2005

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European Journal of Social Psychology
Eur. J. Soc. Psychol. **35**, 181–198 (2005)
Published online 11 November 2004 in Wiley InterScience (www.interscience.wiley.com). **DOI**: 10.1002/ejsp.240

Hash browns for breakfast, baked potatoes for dinner: Changes in food attitudes as a function of motivation and context

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Abstract

Two studies investigated whether participants' motivational state and the context in which attitude reports are made influence food attitudes. Specifically, these studies examined whether hunger and the time-typicality of foods (i.e. match or mismatch between the time when a food is typically eaten and the time the attitude is reported) interact to influence reported attitudes. Study 1 suggests that hunger leads to more positive attitudes toward foods that are typically eaten at the time the attitude report is made (e.g. breakfast foods in morning) compared to foods not typically eaten at the time the attitude report is made (e.g. breakfast foods in evening). Study 2 replicates this time-typical effect of hunger and suggests that time-typical experience rather than general experience with foods is important for hunger induced attitude change. By demonstrating that food attitudes are influenced by motivational states and the match between when the attitude is reported and when it is typically encountered, the present studies extend previous attitude theory and research that has identified other contextual factors that influence attitude reports. Copyright © 2004 John Wiley & Sons, Ltd.

A basic function of attitudes is to provide ready evaluations of objects that can guide behaviour regarding those objects. These object-appraisal and utilitarian functions have been acknowledged, though perhaps not labelled as such, since attitudes were first conceptualized of as summary evaluative judgments that guide behaviour (e.g. Thurstone, 1928; see also Shavitt, 1989). Given the importance of the object-appraisal and utilitarian functions, it seems imperative that attitudes be both (1) relatively stable so individuals can quickly access their stored evaluation and react (e.g. Blascovich et al., 1993; Fazio & Powell, 1997; Fazio, Blascovich, & Driscoll, 1992) and (2) relatively adaptable so individuals can assimilate new information or alter their reactions as circumstances change (e.g. Fazio, Ledbetter, & Towles-Schwen, 2000; Wood, Rhodes, & Biek, 1995). Although these two attributes are seemingly contradictory, research exploring how complex memory structures operate is helping to explain how

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Contract/grant sponsor: National Institute of Mental Health; contract/grant number: MH47167-07.

Received 8 November 2003
Accepted 20 July 2004

attitudes can be both stable and adaptable (Ferguson & Bargh, 2003; Schwarz, 2000; Smith, 1998; Wilson & Hodges, 1992).

Recent research has begun to view attitude reports as a constructive process, offering explanations as to how seemingly stable attitudes can be influenced by the context in which they are reported. In fact, various researchers have demonstrated several ways in which such 'context' effects can be elicited. For instance, Wilson and colleagues have nicely illustrated how introspection can selectively highlight certain types of information that can then alter attitude reports and evaluative behaviour (e.g. Wilson et al., 1993; Wilson & Hodges, 1992; Wilson & Kraft, 1993; Wilson, Hodges, & LaFleur, 1995). Research also suggests that the context set up by the questions or information surrounding an attitude report can highlight certain information and affect the attitude report (e.g. Tourangeau & Rasinski, 1988). Consistent with this, Shavitt and Fazio (1991) demonstrated that highlighting different functional attributes (e.g. taste or social impressiveness) of attitudes sometimes alters reported attitudes and behavioural judgments. Although researchers have long defined attitudes as evaluative summaries of information, there is a growing realization that the evaluative implications of various attitudinal bases are not homogenous and that this evaluative inconsistency can influence a variety of factors, including the stability of attitude reports (e.g. Abelson, Kinder, Peters, & Fiske, 1982; Armitage & Conner, 2000; Ferguson & Bargh, 2003; Lavine, Thomsen, Zanna, & Borgida, 1998; Millar & Tesser, 1986; 1989; Schwarz, 2000; Wilson, Dunn, Kraft, & Lisle, 1989; Zanna & Rempel, 1988). That is, the information comprising an attitude reported at any given time can vary according to the present context; so when attitudes are reported in the same or similar contexts, they appear to be stable, but when attitudes are rated across varying contexts, the reports differ according to the context (Schwarz, 2000).

Inline with research suggesting that attitude reports can be context dependent, we hypothesized that motivational states, such as hunger, can act as contextual factors leading to change in reported attitudes. To examine this, we investigated whether changes in hunger selectively influence attitudes toward foods (Lozano, Crites, & Aikman, 1999). We hypothesized that hunger would influence contextually (motivationally) relevant attitudes (i.e. foods) but not contextually irrelevant attitudes (e.g. activities). Participants rated their attitudes toward foods and non-foods when they were hungry and not hungry. Results revealed that attitudes toward foods were rated more positively when participants were hungry than when they were not hungry but that attitudes toward non-foods did not change as a function of hunger.

Our previous research demonstrates that food attitudes are influenced by a motivational contextual factor (Lozano et al., 1999); however, if motivation were the only relevant contextual factor influencing food attitudes, behavioural decisions would be very difficult. That is, if all foods became equally positive with hunger, which food would you choose? Previous research demonstrating that attitudes ease decision-making (e.g. Fazio et al., 1992; Shavitt, 1989) suggests that other contextual factors might moderate the influence of hunger so that not all food attitudes become equally positive with hunger. One likely moderating factor is time of day. Research has suggested both that (1) contextual factors such as time and place can affect memory constructs such as attitudes (see Ferguson & Bargh, 2003; Smith, 1998) and (2) time is an important determinant of food choice (for discussion see Rozin & Vollmecke, 1986; Tuorila, 1991). Given this, we hypothesized that hunger would have more of an influence on time-typical foods (e.g. breakfast foods in the morning) than on time-atypical foods (e.g. breakfast foods in the evening). The primary goal of these studies was to investigate this hypothesis.

STUDY 1

The primary goal of Study 1 was to demonstrate that hunger has a greater impact on time-typical compared to time-atypical foods, but Study 1 also sought to demonstrate that food attitudes are more positive when people are hungry using a between-subjects manipulation of hunger. Lozano et al. (1999) manipulated hunger within-subjects to minimize the impact of individual differences in food preferences and thus allow the presumably more subtle effects of hunger to be detected. One limitation of within-subjects (compared to between-subjects) manipulations is that it is generally easier for participants to discern the experimental manipulation and purpose of within-subject research. This knowledge may then subtly influence their responses. For instance, if participants realize that hunger is a focus of the study, their food attitude ratings may reflect their beliefs about how hunger should influence attitudes and not genuine attitude change. Therefore, both hunger and time of day were manipulated between-subjects in Study 1. The third experimental variable, type of food, was manipulated within-subjects. Because the goal of this study was to investigate the influence of hunger on time-typical and time-atypical foods, type of food and time of day were collapsed into one variable: time-typicality. Time-typical attitude scores consisted of attitude reports of breakfast foods in the morning and dinner foods in the evening; time-atypical attitude scores consisted of attitude reports of breakfast foods in the evening and dinner foods in the morning.

Method

Participants

Data were collected from 310 undergraduate students (98 males, 209 females, and three who did not report their gender) at the University of Texas at El Paso who participated in this experiment in order to partially fulfil a course requirement. The majority of participants reported their ethnicity as Hispanic American (79.0%; 11.3% reported that they were Anglo American). The mean age of participants was 20.3 years ($SD = 3.60$), and the mean body mass index (BMI) of participants was 24.20 ($SD = 5.03$). Data were excluded from five participants who reported being suspicious of the purpose of the experiment, leaving a sample of 305 participants (97 males, 205 females, and three who did not report their gender).

Stimuli

The 22 stimuli were 11 breakfast (eggs, pancakes, hash-browns, bacon, corn flakes, granola bars, oatmeal, sausage links, grapefruit, cantaloupe, and doughnuts) and 11 dinner (broccoli, garlic bread, carrots, pizza, pork chops, ham, corn dogs, baked potatoes, spaghetti, shrimp, and polish sausage) foods selected by the experimenters as typical breakfast and dinner foods.

Materials

The primary dependent measures were included in a take-home questionnaire. This questionnaire contained three positive (like, good, and positive) and three negative (dislike, bad, and negative) unipolar scales for assessing food attitudes. Each unipolar scale was a 4-point scale labelled ‘not at all,’ ‘slightly,’ ‘moderately,’ and ‘very much.’ The questionnaire was arranged such that all 22 foods were rated first along one scale (e.g. like), then along another scale (e.g. bad), and so on. In addition to the six attitude scales, the questionnaire contained scales for assessing familiarity with each food and beliefs about when each food is typically eaten. A 4-point unipolar scale with labels identical to those in the attitude scales was used to assess familiarity. A 5-point bipolar scale with endpoints of ‘exclusively in the morning’ and ‘exclusively in the evening’ was used to assess when each food is typically eaten. Two other measures were also administered along with the preceding scales: a physiological-state questionnaire to assess hunger, thirst, and tiredness, and the Positive Affect Negative Affect Scale (PANAS) (Watson, Clark, & Tellegen, 1988) to assess mood.

A variety of other measures were collected at the end of the experiment to assess additional factors that might impact food attitudes. First, height and weight were measured so that each participant’s BMI could be computed. Second, the revised restraint scale was given to assess a person’s tendency to control their weight by restricting food intake (Herman & Polivy, 1980). Third, a biographical information questionnaire was used to assess gender, age, and ethnicity. We conducted exploratory analyses investigating age, gender, BMI, positive and negative mood, and restraint. Only gender was found to significantly predict food attitudes (with males having more positive food attitudes than females). However, analyses found no evidence that any of the additional measures qualified the reported analyses and conclusions.

Procedure

When participants arrived for the experimental session in groups ranging in size from five to 20 participants, the experimenter told them that research was being conducted on behalf of a food company that wanted to assess people’s eating habits and food preferences. The experimenter informed participants that they would be required to complete a questionnaire at home and then return in a few days to complete another set of questionnaires. Informed consent was obtained and the take-home questionnaire was distributed. Attached to each questionnaire were instructions informing participants that they should complete the questionnaire either in the morning or evening and either when hungry or when not hungry. Thus, participants were randomly assigned to complete the questionnaires in one of four conditions: in the morning when hungry, in the morning when not hungry, in the evening when hungry, or in the evening when not hungry. Participants were asked to return to the lab within one week.

When participants returned their take-home questionnaire, the experimenter distributed the revised restraint scale and biographical information questionnaire. Once participants completed these questionnaires, the experimenter measured and recorded each participant’s height and weight. Participants were then asked their thoughts about the purpose of the experiment; most participants merely reiterated the cover story. Participants were then debriefed and given credit for their participation.

Analyses and Results

To confirm the appropriateness of the food selections and groupings into breakfast and dinner foods, we first examined participant’s ratings of when each food is typically eaten. A breakfast food score was created by averaging ratings of the 11 breakfast foods, and a dinner food score was created by averaging ratings of the 11 dinner foods. These breakfast and dinner food scores were then compared to the scale midpoint (‘3’ on the 1 to 5 scale, which was labelled ‘in the morning and in the evening equally often’) using one-sample *t*-tests. The breakfast foods were significantly below the midpoint ($M = 2.19$, $SE = 0.02$; $t(301) = -34.28$, $p < 0.001$) indicating that they are typically eaten in the morning, and the dinner foods were significantly above the midpoint ($M = 3.88$, $SE = 0.02$; $t(301) = 38.85$, $p < 0.001$) indicating that they are typically eaten later in the day. Comparable *t*-tests were conducted on each of the 22 foods individually, and each food displayed the appropriate pattern.

To investigate whether the experimental variables differentially influenced positive and negative attitude dimensions (e.g. see Cacioppo & Berntson, 1994), we computed separate positive and negative attitude scores for each food by averaging the three positive unipolar items (like, good, and positive; *Mdn* $\alpha = 0.72$ across all foods) and the three negative unipolar items (dislike, bad, and negative; *Mdn* $\alpha = 0.74$ across all foods).[1] Analyses revealed that the experimental variables had equivalent effects on the positive and negative attitude dimensions. To simplify the analyses and results, therefore, we created an overall attitude score for each food by subtracting the negative attitude score from the positive attitude score (resulting in a possible range of -3 to 3 for the overall attitude score; *Mdn* $\alpha = 0.79$ across all foods). Because we were interested in meal-type categories (i.e. breakfast and dinner foods) and not individual foods, we averaged the attitude scores for the 11 breakfast foods to create a breakfast food attitude score and the attitude scores for the 11 dinner foods to create a dinner food attitude score.

In order to have participants report their food attitudes in an everyday, naturalistic setting we had participants complete take-home questionnaires rather than complete questionnaires in the lab. Although this method allows us to generalize findings to situations in which people normally interact with foods, it reduced our control over experimental compliance. Therefore, to insure that participants complied with instructions, we examined self-reports of hunger and time at which they completed the take-home questionnaire. Compliance with the hunger condition was defined as a self-reported hunger rating of greater than 3 in the hungry condition and less than 3 in the not hungry condition (on a 5-point scale); compliance with the time condition was defined as a self-reported time report of before noon in the morning condition and after noon in the afternoon/evening condition. Based on these self-reports, we excluded data from 112 of the 305 participants because they either did not comply with the hunger or time instructions or did not report either their hunger or time (21 participants complied with the hunger but not time instructions, 41 complied with the time but not hunger instructions, 14 did not comply with either, one participant did not self-report hunger, and 35 did not self-report time).[2] Because of the large number of participants excluded, we examined whether the participants who did not comply differed from those that did comply on any measure. There was no difference between the participants who complied and did not comply in gender, BMI, dietary restraint, age, positive mood, attitudes toward breakfast foods, or attitudes toward dinner foods. Participants who did not comply, however, reported significantly higher negative mood ($M = 17.32$, $SE = 0.77$) than those that did comply ($M = 15.35$, $SE = 0.37$), $t(279) = 2.63$, $p = 0.009$.

The analyses presented below examining the experimental hypothesis include data from the 193 participants for whom we could verify compliance with the experimental instructions. The sample consisted of 58 males, 133 females, and two participants who did not report their gender. Mean hunger ratings for the 93 participants in the hungry condition was 3.97 ($SD = 0.76$); mean hunger ratings for the 100 participants in the not hungry condition was 1.50 ($SD = 0.75$), $t(191) = 22.79$, $p < 0.001$. The mean time at which the questionnaires were completed by the 78 participants in morning condition was 8.69 (roughly 8:30 a.m.; $SD = 1.19$); the mean time at which the 115 participants in the afternoon condition completed their questionnaires was 19.90 (roughly 8:00 p.m.; $SD = 2.55$), $t(191) = -32.94$, $p < 0.001$.

To examine whether hunger exerted a time-typical influence on food attitudes, time-typical and time-atypical composite attitude scores were computed: attitude reports of breakfast foods in the

[1]We also used the positive and negative attitude scores to compute attitudinal ambivalence and conducted exploratory analyses on ambivalence (Priester & Petty, 1996). These analyses revealed that (1) females were more ambivalent toward foods than males and (2) the less familiar people were with the foods the more ambivalent they were about them.

[2]Given the large amount of data that was excluded because people did not comply with experimental instructions, we also performed analyses based on participants' self-reported hunger and/or time at which they completed the questionnaire. This analysis included data from 269 participants (i.e. all but the 36 who did not report either hunger or time), and its findings were identical to those reported.

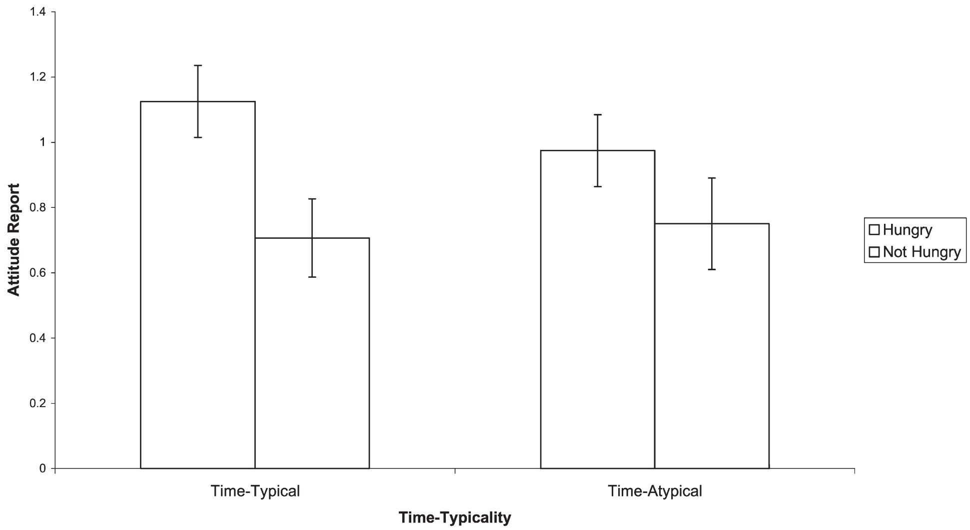

Figure 1. Mean attitude ratings of the time-typical and time-atypical foods as a function of hunger

morning and dinner foods in the evening were averaged to make the time-typical attitude score; attitude reports of breakfast foods in the evening and dinner foods in the morning were averaged to make the time-atypical attitude score. These averaged food ratings were submitted to a 2 (Time-Typicality: time-typical or time-atypical) $\times$ 2 (Hunger State: hungry or not hungry) analysis of variance. As expected, there was a significant main effect of hunger, $F(1, 191) = 9.96$, $p = 0.001$. Participants in the hungry condition rated the foods as more positive ($M = 1.05$, $SE = 0.07$) compared to participants in the not hungry condition ($M = 0.73$, $SE = 0.07$). This main effect of hunger was qualified by the expected hunger by time-typicality interaction, $F(1, 191) = 5.03$, $p = 0.026$. To interpret this interaction, we performed tests of simple effects, examining the influence of hunger on time-typical and time-atypical foods. As can be seen in Figure 1, hunger significantly influenced both time-typical foods, $F(1, 191) = 17.10$, $p < 0.001$, and time-atypical foods, $F(1, 191) = 3.93$, $p = 0.049$; however, the effect was much larger for the time-typical foods (partial $\eta^2 = 0.082$) than for the time-atypical foods (partial $\eta^2 = 0.020$).

Discussion

The findings of this study extended previous research in two important ways. One advance of this study was to demonstrate that the effect of hunger on food attitudes is not uniform across different types of foods. Specifically, the results revealed that the effect of hunger on food attitudes is influenced by the match between the time of day when the attitude is reported and the time at which a food is typically eaten. That is, the largest changes in food attitudes due to hunger occurred for time-typical foods. This finding is inline with research suggesting that attitude reports are contextually generated (e.g. Ferguson & Bargh, 2003; Schwarz, 2000; Wilson & Hodges, 1992)—food attitudes reported at any given time were influenced by the motivational and time context in which the reports were made.

A second advance of this study was to demonstrate that hunger influences self-reported attitudes even when hunger is manipulated between-subjects. That is, although our previous research demonstrated that participants rated foods more positively when they were hungry than when they were not hungry (Lozano et al., 1999), participant exposure to both levels of hunger may have made participants aware that hunger was the focus of the study, subtly influencing their responses. The between-subjects hunger manipulation provides additional evidence that the self-reported changes in food attitudes due to hunger reflect genuine attitude change and not participant's beliefs about what should occur.

STUDY 2

The purpose of Study 2 was to replicate the time-typical effect of hunger observed in Study 1 using a within-subjects manipulation of hunger and to improve upon Study 1 by demonstrating that time-typical experience and not general experience with foods is the primary factor that moderates the effect of hunger on food attitude change. Previous research suggests that general experience is an important determinant of attitudes and behaviour (e.g. Ouellette & Wood, 1998; Tuorila, Cardello, & Lesher, 1994). The objective of this study was to demonstrate that time-typical experience, and not general experience, is the principal moderator of hunger induced food attitude change. To investigate this issue, this study included two general measures of experience, familiarity with each food and how often each food is eaten, and one time-specific measure in which participants indicated when they typically eat each food.

In order to better examine time-typicality, we used multilevel analyses (also commonly called hierarchical linear analyses, random coefficient analyses, or mixed model analyses) that allowed us to examine individual foods for each participant. That is, in Study 1 we a priori identified a set of foods that most people typically eat for breakfast and another set of foods that most people eat for dinner. We then averaged across these foods to create composite breakfast and dinner food attitude scores. The limitation of this type of analysis is that it does not consider individual differences in general experience or time-specific experience with foods. That is, although many people eat pancakes for breakfast and not dinner, there are some people who eat pancakes at dinner and not breakfast and some people who do not eat pancakes at all. By using normative ratings of when most people eat foods, we are adding error to our analyses because the match between foods and individuals will be incorrect for some participants (e.g. a person who eats pancakes for dinner but not breakfast). This makes it more difficult to observe time-typical effects and underestimates the impact of time-typicality. A better way to investigate this issue is to examine each food for each individual and use each person's own ratings of when they typically eat each food. These types of analyses, however, require multilevel analyses because they violate the assumption of the general liner model that observations are independent. That is, if we observe multiple foods within an individual, these observations are not independent because individual and situational variables will influence the ratings of all of the foods. Multilevel models can be used for these situations in which there are non-independent observations (see Hox, 1995; Kreft & de Leeuw, 1998; and Raudenbush & Bryk, 2002 for reviews and discussions).

Because multilevel analyses enable us to use each person's own ratings to correctly identify food-specific characteristics (e.g. if person eats eggs for breakfast and pancakes for dinner), they have more statistical power than the aggregate analyses used in Study 1. This may allow us to overcome another deficiency of Study 1—excluding data because participants did not follow instructions. That is, to investigate time-typicality it is necessary to obtain hungry and not hungry ratings in the morning and late in the day—times at which it would be very difficult to get people to come to the lab and answer questions. Due to practical necessity, therefore, we have to use take-home questionnaires; as Study 1 illustrated, many participants do not follow the experimental instructions. Had we included these participants in the analyses of Study 1, we would not have found the time-typical effect because it was obscured by error due to participants not following instructions (e.g. completing questionnaire in afternoon when assigned to the morning condition or completing the questionnaire when not hungry when assigned to the hungry condition). Study 1, therefore, had two huge sources of error—foods being misclassified as breakfast or dinner on an individual-by-individual basis and participants being 'misclassified' because they did not follow the experimental instructions. In Study 1, we had to eliminate the second source of error by removing over one third of the sample. By using multilevel analyses and correctly classifying each food for each individual, we expected to be able to retain the entire sample of participants.

To help obfuscate the objectives of this study, we also changed the instructions to participants. In Study 1, the experimenter instructed participants to complete the questionnaire either when hungry or when not hungry and either in the morning or in the evening. In this study, the experimenter did not mention hunger or time of day per se. Instead, participants were asked to complete the questionnaires either before and after breakfast or before and after dinner. Furthermore, participants were led to believe they might be assigned to complete the questionnaires at a variety of times throughout the day and that their assigned time would be determined by a random drawing. Finally, in addition to the general and specific experience measures discussed above, we also included three other food-specific measures for exploratory purposes—perceived convenience of each food (e.g. Candel, 2001; Krondl & Lau, 1982; Rappoport, Peters, Downey, McCann, & Huff-Corzine, 1993), perceptions of how filling each food is (e.g. Letarte, Dubé, & Troche, 1997; Shepherd, 1989), and perceptions of when others typically eat each food.

Method

Participants

Data were collected from 91 undergraduate students (30 males and 61 females) at the University of Texas at El Paso who participated in this experiment in order to partially fulfil a course requirement. The majority of the participants reported their ethnicity as Hispanic American (84.6%; 7.7% reported that they were Anglo American). The mean age of participants was 20.5 years ($SD = 3.8$), and the mean BMI was 25.19 ($SD = 4.67$).

Stimuli

The 38 stimuli were foods selected by the experimenters as foods typically eaten in this region. Although there were no specific a priori classifications of these foods as breakfast or dinner foods, we attempted to select a variety of foods that could be eaten for breakfast (e.g. pancakes, egg burritos), dinner (e.g. enchiladas, spaghetti), or throughout the day (e.g. ham, granola bars).

Materials

An experience questionnaire was administered immediately after participants gave their informed consent and included four food measures: (1) familiarity with each food (not at all, slightly, moderately, and very familiar), (2) how often each food is eaten (never, rarely, once or twice a month, once a week, few times a week, or everyday), (3) time of day when each food is usually eaten (breakfast, morning snack, lunch, afternoon snack, dinner, evening snack)—participants could circle as many times of day as applied, and (4) beliefs about time of day when most people eat each food (breakfast, morning snack, lunch, afternoon snack, dinner, evening snack)—participants could circle as many times of day as applied.

The take-home questionnaire included four food measures and a physiological state measure. The four food measures were attitude, convenience, fillingness, and willingness to eat. The attitude measure used a single 7-point bipolar scale with endpoints of negative and positive, and instructions asked participants to consider all factors that are personally relevant to them and that cause them to be positive, negative, or neutral towards each food. The convenience measure used a 4-point unipolar scale (not at all, somewhat, moderately, or very convenient), and instructions asked participants to indicate how convenient they considered each of the foods to be. The filling scale used a 4-point unipolar scale (not at all, slightly, moderately, or very filling), and instructions asked participants to rate their perceptions about how filling each food was. The willingness to eat scale used a 5-point bipolar scale (definitely not, probably not, undecided, probably yes, or definitely yes), and instructions asked participants to report how willing they were to eat each food 'right now'. As in Study 1, the physiological state questionnaire assessed hunger, thirst, tiredness, and mood (the PANAS, Watson, Clark, & Tellegen, 1988). Fullness, in addition to hunger, was also assessed to provide a more complete measure of hunger (see Merrill, Kramer, Cardello, & Schutz, 2002).

An individual differences questionnaire was administered at the end of the experiment and included (1) the Three-Factor Eating Questionnaire (Stunkard & Messick, 1985) to assess dietary restraint, (2) an eating habits questionnaire to assess daily meal/eating patterns and the types of foods usually eaten (this questionnaire was included for exploratory reasons and is not discussed further), and (3) a biographical information questionnaire to assess gender, age, and ethnicity. Finally, the experimenter measured each participant's height and weight so BMI could be computed. We conducted exploratory analyses investigating gender, BMI, and each factor of the Three-Factor Eating Questionnaire. These analyses found no evidence that any of these measures either significantly predicted change in food attitudes or qualified the reported analyses and conclusions.

Procedure

The primary procedural difference between Study 1 and 2 was in the manipulation of hunger and time of day. As in Study 1, time of day was manipulated between-subjects, with the experimenter randomly assigning participants to complete both take-home questionnaires either at breakfast or dinner. Hunger, which was operationally defined as before versus after a meal, was manipulated within-subjects; all participants were asked to complete one questionnaire before they ate breakfast (dinner) and one questionnaire after they ate breakfast (dinner). The order in which each participant completed the questionnaires (before vs. after meal or vice versa) was randomly determined. Also, participants were not aware of when they would have to complete their second take-home questionnaire until after they returned their first questionnaire to the experimenter.

Because hunger was manipulated within-subjects in Study 2, a few other minor changes in the experimental procedure were necessary. First, participants were required to come to the lab on three separate occasions so the take-home questionnaires could be distributed and collected and various other measures could be completed. Second, to explain why participants were asked to complete multiple questionnaires, the cover story was modified as follows: participants were told that this research was being conducted on behalf of a food company that wanted to assess people's eating habits and food preferences throughout the course of a day and in different settings, and therefore they would be asked to complete questionnaires both in the lab and at home at different times of the day. Finally, to help disguise the time of day and hunger manipulation, participants were led to believe that they might be assigned to complete the questionnaire at many different times during the day and that their assignments for each take-home questionnaire would be determined in 'random' drawing. A staged drawing was done in full view of participants at the time they were given each take-home questionnaire, with one participant volunteer drawing the condition randomly for all participants in that session.

Analyses and Results

Descriptive Statistics and Experimental Compliance

We first examined self-reported hunger/fullness and time at which the entire sample of 91 participants completed the questionnaires. The mean hunger/fullness for participants in the before meal experimental condition was 3.95 ($SD = 0.97$) and the mean in the after meal experimental condition was 2.23 ($SD = 1.00$), $t(90) = 11.08$, $p < 0.001$. The mean time at which the 42 participants assigned to the morning condition completed the take-home questionnaires was 11.21 (roughly 11:15 a.m.; $SD = 4.49$), and the mean time at which the 49 participants assigned to the afternoon condition completed the take-home questionnaires was 14.63 (roughly 2:45 p.m.; $SD = 5.21$), $t(86) = 10.16$, $p = 0.002$. These findings suggest that many participants complied with the experimental instructions; however, the overall rate of verifiable compliance is roughly two thirds of the sample, which is very similar to Study 1.

Multilevel Analyses

As discussed above, multilevel analyses are designed to deal with situations in which observations are not independent, or when, in multilevel terminology, units of observation are nested within higher-order units of observation (see Hox, 1995; Kreft & de Leeuw, 1998; Raudenbush & Bryk, 2002). Within-subjects designs are multilevel because measurement sessions (first level) are nested within individuals (second level). In this study, there are three levels of observation—food ratings are nested within measurement sessions, which are nested within individuals. Thus, the first level variables are ones that can change across foods within an individual and measurement session such as attitude and perceptions of fillingness and convenience. The second level variables are state variables that can change across different measurement sessions such as hunger, fullness, and time of day when the questionnaire is completed. The third level variables are relatively stable subject variables such as gender, BMI, and cognitive restraint. We used the statistical software package, MLwiN to conduct the multilevel analyses and used MLwiN's iterative generalized least squares procedure, which is generally equivalent to maximum likelihood, for estimating the models (Rasbash, Browne, Healy, Cameron, & Charlton, 2001). Finally, we centred predictors by subtracting the mean of the 3458 observations for each variable so zero reflects an average on the respective variable (Kreft, de Leeuw, & Aiken, 1995; Wainer, 2000). We did not centre predictors that were difference scores; for these predictors, zero reflects no change between the before and after meal conditions.

Change in Perception of Foods We first explored whether the four food perception variables that were assessed on the take-home questionnaires under both before and after meal instructions (attitude, willingness to eat, convenience, fillingness) changed across these two instructional conditions. To examine this issue, we made foods the units of analysis. Thus, we treated each of the 38 foods for each of the 91 participants as an observation, which produced a data set that consisted of 3458 observations.

Table 1. Change in food perceptions from before to after meal conditions

	Intercept only model		Intercept and fullness Δ model			
Dependent	Intercept	*SE*	Intercept	SE	Fullness Δ	*SE*
Attitude	0.182*	0.082	−0.075	0.122	0.143*	0.052
Willingness to eat	0.631*	0.087	0.125	0.114	0.283*	0.049
Convenience	0.017	0.034	0.016	0.053	0.000	0.023
Fillingness	−0.013	0.027	0.032	0.041	−0.025	0.018

*$p < 0.05$

To assess whether change in attitude, willingness to eat, convenience, and fillingness differed significantly in the two instructional conditions, we created change scores for these variables by subtracting the after meal value from the before meal value for each of the 3458 observations. By analysing change, we are simplifying the three-level model (i.e. food variables, measurement session variables, subject variables) into a two-level model by collapsing across the second-level variables (e.g. hunger). Thus, the second-level variables such as hunger are conceptualized as change scores and thus constant for an individual. We chose to analyse change scores because (1) change is the variable of theoretical interest, and (2) it is simpler to present and discuss the change scores. We ran four separate models that included only the intercept term. As can be seen in Table 1 (intercept only model), the intercept estimates for change in both attitude ($B = 0.18$) and willingness to eat ($B = 0.63$) were positive and significant as their associated 95% confidence intervals (estimate $\pm$ 1.96*SE) did not include zero. Thus, food attitudes were significantly more positive, and participants were more willing to eat the foods in the before meal compared to after meal condition.

We next explored whether adding change in self-reported hunger/fullness significantly improved the fit of the four intercept only models. We expected that including hunger/fullness change would significantly improve the fit of the attitude and willingness models for two reasons. First, a number of participants did not comply with the before/after meal instructions and were thus equally hungry when they completed the two take-home questionnaires or were more hungry when they completed the questionnaire in the after meal condition. Second, a continuous measure of self-reported hunger/fullness should predict change better than the dichotomous (i.e. before vs. after) manipulation that is reflected in intercept only models predicting change scores. Our initial analyses revealed that change in fullness was a better predictor than change in hunger or combined hunger/fullness so change in fullness is presented here. Adding change in fullness significantly improved the fit of both the attitude $\chi^2(1) = 7.24$, $p = 0.007$ and willingness to eat $\chi^2(1) = 28.6$, $p < 0.001$ models. As can be seen in Table 1 (intercept and fullness Δ model), change in fullness positively predicted change in both attitudes toward ($B = 0.14$) and willingness to eat ($B = 0.28$) foods (to be consistent with hunger ratings, fullness was coded such that higher numbers reflected *less* fullness [more hunger]; thus, positive change numbers reflect greater fullness in the after compared to before meal condition). Furthermore, the intercepts in these models are not significant suggesting that when fullness is the same in the before and after meal conditions (i.e. fullness $\Delta = 0$) there are no differences in attitudes toward and willingness to eat foods in these conditions. Finally, adding change in fullness did not significantly improve the models predicting change in convenience, $\chi^2(1) = 0$, or change in fillingness, $\chi^2(1) = 1.20$, suggesting that these perceptions of foods do not change significantly due to hunger/fullness.

Attitude Change and Time-consistency The primary objective of this study was to investigate whether a match between when a food is typically eaten and the time when the attitude is reported is associated with more attitude change due to hunger than a mismatch. To examine this issue, we first coded each of the 38 foods for each participant as either time-consistent or time-inconsistent using

Table 2. Multilevel analyses predicting attitude change from before to after meal conditions. Factors appearing in bold significantly predicted change, $p < 0.05$

	Regression coefficient		95% CI			
	Estimate	*SE*	Low	High	Cases	χ^2
Base model						
Intercept	−0.075	0.122	−0.314	0.164		
Fullness Δ	**0.143**	0.052	0.041	0.245		
−2*loglikelihood	12875.31				3438	—
Step 1						
Intercept	−0.097	0.113	−0.318	0.124		
Fullness Δ	**0.140**	0.048	0.046	0.234		
How often eaten	−0.023	0.025	−0.072	0.026		
Fillingness (average)	**0.084**	0.030	0.025	0.143		
Fillingness Δ	**0.078**	0.034	0.011	0.145		
Convenience (average)	−0.022	0.031	−0.083	0.039		
Convenience Δ	**0.247**	0.029	0.190	0.304		
−2*loglikelihood	12473.11				3366	402.20
Step 2						
Intercept	−0.214	0.115	−0.439	0.011		
Fullness Δ	**0.131**	0.048	0.037	0.225		
How often eaten	−0.032	0.025	−0.081	0.017		
Fillingness (average)	**0.081**	0.030	0.022	0.140		
Fillingness Δ	**0.073**	0.034	0.006	0.140		
Convenience (average)	−0.047	0.032	−0.110	0.016		
Convenience Δ	**0.241**	0.029	0.184	0.298		
Time consistency (consistent)	**0.345**	0.058	0.231	0.459		
−2*loglikelihood	12437.45				3366	35.660

their self-report ratings of (1) the time when they completed the two-take home questionnaires and (2) time of day when each food is usually eaten.[3]

Before investigating the effects of time consistency, we entered the other food perception variables into the model to demonstrate that time consistency significantly improved the model's fit and was a significant predictor of change in food attitudes after controlling for the other food perception variables. Adding ratings of how often eaten and average convenience and fillingness across the two questionnaires allowed us to examine whether these variables moderated attitude change.[4] Because convenience and fillingness were administered on both take-home questionnaires, including the difference in convenience and fillingness allowed us to examine whether they mediated attitude change (Judd, Kenny, & McClelland, 2001). These five predictors were added to the intercept and change in fullness model and significantly improved the fit of the model, $\chi^2(5) = 402.20$, $p < 0.001$ (see Table 2—Step 1).

The final step of the analyses was to enter the variable that coded for time-specific experience with foods (i.e. whether each food was time-consistent or time-inconsistent) to determine whether it

[3]Eight participants did not report the time they completed one or both take-home questionnaires and two participants reported completing one in the morning and one in the afternoon/evening. For these 10 participants, all foods were coded as time-inconsistent. This coding scheme should make it harder to find the hypothesized results (i.e. time-consistent foods change more) because any time-consistent foods for these participants are considered time-inconsistent.

[4] The two experience variables of how often eaten and familiarity were significantly correlated. Because including often in the model significantly improved the fit of the model whereas including familiarity did not, only often was used in the model to reduce potential multicollinearity between the two predictors.

Table 3. Multilevel analyses predicting change in willingness to eat foods from before to after meal conditions. Factors appearing in bold significantly predicted change, $p < 0.05$

	Regression coefficient		95% CI			
	Estimate	*SE*	Low	High	Cases	χ^2
Base model						
Intercept	0.063	0.122	−0.176	0.302		
Fullness Δ	**0.290**	0.052	0.188	0.392		
How often eaten	**0.073**	0.021	0.032	0.114		
Fillingness (average)	**0.339**	0.026	0.288	0.390		
Fillingness Δ	**0.108**	0.029	0.051	0.165		
Convenience (average)	**−0.110**	0.027	−0.163	−0.057		
Convenience Δ	**0.128**	0.025	0.079	0.177		
Time consistency (consistent)	**0.140**	0.050	0.042	0.238		
−2*loglikelihood	11311.86				3337	—
Step 1						
Intercept	0.101	0.119	−0.132	0.334		
Fullness Δ	**0.273**	0.051	0.173	0.373		
How often eaten	**0.050**	0.022	0.007	0.093		
Fillingness (average)	**0.303**	0.026	0.252	0.354		
Fillingness Δ	**0.101**	0.029	0.044	0.158		
Convenience (average)	**−0.146**	0.028	−0.201	−0.091		
Convenience Δ	**0.097**	0.025	0.048	0.146		
Time consistency (consistent)	0.063	0.049	−0.033	0.159		
Attitude (average)	**0.081**	0.018	0.046	0.116		
Attitude Δ	**0.139**	0.015	0.110	0.168		
−2*loglikelihood	11196.83				3335	115.03

significantly improved the model fit and predicted attitude change beyond that accounted for by the other factors. Adding time consistency significantly improved the fit of the model, $\chi^2(1) = 35.66$, $p < 0.001$. As hypothesized, consistency between when a food is typically eaten and the time the questionnaires were completed significantly predicted attitude change ($B = 0.35$; $SE = 0.06$). Time consistency was coded with zero indicating inconsistency and one indicating consistency; thus, the positive estimate reflects more attitude change when there is a match between the time when a food is typically eaten and the time when the questionnaire was completed (see Table 2—Step 2).[5]

Willingness Change Analyses Because theoretical models postulate that attitudes guide behaviour, we explored whether average attitude and attitude change predict change in the willingness to eat foods. We started with the final model that was used to predict attitude change to investigate whether there might be any differences between the variables that predict changes in attitude versus willingness to eat the foods. There were some minor differences in the model predicting willingness compared to the model predicting attitude change. Specifically, both experience with foods (how often eaten) and average convenience predict change in willingness to eat but not in attitude (Table 2—Step 2 compared to Table 3—Base Model). As expected, adding average attitude and attitude change significantly improved the model's fit, $\chi^2(2) = 115.03$, $p < 0.001$. The positive estimate for average attitude ($B = 0.08$; $SE = 0.02$) suggests that attitude moderates willingness to eat foods as people are

[5]We also categorized each food as time-consistent versus time-inconsistent according to each participant's ratings of when others typically eat each food. Time consistency with others was very highly correlated with personal time consistency, but personal time consistency was a better predictor of attitude change.

more willing to eat foods toward which they have more positive attitudes compared to foods toward which they have less positive attitudes. The positive estimate for attitude change ($B = 0.14$; $SE = 0.02$) suggests that attitude change may mediate change in willingness to eat foods (Judd et al., 2001). Finally, when attitude is included as a predictor, time consistency was not a significant predictor of change in willingness to eat foods, suggesting that the effect of time consistency on changes in willingness to eat is mediated via attitude.

GENERAL DISCUSSION

Across two studies, motivation was found to interact with other contextual factors to influence attitudes. Although attitudes toward foods overall were found to be more positive when participants were hungry as compared to when not hungry, hunger had a greater impact on time-typical foods (e.g. hash browns rated in the morning) than on time-atypical foods (hash browns rated in the evening). This research helps to extend extant attitude theory and research in various ways. For instance, the current findings concur with and extend upon the principle of compatibility within the theory of planned behaviour (Ajzen, 1996). Briefly, this principle states that attitudes are better predictors of behaviour when attitudes and behaviours are measured at the same level of generality, making it likely that the same beliefs are salient at the measurement of both the attitude and the behaviour (Ajzen, 1996). In terms of context effects then, this principle suggests that attitudes should better predict behaviours when the measurement context is the same for both the attitude and the behaviour. The current findings support this principle while taking a different approach to establishing compatibility. That is, much of the research investigating the theory of planned behaviour and the principle of compatibility achieves parallel contexts across attitude and behaviour by setting up similar levels of generality through the wording of questions (see Ajzen, 1996). For instance, to investigate the principle of compatibility in food selection, one might ask participants their attitude towards eating hash browns for breakfast. The principle of compatibility would be demonstrated if they reported more positive attitudes toward eating hash browns for breakfast than for dinner *and* they reported eating hash browns more often for breakfast than for dinner. The present research achieves compatibility by placing the attitude measurement in the behavioural context rather than incorporating context into the wording of the attitude question. It would be interesting and worthwhile for future research to investigate what would happen if these two methods of achieving compatibility were both employed but were at odds with each other. That is, what would happen if, in the evening (context established through setting), you asked someone their attitude towards eating hash browns for breakfast (context established through question)? Research suggests people are not always aware that contextual factors influence their responses (e.g. Schwarz & Clore, 1983)—would people be able to disregard the contextual setting and answer according to the context established in the wording of the question?

By demonstrating that specific attitudes can be selectively altered, this research also provides a potential example of how attitudes might ease decision-making (e.g. Fazio et al., 1992; Shavitt, 1989). The present findings suggest that in addition to producing contextually appropriate responses, contextual factors might also shift attitudes to ease decisions in various contexts. That is, if hunger (or other relevant contextual factors) had equivalent effects on all food attitudes, this could potentially make food decisions more difficult (i.e. indecision might result if all food attitudes became maximally positive). One way to make decisions easier is to increase the evaluative distance between attitudes by making some attitudes more positive and some more negative. This type of differential effect is something that might be important in food consumption given the large variety of foods from which people can select. For instance, because salt is an essential mineral that is closely regulated, people who are deficient in salt demonstrate a 'salt appetite' and preferentially eat salty foods when possible (e.g. Stricker & Verbalis, 1990). A person who is both hungry and salt deprived is best served by eating foods high in salt and avoiding foods that might exacerbate the salt deficiency (e.g. foods with high water content and no salt). One way to achieve this outcome is to make attitudes toward salty foods more positive and make attitudes toward foods with low salt content more negative. Inline with this idea, there is evidence in this study that certain foods for certain people are more negative when they are hungry compared to when they are not hungry. That is, the main effect of hunger does not mean that all foods become more positive when people are hungry—just that foods are generally more positive. The present research examined a very small set of factors (hunger and time-typicality) that influence food attitudes. Given the numerous factors that influence food consumption, it is likely that many other factors can also selectively influence food attitudes.

As hinted at above, the current research also has important applied implications for health. The United States is currently facing an obesity epidemic—approximately 65% of adults are either overweight or obese, conditions that create significant health problems (US/Department of Health and Human Services, 2001). Obviously, there are a multitude of factors that are contributing to this dramatic rise in obesity, but one important factor is food selection. The present research suggests that attitudes toward foods are constantly changing due to interactions among various factors. Given the number of factors that influence food attitudes and eating (e.g. Roininen, Lähteenmäki, & Tuorila, 1999; Rozin, 1988; Rozin & Fallon, 1980; Shepherd & Farleigh, 1989; Steptoe, Pollard, & Wardle, 1995), it is very likely that many factors are involved in determining food attitudes at any given point of time. Until we have a much better understanding of how these factors influence food attitudes and eating, it will not be possible to accurately predict or control eating behaviour. For instance, recall that attitudes are based on multiple pieces of information. Taste and health beliefs are two such pieces of information comprising food attitudes (e.g. Aikman, Crites, & Fabrigar, 2003; Roininen et al., 1999; Steptoe et al., 1995). It is possible that hunger highlights taste information underlying attitudes and has no effect on health beliefs. Thus, attempting to change food attitudes using persuasive messages that deal with health qualities of foods may not change eating behaviour because health information may not be important when people are hungry (e.g. see Edwards, 1990; Fabrigar & Petty, 1999).

To summarize, by demonstrating that motivation interacts with other contextual factors to influence attitudes at the time which they are reported, the current research helps to extend extant attitude theory and research in various ways. First, the current findings concur with and extend upon the principle of compatibility within the theory of planned behaviour (Ajzen, 1996) by further demonstrating the importance of taking into account the context of the attitude/behaviour and by demonstrating that compatibility can be achieved by placing the attitude measurement in the behavioural context. Furthermore, by demonstrating that specific attitudes can be selectively altered, this research provides a potential example of how attitudes might ease decision-making and better guide behaviour, demonstrating the utility of contextual attitude change. Finally, the current research illustrates why food attitude research is needed and why this is currently a growing area of investigation, both within food selection literature specifically (e.g. Letarte et al., 1997; Povey, Conner, Sparks, James, & Shepherd, 2000; Roininen et al., 1999; Steptoe et al., 1995) and attitude literature more generally (e.g. Armitage & Conner, 1999; Pliner & Chaiken, 1990; Sparks, Guthrie, & Shepherd, 1997; Sparks, Hedderley, & Shepherd, 1992; Ward & Mann, 2000).

ACKNOWLEDGEMENTS

This research was supported in part by grant MH47167-07 from the National Institute of Mental Health. We would like to thank Luz Elena Horcasitas, Araceli Flores, Tiffany Harmon, Rebecca

Serros, Cynthia Villarreal, and Sonia Arostegui for their assistance with this research, and Robert MacCallum and Leandre Fabrigar for reading and providing feedback on this manuscript.

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