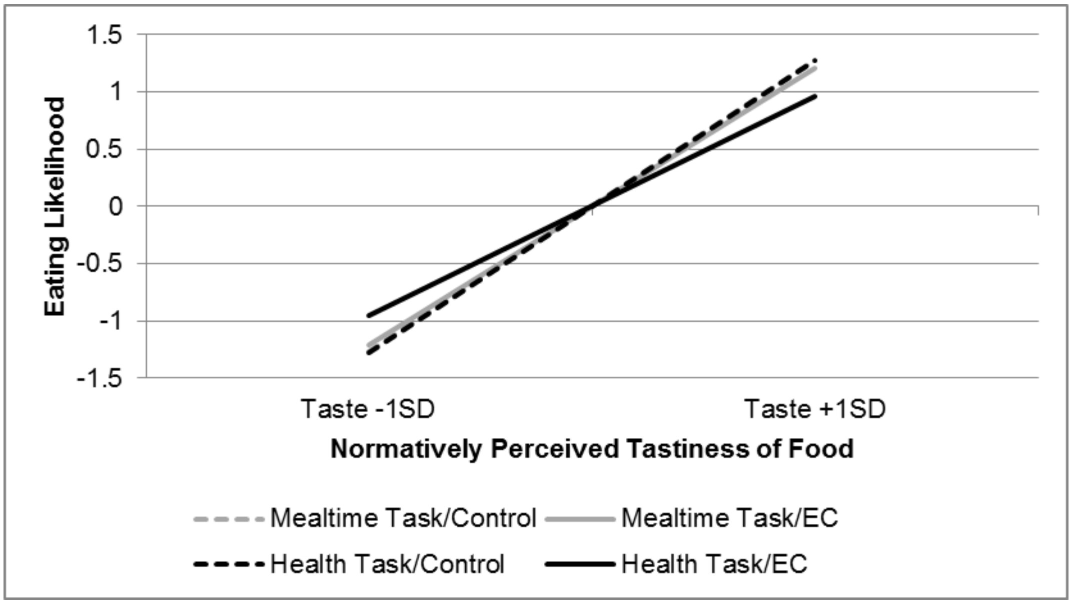

Figure 22. Predicting eating intentions regarding foods of varying tastiness among participants at -1SD in FCQ weight control in Experiment 6, based on HLM coefficient terms. The mealtime task/control line overlaps with the mealtime task/EC and health task/control lines.

Discussion

We again did not find a significant EC effect on the CS foods themselves, but replicated the healthiness generalization effect in the expected condition (health task/EC). Because the CS difference scores were directionally consistent with our hypothesis, we believe that finding a significant generalization effect without a corresponding EC effect was due to a difference in power. By including many more observations and accounting for more variance, the HLM generalization analysis with 42 foods has more power to detect an effect compared to the ANOVA with just the CS.

The finding that priming a healthiness mindset prior to push-pull conditioning facilitates generalization to health, while priming a different mindset interferes with the effect, replicates our findings from the Video Surveillance Experiment 3. Such categorization facilitates generalization to other related stimuli along relevant dimensions. Furthermore, construal by a particular dimension can also be affected by situational factors, such as reminding people about the healthiness of food. We have evidence that priming a specific mindset can be a key situational factor that influences construal of a subliminally-presented stimulus word, which in turn facilitates generalization.

Interestingly, we found evidence that the health task/EC condition was particularly effective in increasing healthiness sensitivity among participants low in weight control. This result contrasts with the results of Experiments 4 and 5. In those experiments, we found that EC was more effective in high weight control participants, probably because they were more likely than low weight control participants to construe food in terms of health. Neither of these previous experiments primed a particular mindset.

In contrast, for Experiment 6, participants were explicitly primed with either healthiness or mealtime, which should have overridden whatever would naturally come to mind when they were exposed to food words. Examining the participants with high weight control scores, it appears that undergoing the health categorization task, even in the control condition, was sufficient to activate weight concerns for these participants and result in high sensitivity to healthiness during the food rating task (see Table 12 in the Appendix). Based on this finding that the health task/control participants were already highly sensitive to health, EC was apparently unable to increase health sensitivity even more, resulting in a ceiling effect. In the mealtime conditions, we also did not find an effect of EC for those highly concerned about weight control, but likely for an entirely opposite reason -- because the dimension of healthiness was not readily accessible for these participants and therefore unable to form a basis for generalization. The effects observed for participants who were lower in weight control are especially interesting. Apparently, a healthiness mindset served as an effective catalyst, allowing EC to nudge participants who do not typically have high motivation to diet to become more sensitive to health in their food choices. Clearly, future research should examine these moderating effects in more detail to achieve a better understanding of how individual differences can affect generalization of EC.

Chapter 7: General Discussion of Experiments 4 - 6

Our consistent finding of generalization occurring from subliminal push-pull conditioning across three experiments clearly demonstrates its potential wide-ranging effects on attitude objects related to the CS. Furthermore, our findings are consistent with the possibility that people can rapidly categorize subliminally presented words, possibly even at an automatic, unconscious level. Strongly-associated concepts of features (e.g., grapefruit-healthy, cheesecake-unhealthy) may be activated automatically even in response to subliminally presented stimuli. While much research has demonstrated subliminal categorical and semantic priming, that is, the presentation of one word facilitating a faster response to another related word (e.g., Abrams et al., 2002; Klauer, Eder, Greenwald, & Abrams, 2007; Klauer, Musch, & Eder, 2005), not much work has been conducted on using those associative relationships to change attitudes.

Two related and contentious issues in the current literature are whether subliminal push-pull conditioning effects can be replicated and whether stimulus detection and contingency awareness is necessary to produce the effect. To our knowledge, only three papers have been published about push-pull conditioning using subliminally-presented CS: Kawakami's work on approaching African Americans, an attempt at replicating that work, and Jones' work on approaching insects and spiders. Van Dessel, De Houwer, Roets, and Gast (2016) unsuccessfully attempted to replicate Kawakami and colleagues'

(2007) findings of subliminal push-pull conditioning leading to reductions in implicit bias towards Black people. Van Dessel and colleagues also attempted conditioning with novel faces and non-words. They were only able to produce conditioning effects when participants were aware of the contingencies through the provision of explicit instructions about the relations between CS and joystick movements before subliminal training (Experiment 2) and when they could detect the patterns during a supraliminal version (Experiment 3). Our consistent lack of significant conditioning effects on the CS difference scores may shed some light on these replication failures. It is possible that the attitude change effect for the CS is simply too small to detect without a very highly powered experiment.

Another potential factor explaining discrepancies among the studies is that these Kawakami et al. and Van Dessel et al. experiments used longer stimulus presentation times (~24 ms), which could have led to higher stimulus awareness, potentially affecting participants' responses to outcome measures. Van Dessel and colleagues reported that 16-21% participants expressed awareness of seeing the face stimuli. In the original race training replication attempt (Experiment 1), 11% could even detect the races of the faces. Similarly, 21% of participants in their Experiment 3 expressed awareness of seeing the flashed nonword stimuli. These awareness rates are roughly equivalent to what we found in Experiment 4, with up to 25% of participants expressing awareness of the presentation of the stimuli. In our experience, both in the current experiments and other pilot studies[9], we have found that shortening the presentation time as much as possible, to 13 ms, substantially minimizes participants' ability to detect and identify the CS stimuli. Reducing the presentation time to 13 ms resulted in 5-9% of participants reporting the ability to read the food words in Experiments 5 and 6, correspondingly. More research, however, needs to be conducted in order to further our understanding of these phenomena, particularly the boundary conditions that influence when subliminal conditioning does and does not work.

Some researchers posit that approach-avoidance training effects are due primarily to propositional knowledge and contingency awareness about CS-US relations, rather than traditional associative learning with repeated pairings between actions and stimuli. Van Dessel, De Houwer, Gast, and Smith (2015) have asserted that receiving mere instructions about contingencies are sufficient to produce training effects, without actually undergoing training, at least for novel social stimuli (but not for familiar stimuli). Van Dessel, De Houwer, Gast, Smith, and De Schryver (2016) extended this, finding that mere instructions about approach-avoid contingencies with novel fictional social groups without actual training affected implicitly measured attitudes, but not explicitly measured ones. They also found this instruction effect when the actual action-CS pairings were

[9] We conducted two pilot studies to assess the degree to which detection rates differ between stimulus presentation times of 13 ms and 26 ms. Participants indicated on a trial-by-trial basis whether they saw a stimulus belonging to one of several categories with a yes/no response immediately after they were actually exposed to subliminal images of insects. Example categories include mammal, car, and flower. Participants exposed to the longer stimulus presentations had substantially higher accuracy rates for detection of insects – 78% in one study and 47% in a second, compared to those exposed to the shorter stimulus presentation times – 15% and 10%, respectively. Participants' self-reports of stimuli detection differed correspondingly, such that many more reported seeing insects in the longer-presentation condition (53%) than the shorter-presentation condition (7%) in the second study.

switched, indicating that propositional information overrode repeated associations. Although these studies show that propositional information can be *sufficient* to produce effects, demonstrating that instructions have the potential to affect implicit measures of attitudes does not mean a propositional process is *necessary* to produce any attitude change that follows approach-avoidance conditioning.

In our studies, very few participants correctly guessed the contingencies or the actual purpose of the experiment, indicating that the research context was characterized by low experimental demand, as we intended. Our repeated finding that push-pull conditioning led to generalization along the health dimension, through various experimental configurations, demonstrates that wide-ranging subliminal training effects without contingency awareness are certainly obtainable. In Experiments 5 and 6, those that used the briefer exposure times, excluding the relatively small percentage of participants who reported being able to see and read the subliminally presented CS did not change the generalization results, indicating that the effects are not driven by participants who were at all aware of the stimuli.

Nevertheless, there are some limitations that need to be addressed in future research. We would need to use larger sample sizes with higher power in order to test whether push-pull EC effects on the CS themselves are real, but small and difficult to detect. The measure we used to assess contingency awareness is not as sensitive as other methods, such as visual discriminability tasks that directly measure the extent to which participants can identify the content of subliminal stimuli (such as the method we used in Footnote 8). Because we found that different experimental conditions resulted in effects for people both high and low in weight control importance, further research should also investigate the different experimental conditions that determine when EC is most effective for whom. The essential findings of push-pull EC generalizability should also be replicated using stimuli other than food that vary from each other along multiple qualities or dimensions.

Our findings can inform the development of healthy eating interventions using EC approaches. Encouragingly, the results of these experiments suggest that conditioning only a few exemplar food items can lead people to become more sensitive to healthiness in their judgments of a variety of other foods. Furthermore, this effect is particularly effective for people high in weight control concern, who would be more likely to seek help for eating behavior change. However, we also found that inducing a health mindset prior to EC enhances the efficacy of the EC push-pull procedure for people low in weight control concern, indicating its ability to shift healthiness sensitivity even among those with low motivation - perhaps the people who need health interventions the most.

Chapter 7: Behavioral Validation of Eating Intentions Measure

Study 7

In order for EC to be a viable diet intervention, we need to demonstrate that effects could extend to actual eating behavior outside of the lab. The eating likelihood measure that we used as the primary dependent measure for Experiments 1-6 asks participants to indicate the likelihood that they would eat a serving of each of 42 foods (Young & Fazio, 2013). Participants' eating likelihood ratings of the various foods were then correlated with corresponding normative health ratings to generate a healthiness sensitivity index for each person. For the following study, we investigated whether this healthiness sensitivity index would prospectively predict the healthiness of participants' actual subsequent eating behavior.

Participants first completed the eating likelihood measure in a lab setting. They then completed detailed food diary questionnaires online for the next five consecutive weekdays. Various raters, including the participants themselves, then made judgments about how healthy the food diary entries were, on average. The goal was to examine whether health sensitivity, as measured by the eating likelihood judgments, would prospectively predict the healthiness of actual eating behavior over the span of a week. We also were interested in the extent to which the eating likelihood measure would predict unique variance in eating behavior beyond that explained by self-reports of the importance of eating healthily. Hence, we examined whether any relationship would be evident over and above the FCQ health subscale.

Methods

For Study 7, 88 undergraduate participants (61 female) completed the 42-food eating intention measure in the laboratory and then submitted food diaries via online questionnaires for 5 consecutive weekdays, beginning with the weekday after they came into the lab. They were asked to list what they ate for breakfast, lunch, dinner, and snacks/other meals in as much detail as possible. On days 3 and 5, they also completed the FCQ. After listing the foods they consumed for each day, participants were asked to rate the healthiness of that day's food as a whole on a scale of very unhealthy to very healthy (1 to 7). We obtained complete diary entries for 69 participants (78%) and four or more entries for 77 participants (88%), indicating relatively high completion rates. Only 6 participants (7%) did not submit any entries. Participants who did not submit diary entries did not appear to differ on any meaningful variables from participants who did submit them.

In addition to participants' healthiness ratings of their food diary entries, two lay judges rated the healthiness of each day's food as a whole on the same scale of very unhealthy to very healthy (1-7). Additionally, we consulted with nutritionists, who calculated a modified dietary variety score (Krebs-Smith, Smiciklas-Wright, Guthrier, & Krebs-Smith, 1987) as a proxy to quantify the nutritional adequacy of the participants' diets. The dietary variety score was a count of the number of six major food groups represented in each day's meals (carbohydrates, proteins, fruits, vegetables, dairy, and fats/sweets/alcohol) and was then averaged across each of the days. Each judge scored the entries of half of the participants after working together extensively to establish a standard scoring methodology on a number of sample entries.

Results

A healthiness sensitivity index was calculated by correlating each participant's eating likelihood ratings for the 42 foods with their corresponding normative healthiness ratings from Young & Fazio (2013). The mean healthiness sensitivity score was .04 (*SD* = .36).[10]

When it came to the food diary entries, agreement between the two lay judges regarding healthiness ratings was high, with Pearson's r value correlations of .81, .74, .83, .68, and .80 (all *p*s < .001) for each of the five days, respectively. Therefore, the two lay judges' ratings were averaged to form a composite score for each day, which was then averaged across all of the available days. As hypothesized, the healthiness sensitivity index scores positively predicted participants' healthiness ratings, $r(82) = .27$, $p = .02$, lay judges' ratings, $r(82) = .55$, $p < .001$, and the nutritionists' scores, $r(81) = .32$, $p = .004$, regarding the food diary entries. These results indicate that the healthiness sensitivity index is a good predictor of the healthiness of actual eating behavior, as judged by different independent kinds of judges. Interestingly, lay judges' composite ratings corresponded significantly more with the healthiness sensitivity index, $r(82) = .55$, $p < .001$, than did participants' own ratings, $r(82) = .27$, $p = .02$, Hotelling-Williams $t(79) =$

[10] Although not relevant to the present analyses, for the interested reader, the mean correlation between eating likelihood scores and normative tastiness ratings, i.e. the tastiness sensitivity score, was .34 (*SD* = .22).

3.09, $p = 0.003$. Similarly, lay judges' healthiness ratings also corresponded marginally more with nutritionists' scores, $r(81) = .44$, $p < .001$, than did participants' own ratings, $r(82) = .27$, $p = .02$, and $r(81) = .27$, $p = .02$, Hotelling Williams $t(78) = 1.74$, $p = .09$.

Importantly, the healthiness sensitivity index significantly predicted nutritionists' scores, standardized $\beta = .29$, $t(79) = 2.42$, $p = .02$, even when including FCQ Health in a regression model, $\beta = .05$, $t(79) = .44$, $p = .66$, indicating that the sensitivity index uniquely explains variance in the healthiness of eating behavior over and above participants' self-reports regarding the importance that they assign to eating in a healthy manner. Similarly, the healthiness sensitivity index significantly predicted healthiness of eating behavior as judged by lay raters, standardized $\beta = .42$, $t(80) = 4.07$, $p < .001$, controlling for FCQ Health, $\beta = .26$, $t(80) = 2.62$, $p = .01$. In contrast, participants' own ratings of the healthiness of their food consumption were significantly predicted by their FCQ Health scores, $\beta = .28$, $t(79) = 2.33$, $p = .02$, but not their healthiness sensitivity index scores, $\beta = .13$, $t(79) = 1.13$, $p = .26$.

Discussion

We demonstrated successfully that the healthiness sensitivity index prospectively predicted participants' reported eating behavior for a week outside of the lab. The results provide good evidence that the index has good predictive and ecological validity as a measure of diet healthiness and is therefore a valid outcome measure for the evaluative conditioning experiments. There was moderately high agreement between the different raters – participants, lay judges, and nutritionists – about the healthiness of participants' diets, indicating that people's understanding of what constitutes a healthy or unhealthy diet is generally accurate, which is consistent with previous literature (Bucher, Müller, & Siegrist, 2015). The healthiness sensitivity index score uniquely predicted the food diary healthiness ratings provided by both lay judges and nutritionists, but not participants' own healthiness ratings when controlling for their self-reported importance of healthiness in daily food choices, as measured by the FCQ health subscale. This pattern suggests that the healthiness sensitivity index may be less influenced by participants' own self-beliefs and judgments regarding their eating behavior. People may perceive the healthiness of their own diets in a skewed manner (Chock, 2011), while distant others might be capable of making more accurate, less biased judgments. Furthermore, the eating likelihood items measures healthiness sensitivity indirectly rather than in a more transparent manner that may encourage socially desirable responses from participants. Bias in healthiness judgments and subsequent behavior could come from individual variations in knowledge or understanding about what foods constitute a healthy diet (Ares, Giménez, & Gámbaro 2008) or from motivated perception to view their own diets as more or less healthy than some standard of comparison. There was no clear indication, however, that participants were, as a whole, systematically rating their diets as either more or less healthy than did other raters.

There are several key advantages of using the healthiness sensitivity index as a dependent measure to assess effectiveness of EC and other eating interventions. The measure is relatively short (42 items) and is easy to administer in a lab setting or over the internet. It predicts unique variance in healthy eating behavior unaccounted for by other self-report measures, such as the FCQ Health subscale. Another potential advantage is that the index may be able to capture both habitual eating preferences but also in-the-moment food cravings because of its wording: “If you were offered this food, how likely would you be to eat a serving of it?”. The measure also covers a large variety of common foods, rather than focusing on a few select examples. These factors give our measure certain advantages over other indices of eating behavior.

One commonly used behavior measure, for example, making a choice between healthy and unhealthy food options, constitutes a one-time binary decision in a situation that may be subject to both relatively high demand characteristics and idiosyncratic food preferences (e.g., Walsh & Kivinemi, 2013). Another commonly used behavioral measure quantifies the amount of food eaten during a supposed taste test, which could be vulnerable to the same factors (e.g., Adams, Lawrence, Verbruggen, & Chambers, 2017). These types of in-lab behavior measurements might not be a good representation of naturalistic eating behavior (Johnson, Pratt, & Wardle, 2012), while the health sensitivity index could better predict general eating behavior.

Other assessments of eating behavior that track food intake over time and in detail can be cumbersome, requiring training, weighing of food, and interference with participants’ daily lives (Lee-Han, McGuire, & Boyd, 1989; Rutishauser, 2005). Some instruments require face-to-face time between participants and a trained interviewer to recall what they ate retrospectively over one or more days (Rutishauser, 2005), which can be labor- and time-intensive. Some questionnaires require participants estimate their typical diet using a checklist of foods, which may have issues with limited accuracy and do not appear to be much more predictive of actual nutrition intake compared to our strategy, with correlations in the range of .47 to .67 (e.g., Block, Woods, Potosky, & Clifford, 1990). Furthermore, measures that assess habitual diets would be unlikely to detect subtle shifts in eating behavior following an intervention.

One caveat for these studies is that the longitudinal diary data measure we used to validate the sensitivity index is more qualitative than quantitative, and therefore is an imprecise measure of the healthiness and nutritional adequacy of participants' diets. A primary goal for the administration of the follow-up food diary questionnaires was to retain as many participants as possible. We therefore chose an approach that would take minimal time and effort, rather than require participants to precisely weigh and measure their food intake, which would have been more intrusive and require intensive training (e.g., Block, Woods, Potosky, & Clifford, 1990; Rutishauser, 2005). Given that the various measures of healthiness correlated with each other, however, particularly lay judges' ratings with the nutritionists' dietary variety score, it appears that the diary measures were a sufficient representation of participants' diets for the purpose of estimating their healthiness.

Overall, the healthiness sensitivity index from our eating likelihood measure seems to be a good predictor of subsequent eating behavior. Our findings across multiple studies support the possibility that EC of healthy and unhealthy foods via EC could shift eating intentions, and in turn actual eating behavior. Demonstrating this link would be valuable in future research endeavors.

Chapter 8: General Discussion

Overall, our seven studies have demonstrated that evaluative conditioning of specific stimuli, via either Video Surveillance or a subliminal push-pull paradigm, can lead to generalization to other attitude objects, depending on their degree of resemblance to the CS. Specifically, positively conditioning healthy foods and negatively conditioning unhealthy foods shifted participants' eating intentions towards other foods as well, such that their preferences aligned more closely with healthiness of the food. This generalization appears to occur because at least some participants implicitly categorize stimuli as healthy or unhealthy as they are exposed to them, even without direct prompting. Inducing participants to interpret food stimuli in terms of other categories (e.g., mealtime) eliminates the health generalization effect.

This work contributes insights to the literature on evaluative conditioning, which has examined generalization in more constrained and artificial ways, using generalization stimuli such as those that had been specifically associated with the conditioned stimuli (Walther, 2002), CS images that were modified by the addition of new features, e.g., eyeglasses (Unkelbach, Stahl, & Förderer, 2012), or stimuli belonging to the same specific category as the CS, i.e., chocolate (Kemps, Tieggemann, Martin, & Elliott, 2013). We found very consistent generalization effects across the studies for a variety of food that naturally resemble the CS in perceived healthiness, but might not otherwise be closely associated with each other. For example, negatively conditioning pizza, cheeseburger, cheesecake, and fried chicken shifted attitudes towards other unhealthy foods as varied as burrito, hot dog, and apple pie. Most novel and intriguing was the finding that conditioning even subliminal presentations of food stimuli could lead to these generalization effects. These results indicate that at least some of the cognitive processes involved in the generalization effect – activation of the healthy or unhealthy nature of the specific CS -- can operate very rapidly and without awareness.

The present results suggest that generalization effects should be modulated by the extent to which the specific CS foods activate the associated concept of healthy or unhealthy. Foods that strongly activate those categories many be especially powerful in encouraging generalization. For a follow-up experiment, we are interested in testing whether using relatively more prototypical healthy and unhealthy foods as CS are more effective in leading to generalization. The reasoning is that more prototypically healthy and unhealthy foods, e.g. apples and candy, should be more likely to automatically activate the related concepts of healthy/unhealthy compared to foods less strongly associated with those categories, e.g., raspberries and donuts. More prototypical foods should act as more effective representatives of the categories. Not only would this be an interesting test of the current theoretical reasoning, but it also could suggest that actual behavioral interventions would benefit by using CS that are highly prototypical of healthy and unhealthy foods.

Our findings could benefit current efforts to develop and improve behavioral interventions. The outcome measure that we used for the EC studies, the healthiness sensitivity index, prospectively predicted the healthiness of participants' eating behaviors outside the lab. Thus, it seems certainly possible that EC by either method could in turn nudge actual eating behavior to benefit participants, which would be an important next step for investigation. Such an investigation could also test either EC procedure as a supplement to existing diet and exercise intervention programs for overweight patients and, more generally, people who seek to improve their physical health and well-being.

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Table 2

HLM regression coefficients for Experiment 1

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.06)	0.00	
Perceived Tastiness (γ_{01})	0.77	(0.06)	13.56	***
Perceived Healthiness (γ_{02})	0.10	(0.02)	4.65	***
Condition (γ_{10})	0.00	(0.06)	0.00	
Cross-level interactions				
Condition x Tastiness (γ_{11})	-0.12	(0.05)	-2.32	*
Condition x Healthiness (γ_{11})	0.10	(0.02)	5.28	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 3

HLM regression coefficients for Experiment 2

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.10)	0.00	
Tastiness (γ_{01})	0.57	(0.5)	12.27	***
Healthiness (γ_{02})	0.21	(0.04)	4.73	***
Task Type (γ_{10})	0.00	(0.12)	0.00	
EC (γ_{20})	0.00	(0.10)	0.00	
Task Type x EC (γ_{30})	0.00	(0.14)	0.00	
Cross-level interactions				
Task x Tastiness (γ_{11})	0.10	(0.08)	1.22	
Task x Healthiness (γ_{12})	-0.12	(0.05)	-2.46	*
EC x Tastiness (γ_{21})	0.01	(0.06)	0.13	
EC x Healthiness (γ_{22})	-0.04	(0.04)	-0.98	
Task x EC x Tastiness (γ_{31})	-0.13	(0.09)	-1.42	
Task x EC x Healthiness (γ_{32})	0.15	(0.05)	3.13	**

Significance: + $p < .10$, * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test).
Standard errors in parentheses.

Table 4

HLM regression coefficients for Experiment 3

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.07)	0.00	
Tastiness (γ_{01})	0.65	(0.06)	10.44	***
Healthiness (γ_{02})	0.06	(0.03)	1.98	
Task Type (γ_{10})	0.00	(0.14)	0.01	
EC (γ_{20})	0.00	(0.10)	0.00	
Task Type x EC (γ_{30})	0.00	(0.17)	-0.01	
Cross-level interactions				
Task x Tastiness (γ_{11})	0.04	(0.09)	0.46	
Task x Healthiness (γ_{12})	-0.06	(0.04)	-1.32	
EC x Tastiness (γ_{21})	-0.01	(0.05)	-0.23	
EC x Healthiness (γ_{22})	-0.14	(0.04)	-3.71	***
Task x EC x Tastiness (γ_{31})	-0.01	(0.10)	-0.13	
Task x EC x Healthiness (γ_{32})	0.44	(0.06)	7.20	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 5

HLM regression coefficients for Experiment 3, Health Task Participants Only

Predictor	Coefficient		t-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.13)	0.01	
Perceived Tastiness (γ_{01})	0.69	(0.07)	9.28	***
Perceived Healthiness (γ_{02})	0.002	(0.04)	0.04	
Condition (γ_{10})	0.00	(0.12)	-0.01	
Cross-level interactions				
Condition x Tastiness (γ_{11})	-0.03	(0.08)	-0.33	
Condition x Healthiness (γ_{11})	0.30	(0.04)	7.66	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 6

HLM regression coefficients for Experiment 3, Mealtime Task Participants Only

Predictor	Coefficient		t-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.07)	0.00	
Perceived Tastiness (γ_{01})	0.65	(0.06)	10.44	***
Perceived Healthiness (γ_{02})	0.06	(0.03)	1.98	+
Condition (γ_{10})	0.00	(0.10)	0.00	
Cross-level interactions				
Condition x Tastiness (γ_{11})	-0.01	(0.05)	-0.225	
Condition x Healthiness (γ_{11})	-0.14	(0.04)	-3.71	***

Significance: + $p < .10$, * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 7

HLM regression coefficients for Experiment 4

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.09)	0.00	
Perceived Tastiness (γ_{01})	0.78	(0.05)	16.43	***
Perceived Healthiness (γ_{02})	-0.006	(0.03)	-0.18	
Condition (γ_{10})	0.00	(0.09)	0.00	
Cross-level interactions				
Condition x Tastiness (γ_{11})	-0.14	(0.06)	-2.11	*
Condition x Healthiness (γ_{12})	0.13	(0.03)	4.23	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 8

HLM regression coefficients for Experiment 4, Moderation by Weight Control

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.09)	0.00	
Perceived Tastiness (γ_{01})	0.78	(0.05)	15.25	***
Perceived Healthiness (γ_{02})	-0.01	(0.03)	-0.45	
Condition (γ_{10})	0.00	(0.10)	0.00	
Weight Control (γ_{20})	0.00	(0.07)	0.00	
Condition x Weight Control (γ_{30})	0.00	(0.09)	0.00	
Cross-level interactions				
Condition x Tastiness (γ_{11})	-0.12	(0.07)	-1.73	
Condition x Healthiness (γ_{12})	0.13	(0.03)	3.94	***
Weight Control x Tastiness (γ_{21})	-0.01	(0.05)	-0.27	
Weight Control x Healthiness (γ_{22})	0.03	(0.02)	1.51	
Condition x Weight Control x Tastiness (γ_{31})	-0.18	(0.06)	-3.21	**
Condition x Weight Control x Healthiness (γ_{32})	0.07	(0.03)	2.30	*

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 9

HLM regression coefficients for Experiment 5

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.08)	0.00	
Perceived Tastiness (γ_{01})	0.69	(0.09)	7.85	***
Perceived Healthiness (γ_{02})	0.03	(0.03)	0.85	
Dummy 1 Condition (γ_{10})	0.00	(0.05)	0.00	
Dummy 2 Condition (γ_{20})	0.00	(0.07)	0.00	
Cross-level interactions				
Condition Dummy 1 x Tastiness (γ_{11})	0.06	(0.07)	0.79	
Condition Dummy 1 x Healthiness (γ_{12})	0.07	(0.02)	4.10	***
Condition Dummy 1 x Tastiness (γ_{21})	0.06	(0.06)	1.14	
Condition Dummy 1 x Healthiness (γ_{21})	0.07	(0.03)	2.52	*

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 10

HLM regression coefficients for Experiment 5, Moderation by Weight Control

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.10)	0.00	
Tastiness (γ_{01})	0.82	(0.08)	9.73	***
Healthiness (γ_{02})	0.06	(0.04)	3.62	***
Task Type (γ_{10})	0.00	(0.08)	0.00	
EC (γ_{20})	0.00	(0.08)	0.00	
Weight Control (γ_{30})	0.00	(0.07)	0.00	
Task Type x EC (γ_{40})	0.00	(0.10)	0.00	
Task Type x Weight Control (γ_{50})	0.00	(0.08)	0.00	
EC x Weight Control (γ_{60})	0.00	(0.07)	0.00	
EC x Task Type x Weight Control (γ_{70})	0.00	(0.10)	0.00	
Cross-level interactions				
Task x Tastiness (γ_{11})	-0.04	(0.06)	-0.61	
Task x Healthiness (γ_{12})	0.03	(0.03)	1.01	
EC x Tastiness (γ_{21})	-0.05	(0.06)	-0.82	
EC x Healthiness (γ_{22})	-0.01	(0.03)	-0.30	
Weight Control x Tastiness (γ_{31})	-0.09	(0.05)	-1.70	
Weight Control x Healthiness (γ_{32})	0.05	(0.02)	2.33	*
Task x EC x Tastiness (γ_{41})	0.02	(0.07)	0.31	
Task x EC x Healthiness (γ_{42})	0.08	(0.03)	2.42	*
Task x Weight Control x Tastiness (γ_{51})	-0.07	(0.05)	-1.31	
Task x Weight Control x Healthiness (γ_{52})	0.11	(0.02)	4.69	***
EC x Weight Control x Tastiness (γ_{61})	-0.04	(0.04)	-0.95	
EC x Weight Control x Healthiness (γ_{62})	0.07	(0.02)	3.53	***
Task x EC x Weight Control x Tastiness (γ_{71})	0.21	(0.06)	3.25	***
Task x EC x Weight Control x Healthiness (γ_{72})	-0.11	(0.03)	-3.84	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test).
Standard errors in parentheses.

Table 11

HLM regression coefficients for Experiment 6

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.10)	0.00	
Perceived Tastiness (γ_{01})	0.81	(0.08)	10.02	***
Perceived Healthiness (γ_{02})	0.14	(0.04)	3.71	***
Task Type (γ_{10})	0.00	(0.08)	0.00	
EC (γ_{20})	0.00	(0.05)	0.00	
Task Type x EC (γ_{30})	0.00	(0.10)	0.00	
Cross-level interactions				
Task Type x Tastiness (γ_{11})	-0.01	(0.05)	-0.16	
Task Type x Healthiness (γ_{12})	0.003	(0.03)	0.13	
EC x Tastiness (γ_{21})	-0.04	(0.05)	-0.63	
EC x Healthiness (γ_{22})	-0.02	(0.03)	-0.60	
Task Type x EC x Tastiness (γ_{31})	-0.01	(0.07)	-0.10	
Task Type x EC x Healthiness (γ_{32})	0.11	(0.03)	3.41	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 12

HLM regression coefficients for Experiment 6, Moderation by Weight Control

Predictor	Coefficient		*t*-ratio	Sig.
Main effects				
Intercept (γ_{00})	0.00	(0.10)	0.00	
Perceived Tastiness (γ_{01})	0.82	(0.08)	9.73	***
Perceived Healthiness (γ_{02})	0.14	(0.04)	3.62	***
Task Type (γ_{10})	0.00	(0.08)	0.00	
EC (γ_{20})	0.00	(0.08)	0.00	
Weight Control (γ_{30})	0.00	(0.07)	0.00	
Task Type x EC (γ_{40})	0.00	(0.07)	0.00	
Task Type x Weight Control (γ_{50})	0.00	(0.08)	0.00	
EC x Weight Control (γ_{60})	0.00	(0.07)	0.00	
Task Type x EC x Weight Control (γ_{70})	0.00	(0.10)	0.00	
Cross-level interactions				
Task Type x Tastiness (γ_{11})	-0.04	(0.08)	-0.61	
Task Type x Healthiness (γ_{12})	0.03	(0.03)	1.01	
EC x Tastiness (γ_{21})	-0.05	(0.06)	-0.82	
EC x Healthiness (γ_{22})	-0.01	(0.03)	-0.30	
Weight Control x Tastiness (γ_{31})	-0.09	(0.05)	-1.70	
Weight Control x Healthiness(γ_{32})	0.05	(0.02)	2.33	*
Task Type x EC x Tastiness (γ_{31})	0.02	(0.07)	0.31	
Task Type x EC x Healthiness (γ_{31})	0.08	(0.03)	2.42	*
Task Type x Weight Control x Tastiness (γ_{31})	-0.07	(0.05)	-1.31	
Task Type x Weight Control x Healthiness (γ_{31})	0.11	(0.02)	4.69	***
EC x Weight Control x Tastiness (γ_{31})	-0.04	0.04	-0.95	
EC x Weight Control x Healthiness (γ_{31})	0.07	0.02	3.53	***
Task Type x EC x Weight Control x Tastiness (γ_{31})	0.21	(0.06)	3.25	**
Task Type x EC x Weight Control x Healthiness(γ_{31})	-0.11	0.03	-3.84	***

Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < .001$ (two-tailed test). Standard errors in parentheses.

Table 13

Eating Intention Food Items and Corresponding Normatively Rated Tastiness and Healthiness

Data from Young & Fazio, 2013

Food	Perceived Tastiness (1-11)	Perceived Healthiness (1-11)
crackers	7.00	5.38
puffed wheat	5.19	6.68
angel food cake	8.00	3.02
grapefruit	5.95	8.80
grapes	9.00	8.92
peach	8.43	8.71
carrot	7.19	8.96
celery	5.71	8.57
zucchini	6.00	8.41
orange	8.43	8.84
spinach	5.38	9.09
cauliflower	4.71	8.45
apple	8.48	9.02
shredded wheat	5.00	7.71
Skim milk	5.90	7.79
fruit salad	8.52	8.65
salad	8.10	8.47
granola bar	7.95	6.80
cottage cheese	2.48	6.10
yogurt	7.24	7.88
cheerios	7.19	6.86
milkshake	9.29	2.49
cheeseburger	7.48	2.34
taco	8.10	3.47
French fries	8.62	1.40
chicken pot pie	7.62	4.32
pecan pie	5.62	2.76
apple pie	7.95	3.17

continued

Table 13, continued

cheesecake	7.52	1.88
potato salad	6.10	4.79
bacon	7.05	2.37
Big Mac	6.62	1.03
potato chips	8.71	1.71
pepperoni pizza	7.76	2.51
sausage	6.81	3.46
steak	8.57	5.59
fried chicken	8.10	1.86
fudge	7.76	1.65
hotdog	7.14	2.65
burrito	8.52	2.76
nachos	8.24	2.15
donuts	7.76	1.27

Table 14

Positive and Negative US Used in Video Surveillance

From Jones, Fazio, & Olson, 2009

Positive US Images	Positive US Words	Negative US Images	Negative US Words
waterfall	useful	bees	inferior
sailboat	calming	contamination suit	harmful
camping	worthwhile	dirty dishes	offensive
diploma	appealing	dirty water pipe	troublesome
happy couple	commendable	junk cars	upsetting
astronaut	terrific	man with toilet	terrifying
woman & baby	valuable	smokestacks	unhealthy
mountain	beneficial	trash in sand	useless
boy & ice cream	relaxing	trash on street	undesirable
chipmunk	desirable	worms	dislikeable