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Development of Food Safety Psychosocial Questionnaires for Young Adults

C. Byrd-Bredbenner, V. Wheatley, D. Schaffner, C. Bruhn, L. Blalock, and J. Maurer

ABSTRACT: Food mishandling is thought to be more acute among young adults; yet little is known about why they may engage in risky food handling behaviors. The purpose of this study was to create valid, reliable instruments for assessing key food safety psychosocial measures. Development of the measures began by examining published studies and behavior change theories to identify the psychosocial factors associated with personal health choices and 3 psychosocial factors were identified: beliefs, locus of control, and self-efficacy. Development of items for the belief questionnaire began by identifying the belief constructs that could provide insight into how food safety behavior change programs should be framed to evoke improved behaviors and drafting items. The locus of control questionnaire was modeled after the Health Locus of Control Questionnaire. Self-efficacy questionnaire development included defining self-efficacy, identifying environmental contexts affecting self-efficacy, and constructing an item pool. The questionnaires were pretested with young adults ($n = 180$) and refined. A pilot test ($n = 77$) was conducted to further refine the beliefs and self-efficacy questionnaires. Finally, young adults ($n = 4343$, mean age 19.9 $\pm$ 1.7 SD y) from 21 universities and colleges across the country completed the questionnaires. Analysis of their responses revealed that these questionnaires met or exceeded standards indicative of high-quality psychosocial food safety measures. These questionnaires should be useful in generating baseline data from adults as well as establishing the value of these measures in assessing the effectiveness of food safety interventions.

Introduction

Headline news stories focusing on widespread outbreaks of foodborne disease (FBD) caused by lapses in personal hygiene or control measures are vivid reminders that the food that nourishes and sustains us also can be debilitating and, in some cases, deadly (Knabel 1995). Although great strides have been achieved in curtailing large-scale outbreaks, FBD continues to be a significant public health problem in the twenty-first century. Indeed, one of the priorities in the *Healthy People 2010* initiative and *Dietary Guidelines for Americans* (U.S. Dept. of Agriculture and U.S. Dept. of Health and Human Services 2000, 2005; U.S. Dept. of Health and Human Services 2001) includes guidance on how to keep food safe.

Food mishandling is thought to be more acute among young adults (aged 18 to 29 y), men, and individuals with education beyond high school (Williamson and others 1992; Fein and others 1995; Klontz and others 1995; Food Safety and Inspection Service and U.S. Dept. of Agriculture 1998; Altekruse and others 1999) than in other population groups. The observation that individuals with education beyond high school have a greater propensity to engage in risky food handling behaviors than those with less education contrasts sharply with studies of other risk-adverse health behaviors such as seat belt use, smoking, engaging in regular physical exercise, and healthy eating practices (Byrd-Bredbenner 2000; U.S. Dept. of Agriculture and Food Safety Inspection Service 2002). Although it is not known why young adults tend to engage in risky food handling behaviors, researchers hypothesize that young adults may choose to ignore hazards associated with FBD because of misconceptions about their own and household members' susceptibility to FBD, an unwillingness to accept personal responsibility for food safety, a lack of confidence in their ability as an individual to exert control over the risk of FBD, or the belief that FBD is only a minor health problem (Fein and others 1995; Yang and others 1998).

According to many cognitive-behavioral theories, such as Social Cognitive Theory (Bandura 1986, 2000), Health Belief Model (Janz and others 2002), Theory of Reasoned Action and the related Theory of Planned Behavior (Ajzen 1991; Montano and Kasprzyk 2002), and stage-based theories such as the Transtheoretical Model (Prochaska and others 1994; Prochaska and Velicer 1997; Prochaska and others 2002) and Precaution Adoption Process Model (Weinstein and Sandman 2002), cognitions such as knowledge, beliefs, locus of control, and self-efficacy have an important impact on whether individuals adopt recommended health behaviors and/or abstain from nonrecommended behaviors (Ajzen and Fishbein 1980; Bandura 1991; Lorig and others 1996;

MS20060484 Submitted 8/29/2006, Accepted 11/16/2006. Authors Byrd-Bredbenner, Wheatley, and Maurer are with Rutgers Univ., 26 Nichol Ave., 220 Davison, New Brunswick, NJ 08901. Author Schaffner is with Rutgers Univ., 65 Dudley Rd., New Brunswick, NJ 08901. Author Bruhn is with 109 Food Science and Technology, Univ. of California, Davis, CA 95616. Author Blalock is with Rutgers Univ., 71 Lipman Drive, New Brunswick, NJ 08901. Direct inquiries to author Byrd-Bredbenner (e-mail: bredbenner@aesop.rutgers.edu).

Rollnick and others 1999; Ajzen and Fishbein 2000, 2005; Ajzen 2002; Glanz and others 2002). These theories help explain why people behave as they do and are useful when it comes to designing strategies to influence behavior. There has been minimal large-scale, comprehensive research describing psychosocial cognitive factors as they relate to safe food handling. A stumbling block to gathering this type of information is the lack of valid, reliable measures available for measuring these factors. Thus, the purpose of this study was to create valid, reliable instruments for assessing key food safety psychosocial measures. This study was approved by the authors' Institutional Review Boards.

Methods and Materials

Development of the questionnaires

The development of the psychosocial questionnaires for food safety began with an examination of published studies and behavior change theories to identify the psychosocial factors associated with a wide array of personal health choices, including food safety practices.

A panel of experts ($n = 8$) in food safety and health behavior change, tests and measurements, and psychology identified 3 psychosocial factors (that is, beliefs, locus of control, and self-efficacy) as being key to understanding current food safety practices and creating interventions to change practices.

Food safety beliefs. Health beliefs appear to influence health practices ranging from smoking, contraceptive use, exercising, compliance with medical regimens, and healthy eating (Conner and Norman 2005). Only a few studies investigating food safety beliefs have been published (Unklesbay and others 1998; Medeiros and others 2004), so the food safety belief questionnaire needed to be almost completely developed *de novo*. A review of key cognitive-behavioral theories and previously reported health behavior studies that employed belief scales served as the starting point for development of the beliefs questionnaire (Fein and others 1995; Byrd-Bredbenner 2000, 2004; Finckenor and Byrd-Bredbenner 2000).

Guidelines for the development of belief scales were carefully followed (Linn and Gronlund 2000; Torabi and others 2001; DeVellis 2003). Development of the scales began with identification of the belief constructs needed to provide insight into how food safety behavior change programs should be framed to evoke improved behaviors. The 3 constructs initially identified were personal interest in learning about food safety, importance of cleanliness/sanitation to the participant, and perceptions of the prevalence (threat) of food poisoning and one's susceptibility to food poisoning.

Belief scales typically take the form of semantic differential, Guttman, Thurstone, and Likert scales (Hopkins 1998; DeVellis 2003; Thorndike 2005). A Likert-type format with 5-response choices (strongly agree, agree, uncertain, disagree, strongly disagree) was selected because this format provides flexibility in item construction, has a familiar format, provides a sufficient degree of accuracy and discrimination ability, can be completed rapidly, was most suitable to the constructs being measured, and is relatively easy to construct and score (Labovitz 1970; Tiku 1971; Cox 1980; Hopkins 1998).

Next, a bank of 10 to 24 belief statements for each construct was constructed by revising items from the literature and/or creating items *de novo*. To prevent a response set, some statements were worded positively and others were worded negatively. All items were reviewed by the panel of experts for clarity and being representative of the construct measured (that is, content validity), then refined.

The statements were pretested with a group of young adults from a variety of majors that were enrolled in freshman/sophomore level courses at the same northeastern university ($n = 180$) during spring semester 2004. Participants responded to each belief statement by indicating their agreement/disagreement with, or uncertainty about, the statement. The statements reflecting each construct were mixed throughout the pretest to prevent a response set. For each statement, a score of 5, 4, 3, 2, or 1 was assigned to responses of strongly agree, agree, uncertain, disagree, or strongly disagree, respectively, for positively worded statements. The scoring was reversed for negatively worded statements. An overall mean score was computed for each scale by summing the score of the items in the scale and dividing by the number of items in the scale. Thus, mean scale scores ranged from 5 (strongly positive) to 1 (strongly negative).

Pretest data were subjected to exploratory principal components factor analysis using an orthotran/varimax rotation method to refine and shorten the scales, establish the unidimensionality of the statements reflecting each construct, and compute a preliminary internal consistency measure for each scale (that is, Cronbach alpha coefficient) (Norman and Streiner 2000). At the beginning of factor analysis procedures, all 56 belief statements were included. Oblique solution factor loadings for all statements were examined and 1 statement at a time was removed from the analysis in an iterative fashion. A statement was selected for elimination based on the strength/weakness of its commonality and factor loading, whether it was the lone item loading on a factor, and/or whether its strongest factor loading made contextual sense in relation to the content of the other items loading strongly on that factor. This process was systematically repeated until the remaining statements ($n = 29$; 5 to 11 per construct) made contextual sense with the other scale items and generated acceptable Cronbach alpha coefficients (range was 0.72 to 0.87).

The exploratory factor analysis indicated that the importance of cleanliness/sanitation to the participant and personal interest in learning about food safety constructs were indeed individual, unique constructs. However, the perceptions of the prevalence (threat) of food poisoning and one's susceptibility to food poisoning construct appeared to be 3 rather than 1, that is, personal susceptibility to food poisoning, threat of food poisoning in the United States, and personal threat of food poisoning. As a result of the division of this single construct into three, 4 additional statements were written to supplement items in these scales. The panel of experts reviewed the 33 statements in the revised scales to confirm their content and construct validity.

To further refine the belief scales, a pilot test was conducted with a 2nd sample of young adults from a variety of majors that were enrolled in freshman/sophomore level courses at a northeastern university ($n = 77$) during fall semester 2004, none of whom participated in the pretest. The pilot test results were subjected to the same type of factor analysis procedures used with the pretest and items were eliminated in a similar fashion. The food safety beliefs instrument had 28 items (4 to 10 per scale) with acceptable Cronbach alpha coefficients (range was 0.69 to 0.92). The belief scale items corresponded to an eighth-grade reading level according to the Flesch-Kincaid Grade Level score. The panel of experts once again reviewed the items and confirmed the content validity of the scales.

Food safety locus of control. Locus of control refers to the extent to which people view the attainment of a particular outcome as being either within their control, where their action determines the outcome (internal), or outside their control, where outcome is controlled by forces of powerful others

(external) or by luck or chance (AbuSabha and Achterberg 1997; Brown 1999). Locus of control is a construct that may assist health educators in understanding learners' beliefs regarding their personal responsibility and ability to influence their own health (Brown 1999). For instance, some studies indicate that a strong internal locus of control is associated with greater long-term weight management success (Senekal and others 1999) and dietary healthfulness in pregnant women (Saturnino-Springer and others 1994). In addition, those with hypertension and type 2 diabetes mellitus have been found to have a higher external locus of control than those with no history of these diseases (Plescia and Groblewski 2004). Other studies, however, have found no difference in weight loss or dietary healthfulness between individuals with an internal compared with external locus of control (Nir and Neumann 1991; Murphy and others 2001).

Although there are various domains within locus of control, such as the health domain (Wallston and Wallston 1978), social domain, nutrition domain, and weight domain (Stotland and Zuroff 1990), a review of the literature did not reveal that a food safety domain had been elucidated. Thus, because of the potential importance of the locus of control construct on food safety behaviors, this domain was defined and scales created.

Food safety locus of control was defined as the degree to which an individual believes food safety (avoidance of food poisoning) is controlled by internal factors (that is, largely under a person's own control) or external factors (that is, largely under the control of powerful others or determined by luck or chance factors) (AbuSabha and Achterberg 1997; Brown 1999). The Health Locus of Control Questionnaire (Wallston and others 1976; Wallston and Wallston 1978) was modified for use in this study (see Table 1). There were 6 Likert-type items in each of 3 scales (internal, external: powerful others, external: chance). Each of the 18 items in this questionnaire was scored from 1 to 6 (strongly disagree, disagree, slightly disagree, slightly agree, agree, and strongly agree). A total score for each scale was computed by summing the score of each item and dividing by the number of items on the scale, so scale scores could range from 1 to 6.

The modified questionnaire was reviewed by the panel of experts for content validity. The questionnaire was pretested with the same undergraduate students who participated in the pretest of the beliefs questionnaire ($n = 180$). The statements from each scale were mixed throughout the pretest to prevent a response set. The pretest findings revealed that the locus of control scales generated Cronbach alpha coefficients of 0.69, 0.53, and 0.59 for the internal, external: powerful others, and external: chance scales, respectively. While the Cronbach alphas are not as high as generally desired, they are in keeping with typical administrations of this instrument as reported by its developer (Wallston 1993). Minor editorial changes were made to increase the clarity of items. The Flesch-Kincaid reading level for the locus of control scales was determined to be at the ninth-grade level.

Food safety self-efficacy. Self-efficacy, a psychosocial construct originally developed by Bandura (1977), appears to be a powerful predictor of behavior change (McAuley and Blissmer 2000; Rejeski and others 2003; Hallam and Petosa 2004) in some cases. Self-efficacy is an individual's confidence in his or her ability to perform a particular recommended health behavior (for example, exercising) or abstain from an unhealthy behavior such as smoking (Healey and Thombs 1997). Perceived self-efficacy is thought to influence which health behaviors will be initiated, the degree of effort expended, and the persistence of the behavior (Lev and Owen 1996; Lev and others 1999; Etter and others 2000). Self-efficacy is often measured in specific environmental contexts or conditions, such as when one is at a party, in a hurry, or has had a stressful day (Ounpuu and others 1999).

Many studies have documented clear associations between level of self-efficacy and other psychosocial constructs such as beliefs, attitudes, stage of change, and social norms for certain health behaviors (Campbell and others 1998). High self-efficacy scores frequently are associated with the more advanced stage of change status and greater readiness to change. For example, significant increases in self-efficacy scores were observed as stage of change increased for exercise, sun protection, smoking, dietary fat intake, and fruit and vegetable intake (Herrick and

Table 1—Food safety locus of control[a] final factor loadings and item convergence values

Scale statements	Item convergence values	Factor loading
Internal locus of control scale item (Cronbach alpha = 0.63)		
If I only eat food prepared in a sanitary manner, I can keep from getting sick.	[c]	[c]
If I am careful about the food I eat, I can avoid food poisoning.	[c]	[c]
My physical well-being depends on how well I take care of myself.[b]	[c]	[c]
It is my own behavior that determines whether I get food poisoning.	0.421	0.737
If I get food poisoning I am to blame.	0.456	0.792
I am directly responsible for protecting myself from food poisoning.	0.440	0.745
External locus of control scale items (Cronbach alpha = 0.63)		
I can only maintain my health by consulting health professionals.[b]	0.697	0.325
If I see an excellent doctor regularly, I am less like to have health problems.[b]	0.768	0.708
Other people play a big part in whether I stay healthy or get food poisoning.	[c]	[c]
Health professionals keep me healthy.[b]	0.746	0.774
The type of care I get from others determines how well I recover from an illness like food poisoning.	[c]	[c]
Following doctor's orders exactly is the best way for me to stay healthy.	0.723	0.722
Chance locus of control scale items (Cronbach alpha = 0.59)		
When I stay healthy, I'm just plain lucky.[b]	0.400	0.706
No matter what I do, if I am going to get food poisoning I will get food poisoning.	0.681	0.688
Most things that affect my health, like food poisoning, happen to me by accident.	0.575	0.427
Luck plays a big part in determining how soon I will recover from an illness.[b]	0.639	0.669
Even when I take care of myself, it is easy to get food poisoning.	[c]	[c]
If it 's meant to be, I will stay healthy.[b]	0.310	0.559

[a]Sources of the original scale are Wallston and others (1976) and Wallston and Wallston (1978).
[b]These items retained the exact wording from the original Health Locus of Control scales (Wallston and others 1976; Wallston and Wallston 1978); all others were modified slightly.
[c]Item deleted due to low commonalities and factor loadings and to make scale more unidimensional.

others 1997; Campbell and others 1998; Ounpuu and others 1999). (Stage of change is a construct of the Transtheoretical Model that describes behavior change as a process in which an individual moves through a series of 5 distinct stages of change: precontemplation, contemplation, preparation, action, and maintenance [Prochaska and DiClemente 1984; Prochaska and others 2002]).

No questionnaire measuring self-efficacy related to safe food handling could be located, so food safety self-efficacy was defined (that is, an individual's confidence in his or her ability to perform specific recommended food handling [food poisoning prevention] behaviors) and some environmental contexts identified (that is, time pressure, hunger status). Then, an item pool was constructed using self-efficacy measures from previous nutrition and health studies as a guide (Lev and Owen 1996; Lorig and others 1996; Healey and Thombs 1997; Lev and others 1999; Etter and others 2000; Byrd-Bredbenner 2004).

The structure of self-efficacy items generally takes 1 of 2 Likert-type forms (Lev and Owen 1996; Sallis and others 1988). In the 1st form, participants are asked to indicate their agreement/disagreement/uncertainty with statements like "I have confidence in my ability to prepare food in a sanitary way" and "I have confidence in my ability to keep my food safe to eat." In the 2nd form, participants are asked to rate how confident they are (that is, I am sure I could do it, I could do it, I do not know if I could do it, I could not do it, and I am sure I could not do it) that they could motivate themselves consistently for at least 6 mo to perform tasks like "prepare food in a sanitary way" and "store food at an appropriate temperature so it is safe to eat." The panel of experts selected the 2nd form because it was more succinct (that is, it had a single stem "Please rate how confident you are that you could really motivate yourself to do things like these consistently for at least 6 mo" followed by a list of behaviors), easily incorporated a specific time frame (that is, 6 mo) within the stem, and permitted answer choices that were more action related.

The pool of self-efficacy items was reviewed by the panel of experts for clarity, comprehensiveness, and contextual value, and to establish content validity. A total of 33 self-efficacy items was pretested with the same undergraduate students who participated in the pretest of the beliefs and locus of control questionnaires ($n = 180$). The items were scored 5, 4, 3, 2, or 1 for the responses noted above (that is, I am sure I could do it, and so on). Total self-efficacy score was computed by summing the score of each item and dividing by the total number of items on the scale. Thus, higher scores reflect greater self-efficacy.

The pretest findings revealed that the self-efficacy questionnaire generated a very strong Cronbach alpha coefficient (that is, 0.91). To reduce participant burden and minimize item duplication, the expert panel identified 9 items to eliminate. In addition, minor editorial changes were made to increase clarity.

To further explore validity of this measure, mean self-efficacy score was compared using analysis of variance with participants' self-identified stage of change related to the way they prepare food in terms of food safety. No studies could be located that used the concept of stage of change for food safety behaviors; thus, instruments used in previously reported health behavior research were modified to assess food safety stage of change (Glanz and others 1994; Greene and others 1994; Prochaska and others 1994; Read and others 1996; Auld and others 1997; Browne 2003). Participants were asked to identify which of these 5 statements best described them: (a) I have no intention of changing the way I prepare food to make it safer to eat in the next 6 mo; (b) I am aware that I may need to change the way I prepare food to make it safer to eat and I am seriously thinking about changing my food preparation methods in the next 6 mo; (c) I am aware that I may need to change the way I prepare food to make it safer to eat and I am seriously thinking about changing my food preparation methods in the next 30 d; (d) I have changed the way I prepare food to make it safer to eat, but I have been doing so for less than the past 6 mo; and (e) I have changed the way I prepare food to make it safer to eat and I have been doing so for more than the past 6 mo. As reported by other health behavior change researchers (Herrick and others 1997; Campbell and others 1998; Ounpuu and others 1999), self-efficacy score tended to increase significantly as stage increased.

The shortened questionnaire (24 items) was pilot tested with the same group of undergraduates ($n = 77$) that pilot tested the belief questionnaire described above. The Cronbach alpha coefficient for the shortened self-efficacy questionnaire was 0.90. The Flesch-Kincaid Reading Grade Level score was grade 10.

Sample

College and university instructors from across the United States were invited via email to recruit students in their introductory-level general education courses to complete an online food safety survey. Most participating instructors awarded extra credit points to students who completed the survey. From January to October 2005, a total of 4548 young adults enrolled at 21 colleges and universities completed the knowledge questionnaire as part of a larger nationwide survey of young adults (participating colleges and universities were located in these states: Arizona, California (3 schools), Florida (2 schools), Georgia, Indiana, Kansas, Montana, Louisiana, Minnesota, Missouri, New Jersey (2 schools), North Carolina, North Dakota, Oklahoma, Pennsylvania, South Carolina, and Texas). The colleges and universities were located throughout the United States and included those ranging from community college to research institutions. Participants who were older than the age criterion set in this study for young adults (that is, 17 to 26 y) were eliminated from the analysis; the final sample size was 4343.

Results and Discussion

The mean age of participants ($n = 4343$) was 19.9 ± 1.7 SD y. Most were female (65%), white (70%), never married (94%), had never held a job preparing food (76%), did not hold a food safety certification (94%), were in good health (88%), self-rated their food safety knowledge level as at least fair (94%), and had never completed a college course in nutrition, food science, or microbiology (64%). The sample was from a wide array of college majors with no major predominating.

Food safety beliefs scales

Confirmatory factor analysis, using the same type of factor analysis procedures as in the pretest and pilot test, was conducted with data from all young adults completing the survey ($n = 4343$) to confirm the unidimensionality of the scales. Except for 1 item that was subsequently deleted, every item loaded strongly (> 0.52) on its *a priori* construct. Eigenvalues for all scales exceeded 1.40 and factor loadings ranged from 0.52 to 0.90. The strongest factor loading for each retained item is shown in Table 2. Cronbach alpha reliabilities for each scale are reported in Table 2.

Additional tests were conducted to further establish the construct validity of the scales. First, each scale item was correlated with the sum of the other items on the scale (item

Table 2—Final factor loadings and item convergence values for belief statements by construct

Construct statements	Item convergence values	Factor loading
Interest in learning about avoiding food poisoning (Cronbach alpha = 0.86)		
I am interested in finding out how to avoid food poisoning.	0.688	0.825
It is not worth my time to learn about preventing food poisoning.[a]	0.614	0.518
I like learning about how to keep my foods safe to eat.	0.689	0.856
It is of little use to me to learn about how to prevent food poisoning.[a]	0.596	0.518
I would like to learn about how to prevent food poisoning.	0.771	0.903
Cleanliness/sanitation is important (Cronbach alpha = 0.81)		
It is important to me that the foods I eat are prepared in a sanitary way.	0.543	0.592
It is important that the restaurants I eat in look clean.	0.657	0.761
It is important that the restaurants I eat in are clean.	0.679	0.778
It does not matter to me if a food store seems dirty.[a]	0.612	0.792
It is not important to me whether or not a food has been prepared in a sanitary manner.[a]	0.520	0.726
Food poisoning susceptibility (Cronbach alpha = 0.76)		
I believe that I could get food poisoning.	0.568	0.712
I have a chance of getting food poisoning.	0.632	0.790
It is possible that I could get food poisoning this year.	0.583	0.781
Food poisoning is a threat in U.S. (Cronbach alpha = 0.87)		
Many people in this country suffer from food poisoning every year.	0.615	0.703
Food poisoning is unusual in the U.S.[a]	0.684	0.797
Few Americans ever get food poisoning.[a]	0.640	0.761
Food poisoning is uncommon in this country.[a]	0.659	0.770
Food poisoning is a problem in the U.S.	0.676	0.714
Food poisoning is a concern in this country.	0.664	0.697
Food poisoning is not a concern in the U.S.[a]	0.508	0.537
Contamination of food by harmful microbes (germs) is a problem in this country.	0.608	0.633
Food poisoning is a personal threat (Cronbach alpha = 0.87)		
Food poisoning is not currently a big threat to my health.[a]	0.506	0.656
I do not worry about getting food poisoning from the food I eat.[a]	0.677	0.815
I am not concerned about getting food poisoning.[a]	0.709	0.698
Getting food poisoning is not a problem I worry about.[a]	0.752	0.829
I am concerned about getting food poisoning.	0.712	0.756
I worry about getting food poisoning.	0.653	0.709

[a]Scoring for this item is reversed.

convergent validity). A stringent standard of 0.40 was used (Hays and others 1995; Lorig and others 1996). The item convergence values indicated that each item on a scale was well correlated with the other items on the scale (that is, correlations ranged from 0.506 to 0.771) and met the standard set (see Table 2). Second, each item was examined to ascertain whether it correlated significantly higher (that is, at least 2 standard errors) with the mean score of the other items on its *a priori* construct than with the mean score of all other scales (item discriminant validity) (Hays and others 1995). The standard error of the correlations was approximately 0.02. All items exceeded the item discrimination standard.

Food safety locus of control scales

The items on each of the locus of control scales used in the survey of young adults ($n = 4343$) are shown in Table 1. Cronbach alpha coefficients computed using the survey data were 0.60, 0.51, and 0.55 for the internal, external: powerful others, and external: chance scales, respectively. Because these values were lower than the pretest, factor analysis was conducted to identify how to improve these scales. The same type of factor analysis procedures employed in the development of the food safety belief scales described above was used. Iterative factor analysis revealed that each scale could be strengthened and made more unidimensional by eliminating items with low commonalities and/or factor loadings. Table 1 indicates the 3 items from the internal scale, 2 from the external: powerful others scale, and 1 item from the external: chance scale that were identified via factor analysis for elimination. Eliminating these items not only shortened the questionnaire, it increased the Cronbach alphas to 0.63, 0.63, and 0.59 for the internal, external: powerful others, and external: chance scales, respectively.

To further examine the validity of the locus of control scales, item convergence and item discrimination values were computed. Correlations of each scale item with the sum of the other items on the scale revealed that the item convergence values ranged from 0.310 to 0.768. All items on all scales met the stringent item convergent validity standard of 0.40 (Hays and others 1995; Lorig and others 1996) except 1 item on the external: chance scale (see Table 1). In addition, the item discrimination for all items on all scales met the standard set; that is, the correlation of each item with the mean score of the other items on its *a priori* scale was significantly higher (that is, at least 2 standard errors) than the item's correlations with the mean scores of the other 2 scales (Hays and others 1995). The standard error of the correlations was approximately 0.01. The single item falling below the item convergent validity standard was retained because this item discriminated well and eliminating it would have reduced the scale's Cronbach alpha coefficient.

Food safety self-efficacy questionnaire

The 24 items on the self-efficacy questionnaire are shown in Table 3. The Cronbach alpha coefficient for the survey of young adults ($n = 4343$) was 0.93. An examination of item convergent values indicated that the correlations of each scale item with the

Table 3—Self-efficacy items and item convergence values

Rate how confident you are that you could really motivate yourself to do things like these *consistently* for at least 6 mo	Item convergence value
Not eat foods that contain raw eggs (for example, Caesar salad)	0.382
Eat only hamburgers that are cooked so that there is no red or pink even when the hamburger is cut open	0.492
Prepare food in a sanitary manner even when I am in a big hurry	0.619
Avoid eating food that I think might be contaminated with harmful germs even if I am very hungry	0.597
Correctly use a thermometer to determine if meat is cooked to a safe temperature	0.496
Keep food safe to eat even when I am in a hurry	0.658
Store food at an appropriate temperature even when I am in a hurry	0.643
Wash my cutting board or get out a clean cutting board after I cut raw meat and before I chop vegetables	0.646
Change the way I prepare foods if I knew that it would help me to avoid getting sick	0.683
Throw away food that has passed its expiration date	0.589
Refrigerate leftovers within 2 h after a meal is eaten	0.617
Always wash fruits and vegetables before eating them	0.599
Select a restaurant based on its sanitation and cleanliness	0.579
Check the temperature of my refrigerator and freezer each month	0.542
Use a cooler or insulated cool bag to transport refrigerated or frozen items	0.562
Place raw meat on the bottom shelf away from ready-to-eat foods	0.654
Wash my hands with soap and water for 20 s before I begin to prepare food	0.649
Clean or disinfect kitchen counters before preparing food	0.670
Thaw raw meat in the refrigerator or in the microwave	0.605
Transfer large containers of food containing meat products (that is, stew) to several smaller containers less than 4-inches deep before refrigerating	0.587
Use paper towels to wipe my kitchen counters	0.534
Read and follow instructions on the label that tell me the safest way to handle and prepare meat, chicken, and fish	0.658
Avoid consuming raw clams, raw oysters, raw mussels, and sushi	0.371
Avoid eating eggs that have runny yolks or are soft scrambled	0.455

sum of the other items on the scale ranged from 0.371 to 0.683. Only 2 items fell below the stringent item convergent validity standard of 0.40 (Hays and others 1995; Lorig and others 1996); these items were retained because they were the only items that focused on eating raw protein foods.

Item discrimination analysis was not possible because self-efficacy was a single scale. However, a comparison of the mean self-efficacy score with participants' self-identified stage of change for food safety was used to further examine the criterion validity of this questionnaire. Analysis of variance and Scheffe's *f*-test follow-up procedures revealed that, like data reported by others (Herrick and others 1997; Campbell and others 1998; Ounpuu and others 1999), self-efficacy score tended to increase significantly as stage increased (see Table 4).

Conclusions

Overall, the food safety psychosocial belief and self-efficacy questionnaires developed in this study meet or exceed standards indicative of strong reliability and validity (Ebel and Frisbie 1986; Gronlund 1997; Linn and Gronlund 1999; Norman and Streiner 2000). The food safety belief scales generated strong Cronbach alpha coefficients of internal consistency, had high factor loadings on their *a priori* scales indicating construct validity, met item convergent and item discriminant validity standards, and were judged to have content validity. Although the locus of control scales exhibited these same high qualities of validity, these scales generated reliability coefficients that should be improved (DeVellis 2003; Thorndike 2005) despite the fact that they are similar to reliabilities reported by the developer of the instrument on which the one used in this study was based, namely, the Health Locus of Control (Wallston 1993). The food safety self-efficacy questionnaire had an excellent Cronbach alpha coefficient and was judged to have good content, item convergent validity, and criterion validity.

Table 4—Self-efficacy scores by stage of change ($n = 4343$)

Stage	Self-efficacy[a] mean ± SD
Precontemplation stage ($n = 666$)	3.89 ± 0.64
Contemplation stage ($n = 1625$)	4.08 ± 0.48
Preparation stage ($n = 1189$)	4.17 ± 0.53
Action stage ($n = 291$)	4.19 ± 0.57
Maintenance stage ($n = 572$)	4.48 ± 0.44

[a] All stages differed significantly from all other stages ($P < 0.0001$) except Contemplation compared with Preparation ($P = 0.0007$), Contemplation compared with Action ($P = 0.0286$), and Preparation compared with Action (not significant).

Potential uses of the questionnaires developed in this study include baseline assessment of food safety psychosocial characteristics as well as measurement of changes in these characteristics after educational interventions. The questionnaires can be used independently in cases where researchers are interested in a single psychosocial variable or in tandem to generate a comprehensive evaluation. In addition, the strength and independence of the 5 food safety beliefs scales indicate that they can be used individually or grouped. The reading level of food safety psychosocial measures indicates that they likely are appropriate for use with a wide variety of adult audiences. However, researchers intending to use the questionnaires with a demographic audience other than young adults enrolled in college should pilot test the questionnaires and recalculate reliability coefficients.

This study is one of very few (Unklesbay and others 1998; Medeiros and others 2004) that has sought to develop valid, reliable psychosocial measures related to food safety. Future research should investigate the usefulness of these food safety questionnaires in generating baseline data from other audiences as well as establish the value of these measures in assessing the effectiveness of food safety interventions. Further, these findings can be used to examine the effectiveness of educational programs that target factors identified as barriers to adopting safe handling.

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References

AbuSabha R, Achterberg C. 1997. Review of self-efficacy and locus of control for nutrition- and health-related behavior. J Am Diet Assn 97(10):1122–32.
Ajzen I. 1991. The theory of planned behavior. Organ Behav Human Decis Processes 50:79–211.
Ajzen I. 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. J Appl Soc Psychol 32:665–83.
Ajzen I, Fishbein M. 1980. Understanding attitudes and predicting social behavior. Englewood Cliffs, N.J.: Prentice-Hall.
Ajzen I, Fishbein M. 2000. Attitudes and the attitude-behavior relation: reasoned and automatic processes. In: Stroebe W, Hewstone H, editors. European review of social psychology. Chichester, England: Wiley. p 1–33.
Ajzen I, Fishbein M. 2005. The influence of attitudes on behavior. In: Albarracín D, Johnson B, Zanna M, editors. The handbook of attitudes. Mahwah, N.J.: Lawrence Erlbaum Associates Publishers. p 173–221.
Altekruse SF, Yang S, Timbo BB, Angulo FJ. 1999. A multi-state survey of consumer food-handling and food-consumption practices. Am J Prev Med 16:216–21.
Auld GN, McNulty J, Bock M, Bruhn C, Gabel K, Lauritzen G, Lee Y, Medeiros D, Newman R, Ortiz M, Read M, Schultz H, Sheehan E. 1997. A stage-of-change classification system based on actions and beliefs regarding dietary fat and fiber. Am J Health Promot 12:192–201.
Bandura A. 1977. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev 84:191–215.
Bandura A. 1986. Social foundations of thought and action. Englewood Cliffs, N.J.: Prentice Hall.
Bandura A. 1991. Self-efficacy mechanism and physiological activation and health promotion behavior. In: Madden V, editor. Neurobiology of learning, emotion and affect. New York: Raven. p 229–69.
Bandura A. 2000. Health promotion from the perspective of social cognitive theory. In: Norman P, Abraham C, Conner M, editors. Understanding and changing health behaviour. Amsterdam: Harwood Academic Publishers. p 299–339.
Brown KM. 1999. Health locus of control. University of South Florida 1999. Available from: www.med.usf.edu/~kmbrown/Locus_of_Control_Overview.htm. Accessed May 2005.
Brown KM. 2005. Health locus of control. Univ. of South Florida 1999. Available from: www.med.usf.edu/~kmbrown/Locus_of_Control_Overview.htm. Accessed May 2005.
Browne JL. 2003. Creating health: osteoporosis. University Park, Pa.: The Pennsylvania State Univ., Information and Communication Technologies in the College of Agricultural Sciences.
Byrd-Bredbenner C. 2000. The ability of college women aged 17 to 25 to perform tasks using nutrition facts labels. Intl Electron J Health Edu 3:97–106.
Byrd-Bredbenner C. 2004. Food preparation knowledge and attitudes of young adults: implications for nutrition practice. Top Clin Nutr 19:154–63.
Campbell MK, Symons M, Demark-Wahnefried W, Polhamus B, Bernhardt JM, McClelland JW, Washington C. 1998. Stages of change and psychosocial correlates of fruit and vegetable consumption among rural African-American church members. Am J Health Promot 12(3):185–91.
Conner M. 2005. Predicting health behavior. Search and practice with social cognition models. Philadelphia, Pa.: Open Univ. Press.
Cox EP. 1980. The optimal number of response alternatives for a scale: a review. J Mark Res 17:407–22.
DeVellis, RF. 2003. Scale development: theory and applications. Applied social research methods series, Vol. 26. 2nd ed. Thousand Oaks, Calif.: Sage Publications.
Ebel RL, Frisbie DA. 1986. Essentials of educational measurement. Englewood Cliffs, N.J.: Prentice-Hall.
Etter JF, Bergman MM, Humair JP, Perneger TV. 2000. Development and validation of a scale measuring self-efficacy in current and former smokers. Addict Behav 95(6):901–13.
Fein SB, Lin CTJ, Levy AS. 1995. Foodborne illness: perceptions, experience, and preventive behaviors in the United States. J Food Prot 58:1405–11.
Finckenor M, Byrd-Bredbenner C. 2000. A nutrition intervention group program based on the transtheoretical model's pre-action stage oriented change processes promotes long-term dietary intake reduction. J Am Diet Assn 100:335–42.
Food Safety and Inspection Service, U.S. Dept. of Agriculture. 1998. FDA: consumers are changing. Food Saf Educ 3(4):2.
Glanz K, Patterson RE, Kristal AR, DiClemente CC, Heimendinger J, Linnan L, McLerran DF. 1994. Stages of change in adopting healthy diets: fat, fiber, and correlates of nutrient intake. Health Educ Q 21:499–512.
Glanz K, Rimer BK, Lewis FM, editors. 2002. Health behavior and health education: theory, research, and practice. 3rd ed. San Francisco: Jossey-Bass.
Greene GW, Rossi SR, Reed GR, Willey C, Prochaska JO. 1994. Stages of change for reducing dietary fat to 30% or less. J Am Diet Assn 94:1105–10.
Gronlund NE. 1997. Assessment of student achievement. 6th ed. Boston: Allyn & Bacon.
Hallam JS, Petosa R. 2004. The long-term impact of a four-session work-site intervention on selected social cognitive theory variables linked to adult exercise adherence. Health Educ Behav 31(1):88–100.
Hays RD, Sherbourne CD, Mazel R. 1995. User's manual for the medical outcomes study (MOS) core measures of health-related quality of life. Santa Monica, Calif.: Rand Distribution Services.
Healey KR, Thombs DL. 1997. Fruit-vegetable consumption self-efficacy in youth. Am J Health Behav 21:172–7.
Herrick AB, Stone WJ, Mettler MM. 1997. Stages of change, decisional balance, and self-efficacy across four health behaviors in a worksite environment. Am J Health Promot 12(1):49–56.
Hopkins KD. 1998. Educational and psychological measurement evaluation. 8th ed. Boston: Allyn and Bacon.
Janz NK, Champion VL, Strecher VJ. 2002. The health belief model. In: Glanz K, Rimer B, Lewis F, editors. Health behavior and health education: theory, research, and practice. San Francisco: Jossey-Bass.
Klontz KC, Timbo B, Fein S, Levy A. 1995. Prevalence of selected food consumption and preparation behaviors associated with increased risks of food-borne disease. J Food Prot 58:927–30.
Knabel SJ. 1995. Foodborne illness: role of home food handling practices. Scientific status summary. Food Technol 49(4):119–31.
Labovitz S. 1970. The assignment of numbers to rank order categories. Am Sociol Rev 35:515–24.
Lev EL, Owen SV. 1996. A measure of self-care self-efficacy. Res Nurs Health 19(5):421–9.
Lev EL, Paul D, Owen SV. 1999. Age, self-efficacy, and change in patients' adjustment to cancer. Cancer Pract 84(3):170–6.
Linn RL, Gronlund NE. 1999. Measurement and assessment in teaching. 8th ed. New York: Merrill Co.
Linn RL, Gronlund NE. 2000. Measurement and assessment in teaching. 8th ed. Upper Saddle River, N.J.: Merrill Co.
Lorig K, Stewart A, Ritter P, Gonzalez V, Laurent D, Lynch J. 1996. Outcome measures for health education and other health care interventions. Thousand Oaks, Calif.: Sage Publications.
McAuley E, Blissmer B. 2000. Self-efficacy determinants and consequences of physical activity. Exerc Sport Sci Rev 28:85–8.
Medeiros LC, Hillers VN, Chen G, Bergmann V, Kendall P, Schroeder M. 2004. Design and development of food safety knowledge and attitude scales for consumer food safety education. J Am Diet Assn 104:1671–7.
Montano DE, Kasprzyk D. 2002. The theory of reasoned action and the theory of planned behavior. In: Glanz K, Rimer B, Lewis F, editor. Health behavior and health education: theory, research, and practice. San Francisco: Jossey-Bass.
Murphy PA, Prewitt TE, Bote E, West B, Iber FL. 2001. Internal locus of control and social support associated with some dietary changes by elderly participants in a diet intervention trial. J Am Diet Assn 101:203–8.
Nir Z, Neumann L. 1991. Self-esteem, internal-external locus of control, and their relationship to weight reduction. J Clin Psychol 47(4):568–75.
Norman GR, Streiner DR. 2000. Biostatistics: the bare essentials. 2nd ed. Hamilton, Ontario: BC Decker.
Ounpuu S, Woolcott DM, Rossi SR. 1999. Self-efficacy as an intermediate outcome variable in the transtheoretical model: validation of a measurement model for applications to dietary fat reduction. J Nutr Educ 31:16–22.
Plescia M, Groblewski M. 2004. A community-oriented primary care demonstration project: refining interventions for cardiovascular disease and diabetes. Ann Fam Med 2(2):103–9.
Prochaska JO, DiClemente CC. 1984. The transtheoretical approach: crossing traditional boundaries of change. Homewood, Ill.: Dorsey Press.
Prochaska JO, Velicer WF. 1997. The Transtheoretical model of health behavior change. Am J Health Promot 12:38–48.
Prochaska JO, Norcross JC, Diclemente CC. 1994. Changing for good. New York: Quill, Harper Collins Publishers.
Prochaska JO, Redding CA, Evers KE. 2002. The Transtheoretical model and stages of change. In: Glanz K, Rimer B, Lewis F, editors. Health behavior and health education: theory, research, and practice. San Francisco: Jossey-Bass.
Read M, Auld G, Bock MA, Bruhn CM, Gabel K, Lauritzen G, Lee YS, Mederios D, McNulty J, Newman R, Nitzke S, Ortiz M, Schutz H, Sheehan E. 1996. Age, dietary behaviors and the stages-of-change model. Am J Health Promot 20:417–24.
Rejeski WJ, Ambrosius WT, Brubaker PH, Focht BC, Foy CG, Brawley LR, Fox LD. 2003. Older adults with chronic disease: benefits of group-mediated counseling in the promotion of physically active lifestyles. Health Psychol 22(4):414–23.
Rollnick S, Mason P, Butler C. 1999. Health behavior change: a guide for practitioners. Edinburgh: Churchill Livingstone.
Sallis JF, Pinski RB, Grossman RM, Patterson TL, Nader PR. 1988. The development of self-efficacy scales for health-related diet and exercise behaviors. Health Educ Res 3(3):283–92.
Saturnino-Springer N, Bogue EL, Arnold M, Yankou D, Oakley D. 1994.

Nutrition locus of control and dietary behaviors of pregnant women. Appl Nurs Res 71:28–31.
Senekal M, Albertse EC, Momberg DJ, Groenewald CJ, Visser EM. 1999. A multidimensional weight-management program for women. J Am Diet Assn 99:1257–64.
Stotland S, Zuroff DC. 1990. A new measure of weight locus of control: the dieting beliefs scale. J Pers Assess 54(1, 2):191–203.
Thorndike RM. 2005. Measurement and evaluation in psychology and education. 7th ed. Upper Saddle River, N.J.: Pearson Education.
Tiku ML. 1971. Power function of the f-test under non-normal conditions. J Am Stat Assn 66:913–5.
Torabi MR, Seo DC, Jeng I. 2001. Health attitude scale construction: importance of psychometric evidence. Am J Health Behav 25:290–8.
U.S. Dept. of Agriculture, Food Safety Inspection Service. 2002. Changes in consumer knowledge, behavior, and confidence, Final report 2002. Available from: www.fsis.usda.gov/OA/research/research.html. Accessed February 22, 2003.
U.S. Dept. of Agriculture, U.S. Dept. of Health and Human Services. 2000. Nutrition and your health: dietary guidelines for Americans. 5th ed. Washington, D.C.: U.S. Government Printing Office.
U.S. Dept. of Agriculture, U.S. Dept. of Health and Human Services. 2005. Dietary guidelines for Americans. 6th ed. Washington, DC: U.S. Government Printing Office.
U.S. Dept. of Health and Human Services. 2001. Healthy people 2010: volume 1. Available from: www.health.gov/healthypeople/Document/tableofcontents.htm. Accessed November 28, 2001.
Unklesbay N, Sneed J, Toma R. 1998. College students' attitudes, practices, and knowledge of food safety. J Food Prot 61:1175–80.
Wallston KA. 1993. Frequently asked questions: multidimensional health locus of control scales. Available from: http://www.vanderbilt.edu/nursing/kwallston/FAQMHLC.htm Accessed May 2003.
Wallston KA, Wallston BS. 1978. Development of the multidimensional health locus of control (MHLC) scales. Health Educ Monogr 6(2):160–9.
Wallston BS, Wallston KA, Kaplan GD, Maides SA. 1976. Development and validation of the health locus of control scale. J Consul Clin Psychol 44(4):580–5.
Weinstein ND, Sandman PM. 2002. The precaution adoption process model. In: Glanz K, Rimer B, Lewis F, editors. Health behavior and health education: theory, research, and practice. San Francisco: Jossey-Bass.
Williamson DM, Gravani RB, Lawless HT. 1992. Correlating food safety knowledge with home food preparation practices. Food Technol 46(5):94–100.
Yang S, Leff MG, McTague D, Horvath KA, Jackson-Thompson J, Murayi T, Boeselager GK, Melnik TA, Gildemaster MC, Ridings DL, Altekruse SF, Angulo FJ. 1998. Multistate surveillance for food-handling preparation, and consumption behaviors associated with foodborne diseases: 1995 and 1996 BRFSS food-safety questions. Morb Mortal Wkly Rev 47(SS-4):33–54.