Need for Cognition and Message Complexity in Motivating Fruit and Vegetable Intake Among Callers to the Cancer Information Service

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This field experiment examined the impact of an individual’s need for cognition (NFC; the tendency to enjoy thinking deeply about issues), complex versus simple messages, and the interaction of NFC and message type on encouraging fruit and vegetable consumption. Callers to the Cancer Information Service of the National Cancer Institute (N = 517) were asked to participate in the experiment at the end of their call. Individual NFC was assessed, and participants were assigned randomly to receive a telephone message promoting fruit and vegetable consumption that was either complex and multifaceted or simple and straightforward. Similarly constructed brochures were mailed immediately following the call, and additional brochures were mailed 2 and 3 months later. Although NFC did not predict intake, complex messages were more effective than simple messages in motivating fruit and vegetable consumption 1 and 4 months later.

Cancer is the second leading cause of death in the United States (Centers for Disease Control and Prevention, 2002). Almost 50% of U.S. cancer incidence and about 35% of cancer deaths are thought to be related to Western dietary habits (Williams, Williams, & Weisburger, 1999). During the past few decades, research has shown a consistent association between regular fruit and vegetable intake and cancer risk reduction (Terry, Terry, & Wolk, 2001). Many health organizations recommend that individuals consume at least five servings of fruits and vegetables per day (e.g., U.S. Department of Health and Human Services, 1991), although only 26% of Americans comply with this recommendation (Stables et al., 2002).

Agencies that communicate cancer-prevention information to the public, such as the National Cancer Institute (NCI), present information in various formats with the goal of motivating behavior change. The Cancer Information Service (CIS) of the NCI is a health communication program that disseminates information to individuals through a toll-free telephone number. One of the purposes of this research is to explore ways in which to communicate cancer-related information through CIS telephone interactions and follow-up print materials that could increase its effectiveness in motivating subsequent behavior, such as fruit and

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vegetable intake. Research is needed to determine ways in which CIS-delivered communications can be optimized to enhance their value and to isolate those message-content variables that are especially critical.

NEED FOR COGNITION

Information-processing styles, such as need for cognition (NFC), are thought to be relatively stable aspects of personality (Kihlstrom & Cantor, 2000). NFC, the tendency to enjoy thinking deeply about issues, could be an important individual difference variable for understanding the influence of health communications (Cacioppo, Petty, Feinstein, & Jarvis, 1996). Individuals with high NFC are motivated to seek information and process it systematically. In addition, they cognitively elaborate on messages and engage in effortful thinking about information presented to them. In contrast, individuals with low NFC tend to be less motivated to put forth the effort required to process and interpret information in health messages systematically. They are more likely to rely on the influence of others, such as celebrities or experts, and utilize mental shortcuts. In addition, they are less sensitive to the actual quality of the arguments in a message (Cacioppo, Petty, Kao, & Rodriguez, 1986).

NFC may moderate the way individuals derive meaning from persuasive health messages, so that some messages are more influential for those people with high NFC and other messages are more influential for those people with low NFC. Because of their characteristic desire to mull over information, individuals with high NFC typically are persuaded most by strong and detailed messages that are clearly articulated in a direct manner (Cacioppo et al., 1986). Facts and statistics are especially persuasive to them. Individuals with low NFC, who are less apt to use effort for decision making, can be persuaded by the presence of peripheral message cues, for example, the source of the argument (e.g., an attractive or eminent public figure or a credible authority) and the ease with which the argument can be processed (e.g., pictorial vs. verbal presentation; Cacioppo et al., 1996; Cacioppo et al., 1986). One goal of this experiment is to examine the impact of individual differences in NFC on health behavior in an ecologically complex setting where individuals are regularly provided with persuasive health messages.

MATCHING MESSAGES TO INCREASE FRUIT AND VEGETABLE INTAKE

There is some evidence that matching messages to individuals' information-processing styles (e.g., monitor–blunter coping styles; Miller, 1987) is effective in motivating subsequent health behaviors (Ludwick-Rosenthal & Neufeld, 1993; Williams-Piehota, Pizarro, Schneider, Mowad, & Salovey, 2005). Tailoring to NFC for encouraging mammog-raphy utilization has been explored previously (Williams-Piehota, Schneider, Pizarro, Mowad, & Salovey, 2003), but we are not aware of any studies focused on individuals' information-processing styles and promoting fruit and vegetable intake.

A number of interventions have tailored messages to other recipient characteristics yielding mixed success in increasing fruit and vegetable intake. In a series of large-scale randomized studies, messages tailored to a recipient's stage in the behavioral change process, for example, were more effective than the receipt of no information in increasing intake (Marcus et al., 2001; Marcus, Heimendinger, et al. 1998; Marcus, Morra, et al., 1998). Information tailored to dietary intake, awareness of intake, and beliefs about diet was more effective than general nutritional information for increasing fruit and vegetable intake (Brug, Glanz, van Assema, Kok, & Van Breukelen, 1998), but these findings have not been especially robust (Brug, Steenhuis, van Assema, & De Vries, 1996; Campbell et al., 1994). However, because many of these studies tailor messages to multiple variables at once, it is not always possible to deduce the message variables that are most promising. Investigators who have examined the message components that are necessary or most effective for tailoring aimed at increasing fruit and vegetable intake found that tailoring to additional components did not significantly improve fruit and vegetable intake (Brug, Steenhuis, van Assema, Glanz, & De Vries, 1999; Lutz et al., 1999). For example, Brug and colleagues (1999) discovered no significant difference in effectiveness between nutritional information tailored only to current intake and eating habits versus this kind of tailoring plus additional tailored psychosocial information addressing recipients' attitudes, self-efficacy, and perceived social support. Perhaps a stable and global information-processing style like NFC is a more appropriate variable for tailoring.

We developed an intervention for increasing fruit and vegetable intake by presenting CIS callers with a series of nutrition education messages that were more or less complex, and thought, therefore, to be tailored to either high or low NFC, respectively. A series of competing hypotheses was formulated. One could predict that individuals with high NFC are more likely to increase their intake than individuals with low NFC because they are more likely to expend the effort to process fully any message they receive (Cacioppo, Petty, & Morris, 1983). Alternately, one could predict that complex messages generally may be more likely to increase individuals' intake than simple messages because they are more informative and engaging. Finally, it seems reasonable to propose that messages matched to individuals' NFC specifically would be more likely to increase individuals' intake than mismatched messages because matched materials are more personally relevant, and, perhaps, more easily processed (Kreuter, Strecher, & Glassman, 1999). Therefore, we examined whether individual differences in NFC, complex or simple messages, or messages matched to individuals' NFC would be influential for increasing intake. That is, we tested
whether we could find evidence for an individual difference NFC main effect, a message type main effect, or an interaction of recipient NFC and message type on increasing fruit and vegetable intake. This experiment, thus, was a two-way factorial—individual NFC (high/low) by message type (complex/simple).

METHOD

Participants

From December 10, 2001, to March 6, 2002, callers to the New England regional office of the CIS were asked questions to determine their eligibility for this experiment at the end of the regular CIS-provided service. To be eligible, callers (a) could not have called the CIS for diet or nutrition information, so the information could be delivered proactively; (b) could not have participated in the study previously; (c) had to be at least 18 years of age; (d) could not be current cancer patients, waiting for treatment, or terminally ill, because participating in the study might create an additional burden for these individuals; (e) could not be on a physician-established diet that limits the number of fruits and vegetables they eat; (f) had to be able to communicate in English; (g) could not be significantly distressed at the time of the call, as determined by the cancer information specialist; and (h) could not be meeting the recommended dietary guideline of five or more servings of fruits and vegetables per day. If, during the course of the regular telephone conversation, callers were deemed ineligible based on the aforementioned criteria, they were not asked further eligibility questions.

A total of 1,579 callers were asked if they were willing to answer the eligibility questions and 139 (9%) refused. Of the remaining 1,440 callers, those who were already involved in the study were excluded (2%), as were those either waiting for cancer treatment (1%) or currently receiving cancer treatment (2%). In keeping with eligibility criteria, callers who refused to report their age and those younger than 18 years of age were excluded (1%). Callers who were on a physician-prescribed diet limiting fruit and vegetable intake (3%), those who could not recall their current fruit and vegetable intake (4%), and those currently consuming at least five fruits and vegetables a day (32%) were excluded from the study. Of the 812 eligible callers, 517 (64%) agreed to participate in the study and, subsequently, were randomized to one of the intervention arms. A total of 432 participants (84%) completed 1-month follow-up interviews, 377 (73%) completed 4-month follow-up interviews, and 315 (61%) participants returned the follow-up survey.

Procedure

At baseline, eligible and consenting callers completed a brief telephone interview and were read a randomly assigned, brief educational message promoting fruit and vegetable intake that was either complex or simple. Within a week, participants received a packet by mail containing a copy of the informed consent form for their records, a brief tailored letter (consistent with the type of message delivered over the telephone), a similarly constructed brochure promoting fruit and vegetable intake, and a “5 a Day” pencil. Two months after baseline, participants received a second packet containing a brief instructional letter, a second complex or simple brochure promoting fruit and vegetable intake, a refrigerator magnet containing a message congruent with condition assignment, and a survey to complete after reading the brochure. Participants who completed and returned at least part of the survey were provided $10 compensation. Three months following baseline, participants received a packet containing another complex or simple letter, five recipe cards, and a complex or simple tip card. Brief 1- and 4-month follow-up telephone interviews assessed changes in fruit and vegetable intake since baseline. If participants could not be reached after eight telephone attempts, they were mailed a stamped, preaddressed postcard on which to indicate their average fruit and vegetable intake.

Description of the Messages

The first message that participants received was the CIS-delivered telephone message that varied depending on whether they were randomly assigned to the group in which the message was complex, and presumed to be tailored for individuals with high NFC, or simple, and presumed to be more appropriate for individuals with low NFC. The next message, which was sent in the first mailing, included National Institutes of Health (NIH) publications that were selected for their presumed relevance to low versus high NFC individuals. Eat 5 Fruits and Vegetables Every Day (NIH, 1999) served as the simple brochure tailored to low NFC. It defines serving sizes for fruits and vegetables verbally and pictorially, provides a few simple suggestions of how to increase intake, and is six pages long (in an 8½ × 11 in. format). Eat More Fruits & Vegetables—Five a Day for Better Health (NIH, 1991) served as the complex brochure tailored to high NFC. It also defines serving sizes and provides suggestions for adding fruits and vegetables to one’s diet, but it provides considerably more scientific evidence concerning the health benefits of fruits and vegetables, and it contains far fewer pictorial representations on its eight pages (in an 8½ × 14 in. format).

The brochures utilized in the second mailing were, in part, adapted from Take Five: A Guide to Healthful Eating, developed by the Fred Hutchinson Cancer Research Center (Leader, Thompson, Kristal, Beresford, & Curty, 1999). The adapted versions of the brochures defined serving sizes, provided information about the benefits of eating fruits and vegetables, presented ways to overcome common barriers, and included suggestions for increasing fruit and vegetable intake. Then, we further modified these brochures for use in this study. The presentation style of the complex brochure
tailored to high NFC, *Important Facts and Strategies to Help You Eat 5 a Day*, emphasized facts and details related to the specific health benefits of fruits and vegetables and presented arguments encouraging fruit and vegetable intake in a detailed manner. Compared to the simple brochure tailored to low NFC, this brochure was slightly longer (20 pages), contained statistics related to the health benefits of fruit and vegetable consumption, included benefits associated with specific types of produce, and gave a few extra suggestions for increasing intake. It also provided additional cooking and serving suggestions, information about the seasonal availability of specific fruits and vegetables, and a resource list for supplementary information.

The simple brochure tailored to low NFC, *Simple Steps to Help You Eat 5 a Day*, presented a condensed message in 13 pages, and, although the same essential information was provided as in the complex brochure, there were fewer details on each subtopic. The message was more succinct and was presented in a less elaborate manner, as low NFC individuals tend to be less motivated to engage in deep processing of information. In addition, the message included celebrity advocacy of fruit and vegetable consumption because low NFC individuals are more influenced than high NFC individuals by the source of arguments—such as public figures—and other peripheral cues (Cacioppo et al., 1996). A photograph of the celebrity was included in the pamphlet for ease of information processing and to draw attention to the source of the arguments. Example sentences from these brochures are provided in Table 1. The tip cards included in the third mailing were based on *Eat More Salads!*, a tip card developed by the American Medical Center Cancer Research Center (Marcus, Morra, et al., 1998), and were adapted in a similar fashion.

**Measures**

**Baseline measures.** Because the length of the baseline telephone assessment and intervention was limited by CIS restrictions to a maximum of 7 min, it was not possible to assess baseline constructs using multiple-item scales. Participants' baseline fruit and vegetable intake was assessed with a single open-ended question from the Block food frequency questionnaire (Block et al., 1986) used in other studies with CIS-based samples (e.g., Marcus et al., 2001; Marcus, Heimendinger, et al. 1998; Marcus, Morra, et al., 1998). The question asked, “About how many servings of fruits and vegetables do you usually eat or drink on an average day? Please include fruits, vegetables, and 100% fruit or vegetable juices in your answer.” We assessed their baseline knowledge of the five-a-day guideline by asking the open-ended question, “How many servings of fruits and vegetables do you think a person should eat each day for good health?” In addition, we assessed their intentions to eat more, less, or about the same number of servings of fruits and vegetables in the future. We also gathered demographic information.

**NFC.** This was measured using three items from the short-form of the NFC Scale (Cacioppo, Petty, & Kao, 1984), selected for their high factor loadings (Cacioppo & Petty, 1982, Table 3), as in prior studies (e.g., Steward, Schneider, Pizarro, & Salovey, 2003; Williams-Piehota et al., 2003). The reliability of these items as a scale was sufficient (Cronbach’s α = .77).

**Immediate post-message measure.** Immediately following the presentation of the telephone messages, we asked participants to indicate on a 5-point scale how interesting they found the message to be ranging from 1 (Not at all interesting) to 5 (Very interesting).

**Follow-up packet measures.** Participants evaluated the brochures. One item served as a message-type manipulation check by asking, “How challenging was the brochure in terms of making you think a lot?” (1 = Not challenging; 5 = Extremely challenging). It was expected that the group who received the complex brochure tailored to high NFC would rate the brochure as being more challenging than the group who received the simple brochure tailored to low NFC. Other items assessed how detailed, informative, and interesting the brochures were.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Samples of the Content of the Complex versus Simple Messages</th>
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<tr>
<td><strong>From the complex brochure:</strong></td>
<td><strong>From the simple brochure:</strong></td>
</tr>
<tr>
<td>Other reasons based on scientific evidence include:</td>
<td>Other reasons people give include:</td>
</tr>
<tr>
<td>To reduce the risk for coronary heart disease, the major cause of death in the United States, by 20% to 40%.</td>
<td>To reduce the risk of getting certain types of cancer, heart disease, and stroke.</td>
</tr>
<tr>
<td>To reduce the risk for developing cancer, the second leading cause of death, by up to 50%, as compared to people who only eat one or two servings a day.</td>
<td>To lose a few pounds or to keep from gaining extra ones.</td>
</tr>
<tr>
<td>To reduce the risk for stroke, the second leading cause of death in the United States, by up to 25%</td>
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One- and 4-month follow-up phone call measures. To assess their familiarity with and use of the health communications that we mailed, we asked how much of the materials they read (0 = None; 4 = All). We also inquired about the amount of information regarding fruit and vegetable intake that was new (0 = None; 4 = All) and whether the materials increased their motivation to eat more fruits and vegetables.

In addition, the baseline measures of fruit and vegetable intake, intentions for future intake, and knowledge of the five-a-day guideline were repeated. Finally, we included a seven-item food frequency questionnaire assessing fruit and vegetable consumption to validate the one-item measure of fruit and vegetable intake. The questionnaire asks how often one eats or drinks 100% orange or grapefruit juice; other 100% juices; green salad; French fries or fried potatoes; and baked, broiled, or mashed potatoes. In addition, it asks how many servings one eats of vegetables, not counting salad or potatoes, and of fruit, not counting juices. The servings of French fries and fried potatoes are subtracted from the total, and the responses to the other questions are combined to provide a measure of daily servings of fruits and vegetables. This questionnaire has been validated (Serdula et al., 1993) and used previously in five-a-day research with CIS-based samples (e.g., Marcus et al., 2001; Marcus, Heimendinger, et al. 1998; Marcus, Morra, et al., 1998).

Data Analysis

The SAS® (Version 8) statistical analysis program was used for all analyses. First, demographic characteristics of the sample were assessed. Bivariate analyses between baseline sample characteristics and intervention groups then were conducted to assess the success of the randomization process. Overall change in fruit and vegetable intake was assessed from baseline to 1 and 4 months. Differences in intake by individual NFC, message type, and their interaction were analyzed using separate generalized linear regression models for the 1- and 4-month follow-ups. All analyses examining fruit and vegetable intake were conducted using the one-item measure. Tukey’s adjustment for multiple comparisons was utilized in all multivariate models. Final models included only those participants for whom complete information was available.

RESULTS

Description of the Sample

The mean age of participants was 48 years (SD = 14.8). Most of the 517 study participants were non-Hispanic White (91%), female (72%), over 35 years old (79%), earned at least $40,000 per year (65%), and had attended at least some college (78%). Four percent of eligible callers identified themselves as African American, 3% Asian, 1.5% Hispanic or Latino, <1% American Indian or Alaskan Native, and <1% Native Hawaiian or other Pacific Islander. Participants reported an average intake of 2.73 servings of fruits and vegetables per day at the start of the study (SD = 1.08; range = 0–4), with 60% consuming between three and four servings per day, as indicated in Table 2.

<table>
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<tr>
<th>Variable</th>
<th>Full Sample</th>
<th>Message Type</th>
<th>Individual NFC</th>
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<td>M</td>
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</table>
| Age               | 47.56       | 14.83        | 48.49 | 14.41 | 47.46 | 15.01 | .42
| Servings per day  | 2.73        | 1.08         | 2.74 | 1.09 | 2.73 | 1.06 | .93
| Gender (%)        |             |              |     |     |     |     |     |
| Female            | 71.7        | 67.5         | 76.0 | .03 | 65.5 | 79.3 | .001
| Race (%)          | 90.8        | 93.4         | 88.8 | .08 | 90.0 | 91.8 | .51
| Education (%)     |             |              |     |     |     |     |     |
| < HS              | 5.0         | 4.5          | 5.5 | .79 | 2.6 | 7.6 | <.001
| HS grad           | 17.4        | 16.0         | 18.9 | 10.0 | 29.1 | 27.0 | <.001
| Some college      | 25.1        | 25.1         | 25.2 | 22.5 | 27.0 | 22.8 | .001
| College grad      | 31.1        | 31.3         | 31.1 | 37.3 | 22.8 |
| Post grad         | 21.4        | 23.0         | 19.3 | 27.7 | 13.5 | .10 | 
| Income (%)        |             |              |     |     |     |     |     |
| $<20,000          | 14.4        | 14.3         | 14.7 | .86 | 10.0 | 19.6 | <.001
| $20–39,000        | 20.6        | 20.6         | 20.8 | 18.0 | 23.7 | 22.3 | .001
| $40–59,000        | 20.8        | 20.2         | 21.2 | 19.5 | 22.3 | 15.6 | .001
| $60–79,000        | 15.3        | 13.9         | 16.3 | 14.9 | 22.3 | 15.6 | .001
| $80,000+          | 28.9        | 31.1         | 26.9 | 37.5 | 18.8 | .001

Note. N = 517, NFC = need for cognition. HS = high school. Grad = graduate.
Participants who were lost to follow-up at 1 month were more likely to be male, $\chi^2(5) = 13.56, p < .05$; be less educated, $\chi^2(5) = 13.56, p < .05$; and report consuming fewer servings of fruits and vegetables at baseline ($M = 2.34, SD = 1.06$) than those participants who completed the 1-month interview ($M = 2.82, SD = 1.06$), $F(1, 155) = 14.79, p < .001$. Participants lost to follow-up at 4 months tended to report less education, $\chi^2(5) = 16.18, p < .05$; lower income, $\chi^2(4) = 11.13, p < .001$; and fewer servings of fruits and vegetables at baseline ($M = 2.46, SD = 1.05$ vs. $M = 2.84, SD = 1.84$), $F(1, 515) = 12.87, p < .001$. Loss to follow-up was not associated with individual NFC, message type, or their interaction at either follow-up time, so we can assume that differential dropout did not compromise the internal validity of this experiment.

NFC scores were calculated by summing the responses for the three NFC questions asked at baseline. NFC scores ranged from 3 to 16 ($M = 10.86, SD = 2.82$). A median split of NFC scores was used to classify participants as having a high or low NFC, with participants scoring below 11 classified as low NFC and those scoring 11 or above classified as high NFC. The low NFC group had mean NFC scores of 8.32 ($SD = 1.57$), and the high NFC group had mean NFC scores of 13.05 ($SD = 1.52$). High NFC individuals were more likely to be younger ($M = 46.75$ vs. $M = 49.27$), $t(513) = 1.95, p = .05$; female, $\chi^2(1) = 12.54, p = .001$; more educated, $\chi^2(5) = 46.45, p < .001$; wealthier, $\chi^2(4) = 26.18, p < .001$; know the current fruit and vegetable intake guidelines (i.e., five or more a day), $\chi^2(1) = 3.38, p < .05$; and consume more baseline servings of fruits and vegetables per day ($M = 2.84$ vs. $M = 2.61$), $t(515) = 2.37, p = .02$, than low NFC individuals. No differences were found between high and low NFC individuals on other variables assessed at baseline. Random assignment to either the complex message intervention or the simple message intervention appears to have been successful; there were no differences between message type groups on any baseline variables.

Evaluation of Messages

When considering how participants evaluated the messages, it is important to keep in mind that they did not see the other intervention group’s message for comparison in this between-subjects design. Participants assigned to the complex message condition reported that the CIS-delivered telephone message was more interesting ($M = 4.72, SD = 0.55$) than those assigned to the simple message condition ($M = 4.57, SD = 0.61$), $F(1, 468) = 8.53, p < .01$. The follow-up survey asked participants to evaluate the mailed brochures. The message type manipulation was effective: Participants who received the complex messages rated the brochures as more challenging in terms of making them think a lot ($M = 3.20, SD = 1.11$) than those who received the simple messages ($M = 2.94, SD = 1.09$), $F(1, 302) = 4.06, p < .05$. Participants who received the complex messages also rated the brochures as more informative ($M = 4.08, SD = .74$) and interesting ($M = 3.89, SD = 1.75$) than participants who received the simple messages ($M = 3.84, SD = .73$), $F(1, 307) = 9.14, p < .01$; ($M = 3.59, SD = 0.80$), $F(1, 307) = 11.07, p < .001$, respectively. Not surprisingly, high NFC participants tended to report that the messages were less challenging ($M = 2.94, SD = 1.16$) than low NFC participants ($M = 3.21, SD = 1.02$), $F(1, 302) = 4.53, p < .05$. No NFC by message-type interactions were found for ratings of how challenging, informative, interesting, and detailed the brochures were.

Postintervention Findings—Changes in Psychosocial Variables

A small but statistically significant improvement in overall motivation to increase intake between 1 and 4 months was found across intervention groups, assessed using McNemar’s score test, $S(1) = 4.17, p < .05$. No differences were found between high or low NFC individuals, message types, or their interaction in the amount of the booklet participants reported to have read or how much of the information in the brochures the participant reported was new to them.

The type of message delivered influenced intentions to consume more fruits and vegetables after 1 month but not 4 months. Participants who received the complex message were more likely to report intentions to eat more fruits and vegetables in the future ($M = 2.69, SD = 0.46$) than were those who received the simple message ($M = 2.56, SD = 0.51$), $F(1, 387) = 6.12, p < .01$. No difference in intentions was found between message types at 4 months. There were also no differences in intentions between high and low NFC individuals or due to the interaction between individual NFC and message type. There was no significant change in intentions over time.

Significant increases in knowledge of the current fruit and vegetable guideline were found between baseline and the 1- and 4-month follow-ups, with 51% of the sample knowing the current recommendation of five a day at baseline; 78% at 1 month, $S(1) = 61.54, p < .05$; and 85% at 4 months, $S(1) = 75.44, p < .05$. There were no differences in participants’ ability to report correctly that a person should eat five or more servings of fruits and vegetables per day with respect to message type. High NFC individuals were more likely to know the five-a-day guideline than low NFC individuals at 1 month, $\chi^2(1) = 4.04, p < .05$, but not at 4 months. No differences in knowledge at 1 month or 4 months were observed with respect to the interaction of individual NFC and message type.

Changes in Fruit and Vegetable Intake After 1 Month

Overall, the average number of fruit and vegetable servings increased from 2.74 per day ($SD = 1.07$) at baseline to 3.89
per day ($SD = 1.39$) at the 1-month follow-up, $t(417) = 17.83$, $p < .001$. As can be seen in Figure 1, participants who received the complex messages reported a higher intake ($M = 4.03$, $SD = 1.50$) than those who received the simple messages ($M = 3.75$, $SD = 1.31$), $F(1, 387) = 3.47$, $p < .06$. High NFC individuals reported a higher intake ($M = 3.99$, $SD = 1.43$) than did low NFC individuals ($M = 3.72$, $SD = 1.37$), $F(1, 387) = 3.58$, $p < .06$.

To examine more thoroughly the impact of individuals’ NFC complex versus simple messages and the interaction (matching) of NFC and message type on encouraging fruit and vegetable consumption (a participant NFC by message type interaction), univariate generalized linear regression analyses were conducted adjusting for baseline fruit and vegetable intake. At 1 month, high NFC individuals consumed an average of 0.11 more servings per day than did low NFC individuals collapsed across message type, but this difference was not significant ($\beta = 0.06$, $p = .33$). Participants who received the complex messages reported consuming 0.24 more servings of fruits and vegetables per day than those who received the simple messages ($\beta = 0.12$, $p < .05$). As indicated in Table 3, no significant differences between matched versus mismatched message groups were found. That is, as shown in Figure 1, although high NFC individuals who received the complex messages reported the highest intake after 1 month ($M = 4.05$, $SD = 0.21$), as would be predicted by a matching hypothesis, low NFC individuals who received the simple messages reported the lowest ($M = 3.69$, $SD = 0.23$), $F(1, 221) = 4.65$, $p < .05$, which is counter to the matching hypothesis.

Changes in Fruit and Vegetable Intake After 4 Months

At 4 months, the average intake of fruits and vegetables was 4.20 servings per day ($SD = 1.55$), an overall increase of 1.46 servings per day from baseline, $t(373) = 17.74$, $p < .001$, and .31 servings per day from the 1-month time point, $t(345) = 3.67$, $p < .001$. As shown in Figure 1, high NFC individuals reported higher intakes ($M = 4.24$, $SD = 1.55$) than did low NFC individuals ($M = 3.96$, $SD = 1.48$), $F(1, 372) = 7.16$, $p < .01$. As well, participants who received the complex messages reported higher intakes ($M = 4.41$, $SD = 1.74$) than those who received the simple messages ($M = 3.99$, $SD = 1.34$), $F(1, 372) = 6.98$, $p < .01$.

Multivariate generalized linear regression analysis was used to determine the effects of individual NFC, message type, and their interaction on fruit and vegetable intake at 4 months, controlling for reported intake of fruits and vegetables at baseline and 1 month. Whereas no statistically significant differences were found between high and low NFC individuals ($\beta = .10$, $p = .16$), participants who received the complex messages reported consuming more fruits and vegetables per day than participants who received the simple messages ($\beta = 0.17$, $p < .05$). No significant differences in fruit and vegetable intake based on the interaction between individual NFC and message type were found, as shown in Table 3. High NFC individuals who received the complex messages, which were presumably better tailored to high NFC, reported consuming the most fruits and vegetables ($M = 4.48$, $SD = 0.27$ servings per day). However, low NFC individuals who received the simple messages, which were presumably better tailored to low NFC, reported consuming only 3.96 ($SD = 0.27$) servings a day, $F(1, 176) = 7.55$, $p < .05$. Figure 1 shows the reported fruit and vegetable intake at 4 months by individual NFC and message type. Overall, the complex messages were more effective than the simple messages.

**DISCUSSION**

This field experiment examined the effects of individual differences in NFC (the tendency to seek out and enjoy effortful thinking); complex versus simple messages thought to be tailored to high or low NFC individuals, respectively; and the matching of messages to participants’ NFC on increasing intake among callers to the CIS. Individual differences in NFC did not have an appreciable ef-
fect on fruit and vegetable intake in this study. Both high and low NFC individuals increased their intake of fruits and vegetables substantially. However, complex messages were more effective across the board than the simple messages. Matching messages to individuals’ NFC was not unusually effective for increasing intake.

Although it seemed reasonable to expect that high NFC individuals who are motivated to mull over information could be more apt to attend to the information in either message, and therefore be motivated to increase their intake relative to individuals with low NFC, it is also true that high NFC individuals are more affected by the quality of arguments in a message (Cacioppo et al., 1983). It appears that the simple messages did not provide the rich information that the high NFC individuals needed. The simple messages were less effective for the high NFC individuals than the complex messages. However, the complex messages actually were more effective for everyone, including the low NFC individuals. We found similar results in a recent study examining the effects of complex and simple messages on individuals high and low in NFC for improving mammography utilization among CIS callers (Williams-Piehota et al., 2003).

It is evident that all intervention messages were influential in promoting fruit and vegetable consumption among CIS callers who were not currently meeting the recommended guideline of five or more servings a day. The increases in fruit and vegetable intake found across all conditions were substantial, with a pooled increase of 1.15 servings by the 1-month follow-up and 1.46 servings by the 4-month follow-up. Further, this intervention continued to produce greater intake over the course of the study; Marcus and his colleagues reported an effect of tailored messages that peaked at 1 month and then weakened over time (Marcus et al., 2001; Marcus, Heimendinger, et al. 1998; Marcus, Morra, et al., 1998). The continued increase in intake may be due to the quantity and timing of the messages participants received. Participants in our intervention received a brief educational message and three mailings over 4 months. However, in the studies done by Marcus and colleagues, participants received only a brief educational message and two mailings within the 1st month (Marcus et al., 2001; Marcus, Heimendinger, et al. 1998; Marcus, Morra, et al., 1998). Perhaps the receipt of multiple “booster” messages over time was powerful enough to produce an effect that strengthened over time rather than a short-term effect that faded.

**Limitations**

It is possible that the 64% of eligible callers who agreed to participate in the study were more motivated to comply with requests in general, including the suggestion to increase their fruit and vegetable intake. In other words, as well, the findings from this study may have limited generalizability. The sample was composed primarily of non-Hispanic White, relatively educated, female CIS callers. Further, these individuals were seeking health information when they called the CIS for cancer-related information, although they were approached proactively concerning fruit and vegetable intake. This kind of intervention may not be as effective with other demographic groups or with groups of individuals who are less interested or motivated to obtain health information. Another limitation of this work was the reliance on a single-item measure of self-reported fruit and vegetable intake. Issues concerned with the reliable measurement of dietary intake are many (Block & Hartman, 1989; Thompson & Byers, 1994). Nonetheless, the intake measures employed in this study have been used in other studies recruiting CIS-based samples (e.g., Marcus et al., 2001; Marcus, Heimendinger, et al., 1998; Marcus, Morra, et al., 1998), enabling comparison of intervention effects across studies. Correlations between the one-item and seven-item measures of intake at each follow-up time point were moderately high, r(343) = 0.49, p < .001 for 1 month and r(207) = .59, p < .001 for 4 months, and similar to other studies (e.g., Marcus et al., 2001; Marcus, Heimendinger, et al., 1998; Marcus, Morra, et al., 1998). Further, there is some evidence that social desirability and the need for social approval do not influence self-reported dietary intake (Smith et al., 1998). Seasonality may have influenced overall study outcomes, as baseline data collection began during the winter and early spring and the 4-month follow-ups were conducted in the spring and summer. However, in subsequent studies when baseline data col-

### Table 3

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>SEβ</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Month</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual NFC (1 = High, -1 = Low)</td>
<td>0.06</td>
<td>0.06</td>
<td>0.98</td>
<td>.33</td>
</tr>
<tr>
<td>Message Type (1 = Complex, -1 = Simple)</td>
<td>0.12</td>
<td>0.06</td>
<td>2.10</td>
<td>.04</td>
</tr>
<tr>
<td>Individual NFC × Message Type (matched vs. mismatched)</td>
<td>-0.02</td>
<td>0.06</td>
<td>0.33</td>
<td>.74</td>
</tr>
<tr>
<td><strong>4 Months</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual NFC (1 = High, -1 = Low)</td>
<td>0.10</td>
<td>0.07</td>
<td>1.41</td>
<td>.16</td>
</tr>
<tr>
<td>Message Type (1 = Complex, -1 = Simple)</td>
<td>0.17</td>
<td>0.07</td>
<td>2.37</td>
<td>.02</td>
</tr>
<tr>
<td>Individual NFC × Message Type (matched vs. mismatched)</td>
<td>-0.00</td>
<td>0.07</td>
<td>0.05</td>
<td>.96</td>
</tr>
</tbody>
</table>

*Note:* NFC = need for cognition, β = standardized regression weight, SEβ = standard error of the standardized regression weight.

* N = 428. Adjusted for reported fruit and vegetable intake at baseline. N = 346. Adjusted for reported fruit and vegetable intake at baseline and 1 month.
lection began in the summer, we have found similar effects (Williams-Piechota et al., 2004). Participants lost to follow-up reported slightly fewer baseline servings, which may have inflated the overall reported consumption rate to some extent. There is no reason to suspect that these factors led to differential reporting of intake between the groups, however.

Although complex versus simple messages were perceived differently, as we had hoped, in how challenging, informative, and interesting they were rated, it is possible that the messages were also not equivalent along other dimensions. The first set of brochures that participants received were existing NCI brochures selected for use in this study, making it difficult to ensure that these messages were similar in every aspect other than those deliberately manipulated (Jackson, 1992). The inability to decompose the various message factors from the first set of brochures limits our ability to interpret the lack of message matching evidence found here. Further, message length and complexity may be confounded, as the simple message was both shorter and less complex than the complex message. For example, an information-processing perspective might have led to the prediction that less-involved individuals would be influenced by the complex message simply because it contained the greater number of arguments (Petty & Cacioppo, 1984).

Conclusions and Future Directions

Even with these considerations, the findings suggest that CIS callers not meeting the recommended dietary guideline for fruit and vegetable consumption can be motivated to increase their intake substantially. Complex messages about fruit and vegetable intake were especially effective for encouraging intake among CIS callers, particularly high NFC individuals. These findings raise questions about the information-processing styles likely to be characteristic of information seekers such as CIS callers. Perhaps the callers in this sample were higher in NFC than the general population. Future research should assess the relevance of NFC and complex versus simple messages for motivating individuals of lower education and lower socioeconomic status and individuals who are not information seekers to see if our findings generalize to these groups. In addition, further investigation is needed to determine whether complex messages are more effective when people attend to the information in the messages, regardless of their NFC. Meanwhile, it is clear that the fruit and vegetable consumption of callers to health information services can be improved substantially with a multicomponent, information-rich communication campaign.

Research reported in this article was funded by National Cancer Institute Grant R01-CA66427. Preparation of the manuscript was also facilitated by a grant from the Ethel Donaghy Foundation Women's Health Investigator Program at Yale University, National Institute of Mental Health Grant P01-MH/DA56826, and National Institute on Drug Abuse Grant 5P50-DA13334. Portions of this article were presented as a poster at the annual meeting of the Society for Behavioral Medicine, Salt Lake City, Utah, March 2003. We gratefully acknowledge Sharon Garcia, Ashley Cox, and the Cancer Information Specialists at the New England office of the Cancer Information Service for their contributions to this research. We also thank Al Marcus and A. F. Smith for methodological advice relevant to the experiment reported here, and two anonymous reviewers for their helpful suggestions.

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ACKNOWLEDGMENTS

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