"Myths & Facts" about the flu: Health education campaigns can reduce vaccination intentions

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Fighting infectious disease is a high global priority. Infectious diseases create widespread disability and suffering, and lead to one quarter of the world's deaths each year (*1*). The disease burden includes large economic costs, both direct (medical care) and indirect (lost productivity, wages, and investment) (*2*). In developing nations, disease incidence predicts a range of political outcomes, including underdevelopment and government instability (*3*).

Vaccination is the most effective measure for preventing infection and transmittal of infectious disease (*4,5*). Yet even when vaccines are highly effective and widely available, most populations worldwide are underimmunized (*6*). For example, in the United States, although vaccination programs can reduce the incidence of influenza by up to 90% in healthy adults (*7*), estimated flu vaccination coverage for people aged 65 or more is only about 65%, and falls to 29% for adults aged 18-64 (*4*). Despite improvements in vaccine delivery, the number of US deaths attributed to the flu has climbed steadily since 1972, and if current low levels of vaccine coverage continue, the death toll from flu is projected to double during the next 25 years (*8*). Economic costs of flu infection will follow suit. Currently, direct annual costs of flu infection are conservatively estimated to be $31.9 billion (*9*), and indirect costs $5.4 billion (*2*) in the U.S.

An important cause of low immunization rates is incorrect beliefs about vaccines. Specifically, people sometimes believe that vaccines themselves induce the conditions they purport to prevent, or that vaccines will cause other health problems in the future, despite the fact that there is currently no scientific evidence for such adverse effects (*5,*

10, 11). Diverse sources of medical misinformation have been documented, including anti-vaccination websites (*12*), advertisements in medical journals (*13*), word of mouth and news media (*14*), and mistaken health care workers (*15*).

Among medical professionals, the near-universal response to medical misinformation is a call for educational measures that correct misconceptions. This recommendation assumes, quite reasonably, that false beliefs are best corrected through explicit disconfirmation of false information by a credible source. Published information generally follows this approach. Many government agencies, university hospitals, and other health care providers have consumer-friendly web sites with a wide range of educational information on health and medicine, including materials whose specific purpose is to correct false information. For example, a downloadable flyer on flu vaccine "facts and myths" is available from the US Centers for Disease Control and Prevention (CDC). The flyer lists some statements about the vaccine, identifies each as a "fact" or a "myth," and includes a short paragraph of additional information about each statement.

Memory for True and False Information

Such public education materials have been shown to increase people's familiarity with vaccine-related information (*16*), which presumably increases their likelihood of deciding to get vaccinated. But research on patterns of memory performance suggests exactly the opposite effect: attempts to warn people about false information can backfire and unintentionally increase people's acceptance of the false information as true (*17*). This "illusion of truth" for remembered information occurs because people are more likely to remember the gist of the statement than the details of its presentation context

(*18, 19*). For example, they may recall that they heard something about "the side effects of flu vaccination being worse than the flu" without remembering that this was presented as a myth and countered by some facts. Emerging evidence suggests a neuroanatomical link to this pattern of remembering, with different patterns of activation for core information's familiarity and its associated context across prefrontal, parietal, and temporal cortices and related structures such as hippocampus (*20, 21*).

When faced with this sort of incomplete memory, people show a marked tendency to think of recalled information as true (*17*). Hence, repeating misinformation in order to discredit it can enhance its perceived truth. To address the possibility that materials such as the CDC Facts & Myths flyer (*22*) could unintentionally foster belief in false information, we had undergraduate study participants read it, and then assessed their memory for the information and attitudes about the vaccine. The possibility that false information can be misremembered as true also raises the question of how best to correct misconceptions; one reasonable expectation is that it is better to emphasize true information rather than repeat false information. Accordingly, we had other participants read a version of the flu flyer that only presented the facts relevant to a "myth," without reiterating the false information. In both cases, participants' memory for the flyer information and attitudes toward the vaccine were measured either immediately after reading the flyer, or after a delay of half an hour (*23*).

Participants who read the CDC Facts and Myths flyer showed a clear tendency to misremember flu myths as flu facts, once half an hour had passed. Immediately after reading the flyer, participants made few mistakes in recalling whether a particular

statement from the flyer was described as a fact or myth, and there was no difference in the type of mistake. However, after half an hour, participants were much more likely to misremember a myth as a fact than to misremember a fact as a myth. Although they had successfully learned the information in the flyer, as shown by immediate memory, after a brief delay they were unable to recall whether some information was a fact or a myth; and appeared to resolve their uncertainty in favor of fact.

Figure 1 about here

Acceptance of the flu vaccine "myths" (e.g., "The side effects are worse than the flu") would presumably discourage people from getting vaccinated; realizing that the myths were false should encourage vaccination. To test this reasoning, participants answered questions about the vaccine and their own behavioral intentions immediately after the memory task; control participants, who did not read a flyer, answered these questions only. Without a delay, participants who read either the Facts & Myths or Facts Only flyer reported increased intentions to get vaccinated, relative to controls. After the half an hour delay, intentions were still increased for participants who read the Facts Only flyer, but *not* for participants who read the Facts & Myths flyer. In addition, the latter reported the lowest perceived personal risk for catching the flu of any group in the study, including those who read no flyer at all.

Figure 2 about here

There were no differences across groups in self-reported incidence of flu infection or receipt of the flu vaccine for the previous year.

Conclusions

An important public policy objective is to ensure that people make decisions about their health with reference to the most accurate current knowledge; this goal is particularly important when in the realm of infectious disease. The standard policy advice among medical professionals is to ensure that people get their medical information from credible sources, rather than questionable or discredited ones (*24,25*). We presented people with information from a highly credible source, which had the immediate effect of boosting intentions to vaccinate. However, after a delay, the Facts & Myths flyer left people mistakenly thinking that "myths" about the vaccine were true. After a brief delay the same flyer also reduced people's intentions to get a vaccine in the future, compared to people who read the Facts Only version of the flyer. In addition, the Facts & Myths flyer, after a delay, reduced perceived risk for catching the flu in the future. In short, the current findings suggest that damaging misinformation can be inadvertently supplied or reinforced by the very attempt to refute it.

Policy makers can avoid many of these problems by emphasizing what is true rather than what is false. The common "facts & myths" format, used in many public information campaigns, runs the risk of spreading misinformation in an attempt to discredit it. This undesirable side-effect is particularly pronounced for older people, due to age-related memory limitations (*17*). Accordingly, information campaigns should focus on the facts, avoiding any reiteration of the myths.

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Figure 1: **Memory for information in the flu Facts & Myths flyer, by delay condition.** Error bars represent standard errors.

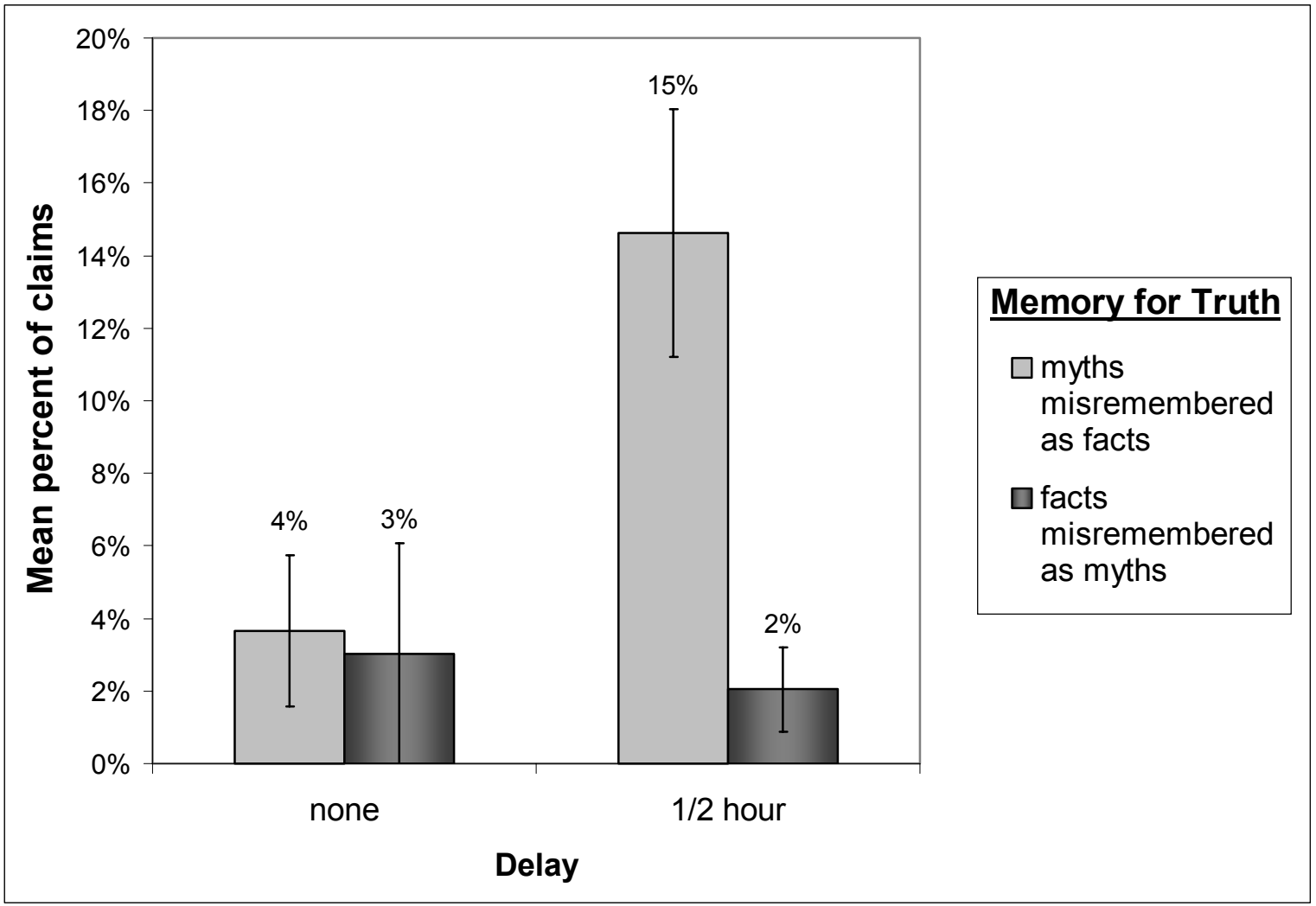
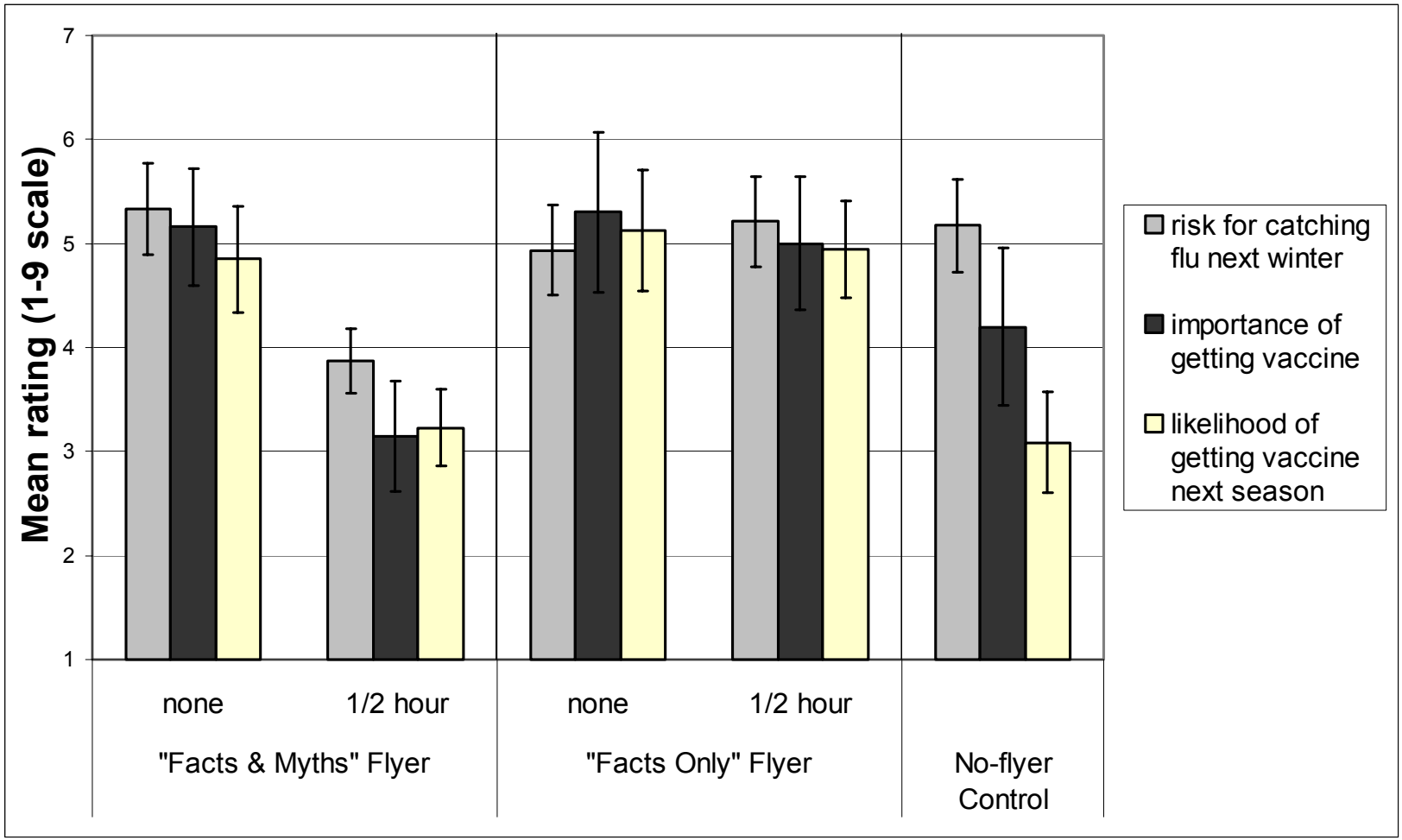


Figure 2: **Perceptions of flu and vaccine, by flyer and delay conditions.** Error bars represent standard errors.



Supporting Online Material

1. Materials and methods.

Design. Participants read one of two versions of a flyer about influenza vaccine, or were in a no-flyer control group; these groups defined three between-subjects conditions. The two flyers were: (a) a flu "Facts & Myths" flyer published by the CDC, and (b) a modified "Facts-only" version of the CDC flyer with the same information. Participants read a flyer (depending on condition), and then answered questions about the information in the flyer, and about their perceptions of the flu and their intentions to get the vaccine. Participants in the control condition answered the final perceptions-and-intentions questionnaire only.

Participants. One hundred eighty-seven younger adults (ages 18-26, $M = 22.6$) participated for partial course credit. Approximately half of the participants in each condition were students at the University of Toronto; the other half were students at the University of Michigan. Participants were run singly or in groups of up to five. All participants completed the procedure.

Materials. The Facts & Myths flyer is published by the CDC and is available for free on-line (as of June 21, 2005 at http://www.cdc.gov/flu/professionals/flugallery/images04_05/f_factmyth_pt.pdf). The flyer is listed under materials that physicians can download to educate patients, and lists three facts and three myths about the vaccine (e.g., "The side effects are worse than the flu"). Each statement was identified as a "fact" or "myth" in a space adjacent to each statement. Following each statement are between one and four sentences explaining each fact or myth (e.g., "The worst side effect you're likely

to get with injectable vaccine is a sore arm…"). In other words, the text explaining each fact or myth always presented factual information.

The "Facts-only" flyer was a slightly modified version of the CDC flyer and had identical format and layout. The words "and Myths" were deleted from the CDC flyer's title, and each myth was rephrased as a fact (e.g., for the example above, "Any side effects beat getting the flu"). Each statement was explicitly identified as a fact. No changes were needed for the explanatory sentences that followed each fact. (Please contact the authors for a copy of this version of the flyer.) All versions of the flyer were printed in color, and each participant received a new copy to read.

Procedure. In the flyer conditions, the procedure was divided into a study phase, where participants read the flyer, and a test phase, where they tried to remember the flyer information and reported their own perceptions about the vaccine and intentions to get vaccinated in the future. Depending on condition, the test phase took place immediately or 30 minutes after the study phase. At the study phase, participants read the flyer and rated it on six-point scales for legibility, ease of understanding, and appropriateness for the general public. Participants were given about five minutes to read the flyer.

At the test phase, participants read all six of the statements from the flyer, as well as six new statements about the flu that were not on the flyer (e.g., Flu vaccine does not last more than a year, Flu symptoms appear over a couple of days). For each statement, participants indicated whether they thought it had been described as true or false on the flyer, or "new" and not on the flyer. Next, participants answered a number of questions on nine-point scales, including: Do you feel that you personally will be at risk next winter

for catching the flu, How important do you feel it is for you personally to get a flu vaccine next winter, How likely are you to get a flu vaccine next winter, Did you catch the flu last winter, and Did you get a flu vaccine last winter. Participants in the control condition answered only this questionnaire. Finally, participants were debriefed and thanked for their participation.

2. Supporting text.

Results

Response Type. For participants in the Facts & Myths flyer condition, their memory for each statement's truth was coded according to their answers ("true," "false," or "new") and the claims' real status (true, false, or new). Once in a while, participants did not respond to a particular statement on this measure. Based on debriefing conversations, we interpreted this behavior as a lack of confidence on their part in their own memory for some statements. At most, 3% of any statement type were left blank in any condition. Nonetheless, we coded responses for each participant conditionalized on the number of responses given for that type of statement (e.g., "true" responses as a proportion of all true statements that the participant did not leave blank). See Table 1 for means of all response types for this measure.

Memory for the flyer. Most important from the present perspective are cases where participants realized that they had read a statement on the flyer, but wrongly remembered whether it was a fact or myth about the flu vaccine – that is, reporting myths as facts, or facts as myths. These response types are shown in bold type in Table 1. A pattern in these responses reveals a bias to call familiar information true. Specifically, a bias

toward truth would emerge in a greater likelihood of thinking that myths are facts than in thinking that facts are myths. Equal likelihoods of these two responses would mean that people are making mistakes, but that they are not favoring truth or falseness in their responses. Note that if participants did not remember seeing a statement on the flyer at all, they would have responded "new" to the statement. In addition, given a truth bias, participants could see a factual statement and correctly call it a fact either because of correct recollection of the statement from the flyer, or because of a guessing bias or inference that it must be factual if it seems familiar.

For analysis, these responses were calculated as proportions of statements that had been correctly identified as seen on the flyer. This method of scoring guards against a potential confound from differences in old-new memory for the statements across condition, and also creates a conservative test of any truth bias. These scores are reported in Figure 1 in the article body. A 2 (delay) X 2 (response type: "true" to false or "false" to true) mixed analysis of variance (ANOVA) on these responses yielded several effects. First, participants showed poorer memory for truth after ½ hour than after no delay, reflected in a marginally significant main effect of delay (*M* for no delay = .03 and for ½ hour delay = .09, $F(1,78)=3.86$, $p=.053$). Second, there was an overall "illusion of truth" effect or bias toward truth: misremembering facts as myths was much more likely than misremembering facts as myths (respective *M*s of .10 and .02, $F(1,78)=5.56$, $p=.02$). Both main effects were qualified by a significant interaction ($F(1,78)=4.72$, $p=.03$). All effects are due to an increase in remembering false information as true after ½ hour,

compared with remembering true information as false: respective *M*s of .15 and .02, 2-tailed $t(47)=3.33$, $p=.002$); there were no other differences.

Final flu questionnaire. The final questionnaire contained questions about perceived personal risks and intentions about the flu and getting vaccines, on 9-point scales coded so that higher numbers reflect greater perceived risk, greater intentions, etc. In addition, there were yes-no questions about whether participants caught the flu or got the vaccine in the prior year (see Table 2 for means). In order to take the control condition into account, answers to the scale response questions were submitted to a series of one-way ANOVAs with 5 conditions: the control condition and the four cells of the remaining factorial design. The first question asked about perceived personal risk for catching the flu next winter, and responses showed a significant main effect, $F(4,181)=2.52$, $p=.04$. A post-hoc LSD test revealed that the Facts & Myths – delay group mean was lower than all other means (all ps $< .05$), and that there were no other differences. An ANOVA for the second question, about perceived importance of getting the vaccine next winter, yielded a significant effect, $F(4,100)=2.48$, $p=.05$. The post-hoc LSD test showed that participants in the Facts & Myths – delay group rated the importance of getting the vaccine next winter lower than did any other group (all ps $< .05$), except the no-flyer control group, whose ratings did not differ from those of any group. The third question, about perceived likelihood of getting the vaccine next winter, also showed a significant effect in an ANOVA, $F(4,180)=4.57$, $p=.002$. The LSD test confirmed that both the Facts & Myths – delay group and the control group had lower intentions to get the vaccine next season than any other group (all ps $< .02$); no other differences approached significance.

Chi-square tests for differences across conditions on the final two questions (whether participants caught the flu or got the vaccine the previous winter) were not significant, all test statistics < 2, *n.s.* These questions were included as checks on randomization and responses were not expected to differ as a function of flyer condition. Condition was manipulated within experimental session for this research.

Overall, reading either version of the CDC flu flyer – the original Facts & Myths or the Facts-only version – had the intended effects immediately. Compared to the no-flyer control group, both flyer groups showed increased intentions to get a flu vaccine next winter. After ½ an hour, the Facts-only flyer left these intentions higher than controls, and as high as they were immediately after reading the flyer. However, after ½ an hour participants who read the Facts & Myths flyer began to misremember the flyer's "Myths" as "Facts." In addition, their intentions to get a vaccine dropped to the level of the control group, their perceived importance of the vaccine fell to the level of the control group, and their rated personal risk of catching the flu dropped below the level of all groups, including the control group. In sum, the Facts & Myths format increased intentions immediately, but had the opposite effect after ½ an hour – after this brief delay, reading the Facts & Myths flyer left participants worse off than they would have been had they not read any flyer at all. The Facts-only format of the flyer, which did not present any false information, boosted intentions and perceived risks even after the delay.

4. Supporting tables.

Table 1: Mean proportions of responses for each statement type at the test phase, Facts & Myths flyer condition.

		Delay between study and test phases					
		none			½ hour		
	On flyer as→	True	False	New	True	False	New
Reponse at test phase	"True"	.919	**.031**	.313	.818	**.133**	.201
	"False"	**.010**	.837	.068	**.020**	.720	.027
	"New"	.071	.133	.620	.162	.147	.772
		1.000	1.000	1.000	1.000	1.000	1.000

Table 2: Mean responses to the final questionnaire.

	Facts & Myths flyer		Facts only flyer		
Question	no delay	½ hr delay	no delay	½ hr delay	Control
Personal risk of catching flu next winter	5.3 (2.5)	3.9 (2.1)	4.9 (2.5)	5.2 (2.7)	5.2 (2.7)
Personal importance of getting vaccine next winter	5.2 (2.4)	3.1 (2.4)	5.3 (3.4)	5.0 (2.9)	4.2 (3.4)
Likely to get vaccine next winter	4.9 (2.9)	3.2 (2.5)	5.1 (3.3)	5.0 (2.9)	3.1 (2.8)
Caught flu last winter (%)	24	18	17	23	37
Got vaccine last winter (%)	18	18	27	21	22

Note: Questions 1-3 reflect a 9-point scale, with higher numbers indicating greater perceived risk, importance, or intentions. SDs in parentheses. Flu and vaccine history questions reflect the percent of participants answering in the affirmative.