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Research Note

Evaluating the Effects of a Message on Attitude and Intention To Eat Raw Meat: Salmonellosis Prevention

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ABSTRACT

Salmonellosis is one of the most common foodborne human diseases. The risk of infection can be reduced by communication campaigns. The aim of this study was to demonstrate the efficacy of a food safety message that underlines that eating well-cooked meat is an effective strategy for preventing salmonellosis. The target audience was young adults (university students). They were presented with one of two messages, a prevention message or a control message. The prevention message proved to be very effective. First, it changed the attitude toward raw or rare meat, which after having read the prevention message was evaluated less positively and more negatively. Second, intentions to eat raw or rare meat were weaker in those who read the prevention message compared with those who read the control message. Third, after the message, participants in the experimental condition, but not in the control condition, associated the self-image more with well-done meat than with raw or rare meat.

Foodborne diseases have become one of the most widespread public health problems in the world *(22)*. *Salmonella,* in particular, is one of the leading foodborne pathogens in developed countries *(3, 5)*. In Italy, *Salmonella* has been the prevalent pathogen causing human infection since 2001 *(7)*. Although in the European Union (EU) eggs and egg products continued to be the most important food vehicle in foodborne *Salmonella* outbreaks in 2008, *Salmonella* was also detected in fresh broiler, turkey, and pig meat. Moreover, incidences of noncompliance with the EU legislation on *Salmonella* were mainly observed in minced meat and meat preparations *(5)*. Since raw meat is one of the most important sources of contamination, a change in people's attitude and in food practices involving raw meat is crucial to prevent salmonellosis.

The EU strategy for *Salmonella* control is mainly based on reducing *Salmonella* presence in primary production. In addition to that, the risk of infection can be reduced by educating consumers regarding risks and helping them to develop a sense of responsibility. Food risk communication may be used to help consumers understand how to prevent foodborne diseases *(19)*.

The target group of the present research was young people. According to the literature, young adults (aged between 18 and 29 years), especially those with higher education, are the most likely to engage in risky food handling *(12, 17, 20)*. Moreover, young people's knowledge of food safety seems inadequate *(2)*. Therefore, it is crucial for this population to be exposed to food safety education.

Effective food risk communication must be consistent and clear, providing direct messages that are not excessively long *(10)*. Key information should be highlighted throughout the text and must be easy to retrieve. To further clarify messages, graphs and other pictorial material should be included *(4)*. Importantly, food safety communication should enhance the personal perception of risk. One strategy might be to evidence the severity of the consequences of food-related risks *(18)*. Moreover, any message must be adapted to the target audience's needs, concerns, and interests *(13)* and must provide practical advice that is relevant to the audience's life *(4, 11)*.

Based on these considerations, we developed a message addressing the risks associated with the consumption of raw meat. In Italy, common dishes containing raw or rare beef include tartar, carpaccio, roast beef, and tagliata. Sausages, which mainly contain pork meat, are eaten either raw or cooked. Poultry is usually cooked thoroughly; however, hamburgers made with chicken or turkey may be insufficiently cooked. The decision to focus on a specific behavior—not eating raw meat—as a strategy for preventing salmonellosis was based on the observation that any message aimed at changing behavior should identify specific actions that individuals can take to protect their health *(4)*. According to the U.S. Department of Agriculture, Food Safety and Inspection Service, ground meat should be cooked to a higher internal temperature (160°F) than whole cuts of meat (145°F; for all poultry, the suggested temperature is 165°F) *(21)*. However, to keep our message as simple and clear as possible, we did not distinguish between different levels of doneness and only recommended that raw or rare meat not be eaten in general.

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The aim of the present study was to assess the efficacy of our salmonellosis prevention message in changing attitudes and intentions to eat raw meat. The message was specifically aimed at university students. To date, little has been done to inform young people of the potential health risks associated with the mishandling of food *(14)*. Participants were presented either with a message providing information about salmonellosis and its prevention (experimental condition) or with a message concerning physical exercise (control condition). In particular, we hypothesized that in the experimental condition, but not in the control condition, the message would lead to a less favorable attitude toward raw or rare meat (hypothesis 1a); in contrast, in the experimental condition the evaluation of well-done meat should become more positive or should not be affected by the message (hypothesis 1b). After reading the message, moreover, intentions to eat raw or rare meat should be weaker in the experimental than in the control condition (hypothesis 2a), while for well-done meat an inverse pattern or no difference between these conditions should appear (hypothesis 2b).

An additional aim of our study was to explore whether the message succeeded in creating a distance between the concept of raw meat and a participant's self-concept. After reading the message, participants in the experimental condition should associate themselves less with raw or rare meat than with well-done meat. No difference was expected in the control condition (hypothesis 3).

MATERIALS AND METHODS

Participants. Forty-five students at a large Italian university participated in the study on a voluntary basis. The sample consisted of 22 males and 23 females. Mean age was 22.36 years ($\pm$3.43 SD). Participants were randomly allocated to either the experimental (n = 21) or the control (n = 24) condition. All participants claimed to be regular eaters of both raw or rare and well-done meat.

Procedure. Participants were recruited to take part in a study on health psychology. The experiment was carried out in two sessions, 2 to 7 days apart. At time 1 (T1), participants completed a questionnaire assessing their attitude toward two objects: raw or rare and well-done meat. Participants were not asked to evaluate specific items of raw or rare or well-done meat, but the two categories of meat in general.

At time 2 (T2), they were presented with the experimental or control message. In the experimental condition, the message illustrated the symptoms of *Salmonella* infection (e.g., abdominal pain, fever) and highlighted the personal and social costs associated with this illness. References to the effects of *Salmonella* infection on everyday activities, such as studying and doing sports, were included. To enhance the personal perception of risk, emphasis was placed on the fact that such activities may be precluded for days, and that cognitive functions (e.g., attention, memory) may be impaired, with negative effects on work and study. A colored illustration of a group of students sitting at their desks was presented with a red cross on it, meaning that studying may be hampered. Moreover, the message explained that salmonellosis may be acquired through contaminated food and that avoiding raw or rare meat is an effective strategy for preventing salmonellosis. The most important points were highlighted in bold type (see Fig. 1). The control message focused on physical exercise and its benefits for physical health (e.g., heart disease prevention) and mental health (e.g., stress reduction), as well as for social relationships. No reference was made to salmonellosis or its prevention. A colored illustration showed a boy and a girl running. The two communications were roughly matched for length: 399 words (experimental) and 377 words (control).

After having received the message, participants completed a questionnaire including manipulation check measures and measures of attitude and intention, and performed the "Go/No-go association task" (GNAT) *(15)*, an implicit task assessing the automatic associations of the self-image with raw or rare and well-done meat. The GNAT differs from self-report measures in that it assesses the strength of mental associations between pairs of concepts (e.g., the self and raw or rare meat), without requiring participants' conscious control of their responses. Indeed, it is likely that participants in this study were unaware of the extent to which they felt raw meat close to or distant from their self-identity.

All the materials were presented in Italian. At the end of the experimental session, participants were debriefed, thanked, and dismissed.

Measures: manipulation checks. To ensure that the two messages were not different in terms of the emotions they elicited, participants were asked to indicate to what extent the message made them feel each of seven emotions, three positive (e.g., satisfaction) and four negative (e.g., anxiety). Responses were given on a 9-point scale (1 = not at all; 9 = very much).

Two additional items focused on raw or rare meat as a source of contamination ("It is established that eating raw or rare meat can cause salmonellosis"; "It is still uncertain whether the consumption of raw or rare meat can cause salmonellosis," reverse code). Participants answered on a 9-point scale, ranging from 1 (absolutely false) to 9 (absolutely true), with 5 (neither false nor true) as the neutral point. Agreement with the first item and disagreement with the second item should be higher in the experimental compared with the control condition.

To check whether participants grasped the content of the message, a recognition task was also used. Five sentences from the message and five new sentences were presented in random order. For each sentence, participants had to decide whether or not it was included in the message they had just read. To measure recognition, and thus the degree of learning, a measure (d′) developed by signal detection theory *(8)* was used; this index is calculated by subtracting the proportion of false recognitions from the proportion of correct recognitions. In both the experimental and control conditions, the mean of d′ scores was expected to be significantly higher than zero.

Measures: positive and negative traits (evaluation or attitude). Both at T1 and at T2, participants evaluated raw or rare and well-done meat according to 10 positive attributes (e.g., healthy, pleasant) and 10 negative attributes (e.g., harmful, unpleasant). Responses were given on a 9-point scale (1 = absolutely false; 9 = absolutely true; 5 = neither false nor true).

Measures: intentions. Intention to eat raw or rare meat was assessed at T2 with three items, for instance: "I intend to eat raw or rare meat in the next month." A 7-point scale was used, anchored by 1 (strongly disagree) and 7 (strongly agree), with 4 (neither agree nor disagree) as the neutral point. The three items were also used to assess the intention to eat well-done meat.

Measures: GNAT. The GNAT consisted of four blocks of trials presented in a randomized order. Each block included 24

FIGURE 1. *Salmonellosis prevention message.*

SALMONELLOSIS FROM RAW/RARE MEAT

- **Eat well-cooked meat**

Proper eating habits, for instance eating well-cooked meat, can have a big impact on your health. Experts claim that cooking meat thoroughly prevents foodborne illnesses, including salmonellosis.

- **Eating well-cooked meat can prevent Salmonella**

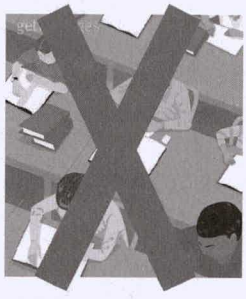
Salmonellosis is caused by Salmonella bacteria that live in the intestines of animals. Humans are infected by eating food of animal origin that was contaminated by faeces.

- **The symptoms of salmonellosis include:**[1]

- Abdominal pain
- High fever
- Vomiting
- Diarrhoea and dehydration
- Nausea
- Headaches
- Lethargy
- Joint pain
- Irritation of the eyes
- Forms of chronic arthritis

- **The personal and social impact of salmonellosis**

Salmonellosis is truly debilitating. It can knock out the person who contracts it for several days, preventing normal day to day activities as studying, working, and doing sports.



- **Salmonellosis leads to delays, to backlogs of work or studying**

Catching up on lost time can worsen an already debilitated physical and mental condition.

- **The social impact of salmonellosis**

Psychophysical stress related to the illness can become chronic and can *impair concentration, memory* (Olsson, 2005), *and learning ability.* In addition, it can lead to disadvantageous decision making (Starcke, Wolf, Markowitsch, & Brand, 2008). As *cognitive functions* continue to worsen studying and working environments are inevitably affected.

- **How to prevent salmonellosis?**

Be particularly careful to respect all basic rules of personal hygiene and of food hygiene where food is prepared.

- **To prevent salmonellosis do not eat raw/rare meat**

Do not eat raw or rare meat: red meat, sausages, pork or poultry.

These basic prevention recommendations can help prevent salmonellosis and avoid that normal daily activities as studying, working, or doing sports are compromised.

1. For a review of the most important studies, see: Riley, L. W., Rape, J. W., & Warren, D. J. (2001). Salmonella Infections and Epidemiological Aspects. New York: Pergamon Press. See also www.epicentro.it

experimental and 12 practice trials. Stimuli were images for the two categories of meat (raw or rare and well-done meat) and words for the two attributes (''me'' items and ''not-me'' items). For the two categories of meat, six images of well-done meat and six images of raw or rare meat were used. As verified in a pilot study, the images for the two categories were matched for quality, clarity, and pleasantness. For the two attributes, the me items included four self-related words (I, me, myself, mine) and the participant's first and last name; the not-me items included six other-related words (he, them, other, they, others, other people's). For each trial, two labels were shown in the upper-left and upper-right quadrants of the screen to denote the category and the attribute to be identified (e.g., well-done meat and me). Stimuli appeared in random order in the center of the screen. Participants were asked to hit the space bar (''go'') as quickly as possible for items representing the target category (e.g., well-done meat) or the target attribute (e.g., me), and to do nothing (''no go'') for the distracter items, representing the contrast category (e.g., raw or rare meat) or the contrast attribute (e.g., not me). The response deadline was 600 ms for images and 800 ms for words. A subsequent trial started after the answer was given or once the time had run out. A 400-ms interstimulus interval was used *(1)*. Targets in the four blocks were: well-done meat + me; well-done meat + not me; raw or rare meat + me; raw or rare meat + not me.

Statistical analyses. For positive and negative emotions, positive and negative traits (both at T1 and T2), and intentions, a measure of internal consistency (Cronbach's alpha) was computed. Alphas, all higher than 0.85, were obtained across the two conditions; separate coefficients (traits and intentions) were calculated for raw or rare and well-done meat. A composite score was computed for each measure by averaging the respective items. The two manipulation check items focusing on raw or rare meat as a source of *Salmonella* infection were highly correlated ($r = 0.61$, $P < 0.001$); therefore, they were averaged to yield a reliable composite score. Data were analyzed by using ANOVA and *t tests*.

RESULTS

Manipulation checks. A 2 (condition: experimental versus control) × 2 (emotions: positive versus negative)

mixed ANOVA, with the last variable serving as a within-participants variable, was applied to positive and negative emotions. The level of positive (M = 3.05 ± 1.76 SD) and negative emotions (M = 3.22 ± 1.89 SD) induced by the two messages was similar, $F < 1$. Neither the main effect of condition nor the interaction was significant; for both, $F(1,43) \leq 1.65$. Thus, the two messages did not evoke different emotional reactions.

Regarding the risks associated with eating meat, raw or rare meat was considered as a source of contamination more in the experimental condition (M = 7.67 ± 1.11 SD) than in the control condition (M = 6.60 ± 1.72 SD), $t(43) = 2.42$, $P < 0.03$. To assess message learning we calculated the measure d′ by computing the proportion of sentences recognized among those actually present in the message (proportion of hits) and the proportion of sentences wrongly defined as present among those not included in the message (proportion of false alarms). The two proportions were transformed in *z*-scores, and the difference was calculated: the higher the d′ value, the higher the number of correct responses and the better the knowledge of the message. The mean score in the experimental condition (M = 2.37 ± 0.65 SD) was not different from the respective mean in the control condition (M = 2.35 ± 0.56 SD). Both means were different from zero; in each case, $t > 16.76$ and $P < 0.001$.

Thus, manipulation checks indicated that the two messages were understood well and elicited similar emotions. Moreover, the experimental message was effective in persuading participants that raw or rare meat can be a risk factor for salmonellosis.

Positive and negative traits. A 2 (condition) × 2 (target: raw or rare versus well-done meat) × 2 (time of measurement: T1 versus T2) × 2 (traits: positive versus negative) mixed ANOVA was performed, with the last three factors serving as within-participants factors. Results showed a significant four-way interaction, $F(1,43) = 7.02$, $P < 0.02$.

We decomposed the interaction by performing a 2 (target) × 2 (time) × 2 (traits) repeated measures ANOVA for each condition separately. In the control condition, a significant target × traits interaction was found, $F(1,23) = 6.00$, $P < 0.001$ (Table 1). Simple effects showed that, irrespective of time of measurement, well-done meat was evaluated as more positive and less negative than raw or rare meat: for positive traits, $F(1,23) = 3.36$, $P = 0.08$ (marginal effect); for negative traits, $F(1,23) = 8.79$, $P < 0.01$. However, both raw or rare and well-done meat were perceived as more positive than negative; for both, $F(1,23) \geq 7.66$, $P < 0.02$. Time of measurement did not have any significant effect, thus indicating that the control message did not affect attitudes toward the two types of meat.

In the experimental condition, the three-way interaction target × time × traits was significant, $F(1,20) = 11.90$, $P < 0.01$. A 2 (time) × 2 (traits) ANOVA was conducted separately for each target. For well-done meat, only the main effect of traits was significant, $F(1,20) = 68.10$, $P < 0.001$, with well-done meat being defined more by positive (M = 7.02 ± 1.20 SD) than negative (M = 3.18 ± 1.13 SD) attributes, regardless of time of measurement. Concerning raw or rare meat, there was a significant time × traits interaction, $F(1,20) = 13.91$, $P = 0.001$ (Table 2). Simple effects showed that the evaluation of raw or rare meat at T2 was both more negative and less positive than the evaluation at T1, $F(1,20) \geq 5.05$, $P \leq 0.04$. Moreover, at T1 there was a tendency to evaluate raw meat as more positive than negative, $F(1,20) = 3.85$, $P = 0.065$ (marginal effect), while at T2 mean scores on positive and negative traits did not differ, $F < 1$.

TABLE 1. *The target × traits interaction (control condition,* n *= 24)*

Target	Traits[a]: Positive	Negative
Raw or rare meat	6.02 ± 1.53 A[b]	4.33 ± 1.54 B
Well-done meat	6.72 ± 1.21 A	3.24 ± 1.29 C

[a] Values represent means ± standard deviations. On the 9-point scale, the higher the score, the greater the attribution of positive or negative traits to the target. In the control condition (physical exercise message), time of measurement (before versus after exposure to the message) did not have any significant effect. Therefore, mean scores reported in this table pertain to the interaction target × traits, irrespective of time.

[b] A different letter in the same row or column indicates that the two means are different, $P < 0.02$. The difference between mean scores of positive traits for the two targets was marginally significant, $P = 0.08$.

Thus, results fully support hypotheses 1a and 1b. In the experimental condition, the message produced less positive evaluations of raw or rare meat, whereas the evaluation of well-done meat remained unaffected.

Intentions. A 2 (condition) × 2 (target) ANOVA was conducted. The two-way interaction was marginally significant, $F(1,43) = 2.88$, $P = 0.10$. Simple effects analysis showed that the intention to eat well-done meat was not different in the two conditions (experimental: M = 5.82 ± 1.34 SD; control: M = 5.82 ± 1.24 SD), $F < 1$; while for raw or rare meat the intention was lower in the experimental condition (M = 3.43 ± 1.43 SD) than in the control condition (M = 4.46 ± 1.92 SD), $F(1,43) = 4.06$, $P = 0.05$.

Consistent with hypothesis 2a, participants were less inclined to consume raw or rare meat after reading the experimental compared with the control message. By contrast, our manipulation did not affect the intention to eat well-done meat (hypothesis 2b).

Implicit associations to the self. For each block of the GNAT, the d′ (sensitivity index) was computed. Higher d′ values indicate greater accuracy in discriminating target items (e.g., well-done meat + me) from distracter items (e.g., raw or rare meat + not-me) and, thus, a stronger association between the target category and attribute. Sensitivity scores of 0 or below indicate that respondents were unable to discriminate targets from distracters or were not performing the task according to instructions *(15)*.

The data of three participants (one in the experimental and two in the control condition) were removed for

TABLE 2. *Evaluations of raw or rare meat in the experimental* (n = 21) *and control* (n = 24) *conditions, before and after exposure to the message*[a]

	Condition[b]:			
	Experimental		Control	
Time	Positive traits	Negative traits	Positive traits	Negative traits
T1	5.60 ± 1.37 A[c]	4.48 ± 1.44 A	5.91 ± 1.60	4.45 ± 1.45
T2	5.19 ± 1.63 B	5.14 ± 1.54 B	6.14 ± 1.67	4.20 ± 1.76

[a] Experimental condition, salmonellosis prevention message; control condition, physical exercise message; T1, evaluations measured before the message; T2, evaluations measured after the message.

[b] Values represent means ± standard deviations. On the 9-point scale, the higher the score, the greater the attribution of positive or negative traits to raw or rare meat. In the experimental condition, a significant time × traits interaction was found, $F(1,20) = 13.91$, $P = 0.001$. This interaction was not significant in the control condition.

[c] For the experimental condition, a different letter in the same row or column indicates that the two means are different, $P \leq 0.04$. The difference between the means for positive and negative traits at T1 (experimental condition) was marginally significant, $P = 0.065$.

excessive errors ($d' \leq 0$) in one or more of the four blocks. Sensitivity scores were submitted to a 2 (condition) × 2 (target) × 2 (attribute: me versus not-me) ANOVA. The three-way interaction was significant, $F(1,40) = 5.10$, $P < 0.03$. A 2 (target) × 2 (attribute) ANOVA was thus conducted for each condition. In the control condition, only the main effect of attribute was significant, $F(1,21) = 6.96$, $P < 0.02$, with me words being more associated with both types of meat (M = 3.07 ± 0.44 SD) than not-me words (M = 2.82 ± 0.48 SD). In the experimental condition, ANOVA revealed a significant target × attribute interaction, $F(1,19) = 6.84$, $P < 0.02$. Simple effects showed that, after being exposed to the experimental message, participants associated the self more with well-done than with raw or rare meat, $F(1,19) = 4.90$, $P < 0.05$, and they associated raw or rare meat more with others than with the self, $F(1,19) = 5.34$, $P < 0.05$. Finally, others were more associated with raw or rare than with well-done meat, $F(1,19) = 4.86$, $P < 0.05$ (Table 3).

Thus, findings support hypothesis 3. In the experimental condition, the association of the self with raw or rare meat was weaker than the association of the self with well-done meat. By contrast, in the control condition the association of the self with the two types of meat did not differ.

TABLE 3. *The target × attribute interaction for d′ values in the experimental condition* (n = 20)[a]

	Attribute[b]	
Target	"Me" items	"Not-me" items
Raw or rare meat	2.70 ± 0.87 A[c]	3.29 ± 0.49 B
Well-done meat	3.12 ± 0.67 C	2.74 ± 0.83 C

[a] Experimental condition, salmonellosis prevention message.

[b] Values represent means ± standard deviations. The higher the d′ value, the stronger the association between the target meat and the me or not-me items.

[c] A different letter in the same row or column indicates that the two means are significantly different, $P < 0.05$.

DISCUSSION

Salmonella is one of the most important pathogens responsible for foodborne diseases. The current study strives to demonstrate that food risk communication can be an appropriate tool for reducing the risk of *Salmonella* infection. The target audience was university students. Reaching this audience is especially important, since young adults generally have poor levels of food safety knowledge *(2)* and are likely to engage in risky food behaviors *(12, 17, 20)*. Participants in the experimental condition were exposed to a prevention message that focused on the importance of eating well-cooked meat as a prevention practice. The message proved to be effective. First, it changed the attitude toward raw or rare meat, which after the message was given, was evaluated both less positively and more negatively. Second, intentions to eat raw or rare meat were weaker after having read the experimental message, compared with the control message. Third, after the salmonellosis message, the self-concept was implicitly closer to well-done than to raw or rare meat.

Presenting the prevention message only once is sufficient to reduce the positive attitude toward raw meat, at least in the short term. Future research is needed to determine the number of times the message needs to be presented for obtaining a long-lasting change. It would also be interesting to evaluate to what extent other factors, such as flavor, can affect the choice to eat raw meat and whether these factors could limit the impact of the message.

Although the message targeted university students, we believe it is also suited to other groups, such as high school students and people in intellectual professions, as it underlines the temporary negative effects that *Salmonella* infection can have on basic cognitive functions. These groups should be especially interested in the content of the message, since it provides a simple, effective strategy for reducing the risk of salmonellosis and, thus, the risk of poor job or academic performance. The message we have proposed in this article could be presented to these populations through awareness campaigns conducted on location, or it could be disseminated within schools and

universities through paper-based or Web-based communication tools.

One limitation of this study is that we evaluated the effectiveness of the message by considering behavioral intentions, but not actual behavior. However, although research on automaticity *(6, 9)* and habits *(16)* suggests that intentional control of action may be more limited than was previously thought, intentions remain the key psychological predictor of voluntary behaviors.

Moreover, in assessing the influence of the message on intentions and automatic associations, we only considered the difference between the experimental and control conditions at time 2. At time 1, we only measured attitude, in order to simplify the participants' task, given that they had to return to the laboratory for the second research phase. Future research should check the validity of our findings using a full experimental design, namely, measuring intentions and implicit associations also at time 1, before reading the prevention or the control message.

In conclusion, we developed a prevention message that affected young adults' attitudes, intentions, and automatic associations in a very consistent way.

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