The effect of health worry on processing of health information, behavioral intentions, and behavior

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Although correlational studies show a relationship between worry about health concerns and higher rates of self-protective behavior, there has been no experimental research supporting the relationship and little research on the mechanisms by which worry might lead to health behaviors. This study experimentally induced a state of worry about influenza in undergraduate college students (N = 165), and examined their intentions to get a flu shot, systematic processing of a message about influenza, and vaccination behavior. The study had four main findings. First, the worry induction was successful in inducing worry about influenza. Second, participants in the experimental (worry) group reported significantly greater intentions to get a flu shot when compared with the intentions of the control group. Group differences in vaccination behavior were in the predicted direction, but were not significant. Third, participants in the experimental group had significantly higher rates of systematic processing of the flu message. However, systematic processing did not mediate the relationship between worry about the flu and intention to get a flu shot. The results support the role of emotion in health behavior decisions and introduce an effective experimental technique for inducing worry about a health condition.

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INTRODUCTION

For most people, the experience of worrying about a health concern is unpleasant. Nevertheless, ruminating on a health threat and experiencing a sense of anxious apprehension could motivate self-protective health behaviors. Indeed, evidence suggests that worry does predict higher rates of preventative health behavior (Calnan, 1984; Harris, Fletcher, Gonzales, et al., 1991; Lerman, Kash, & Stefanek, 1994; McCaul & Mullens, 2003; Swanson, McIntosh, Power, & Dobson, 1996). Yet there has been very little research on how the experience of worry might lead to health-related behavior. Worry may function as a normal part of the problem-solving process, leading worriers to seek out and systematically process information about a health threat, therefore causing the worrier to engage in preventative health behaviors. The current study explored whether systematic processing is a mechanism that may explain the association between worry about a health topic and preventative health behaviors.

The experience of worry, or anxious apprehension, consists of a negative mood state in which the worrier cognitively focuses on a potential negative outcome or event. The experience can involve negative affect, arousal, and increased vigilance to threatening stimuli (Brown, O'Leary, & Barlow, 2001). This conceptualization of worry is consistent with the multi-response theory of emotion that suggests that emotion manifests itself in behavior, physiologic activity, and verbal-cognitive activity (Lang, 1968). Worry in a normal population is distinguished from worry in a clinical population in that pathologic worry is characterized by

excessive worry about a number of events or activities, and is accompanied by symptoms such as irritability, disturbed sleep, restlessness, and fatigue. Individuals who experience pathologic worry report subjective distress due to constant worry, have difficulty controlling the worry, and may experience social impairment (American Psychiatric Association [*DSM-IV-TR*], 2000). Worry in a normal population is generally confined to thoughts and feelings about a specific potential negative outcome, does not interfere with everyday life, and is not accompanied by physical or psychological symptoms.

In the health literature, health worry is conceptualized as a normal part of most people's lives, and is not considered to be pathological. Health worry is measured by asking questions such as, "How much do you worry about breast cancer," "How much do worries about breast cancer impact your mood?" "How anxious are you about getting breast cancer," and "How concerned are you about getting cancer?" If an individual is experiencing worry and anxious apprehension about a health threat, he may feel negative affect, ruminate about the threatening health condition and what might happen to him if he experiences it, and feel some arousal.

Worry is distinct from more cognitive constructs such as risk perception and perceived severity. Health worry has both cognitive and affective components, whereas measures of risk perception and perceived severity are primarily cognitive. Research has shown only a modest correlation between worry and perceived risk (0.2-0.4; Dolcini, Catania, Choi, Fullilove, & Coastes, 1996; Sjoberg, 1998; Webb, Friedman, Bruce, Weinberg, & Cooper, 1996), and recent studies have shown health worry to be a better predictor of behavior than perceived severity and perceived risk (Chapman & Coups, 2006; Weinstein, Kwitel, McCaul, Magnan, Gerrard, & Gibbons, 2007).

The experience of worry is different from the anxiety experienced by fearful or panicked individuals (Heller, Nitschke, Etieene, & Miller, 1997a; Heller & Nitschke, 1998). Worry seems to be a primarily verbal-linguistic type of anxiety associated with muscle tension, whereas panic and fear are characterized by symptoms such as shortness of breath, pounding heart, dizziness, and sweating (Heller et al., 1997a). Neuropsychological research supports the distinction between the two types of anxiety, showing that a group of chronic worriers (measured by the Penn State Worry Questionnaire; Meyer, Miller, Metzger, & Borkovec, 1990) differed in hemispheric asymmetry from a group of people whose anxiety was more characterized by anxious arousal and panic (as measured by the Anxious Arousal scale of the MASQ; Watson & Clark, 1991; Nitschke, Heller, Palmieri, & Miller, 1999). It is possible that fear and panic are simply more severe forms of anxiety than the anxiety characterized by anxious apprehension and worry. Because people are more likely to experience anxious apprehension and worry than panic when they feel anxious about a potential health threat, it makes sense to study if and how the specific anxious experience of worry might influence health behavior.

One explanation might be that worry leads to active coping behaviors. Given that coping is widely viewed as a response to emotion (Folkman & Lazarus, 1988), worry and anxiety can certainly evoke coping behaviors. According to coping theory, distress can lead to problem-focused coping or emotion-focused coping (Lazarus & Folkman, 1984). If people are distressed by worries about a potential health threat, then they might engage in problem-focused coping by seeking out information or taking action to control the health threat. Emotion-focused coping occurs when people feel that nothing can be done about a threat, and may be less likely to occur in response to preventable health threats. However, there has been little research in the coping literature on how the specific experience of having worries about a health threat might lead to

specific coping behaviors such as engaging in preventative health behaviors or systematically processing worry-related information. One of the aims of this study is to examine how the experience of worry might lead to preventative health behaviors.

Worry and health behaviors

Most research on worry in health psychology has focused on cancer worry and the role that it may play in individuals' decisions to get mammograms or colonoscopies (Hay et al., 2005; McCaul & Mullens, 2003). Does cancer worry lead to increases in screening behavior (with worry and anxiety as motivating factors) or does it lead to decreases in screening, as people might be so distressed about the possibility of getting a positive test result that they would avoid getting screened?

The first research to examine worry and anxiety in a health context focused on the emotional consequences of worry about a medical procedure. Early research on the "work of worrying" found a curvilinear relationship between reported worry about a medical procedure and emotional disturbance after the procedure (Janis, 1958). In this retrospective study, Janis asked 149 male college students who had recently had a medical or dental procedure (i.e., hernia repair, tooth extraction) to recall how worried or anxious they felt prior to undergoing the medical procedure. The students also recalled how anxious, "emotionally disturbed," and angry they felt in the days after the surgery. The researcher found a curvilinear relationship between the variables such that those students who reported that they felt low or high levels of worry and anxiety prior to surgery also reported having had high levels of anxiety, emotional disturbance, and anger after the surgery. Students who reported having had moderate levels of worry and anxiety prior to surgery reported the best postoperative adjustment (Janis, 1958). Janis hypothesized that the moderately anxious students performed the "work of worrying" and

prepared themselves more effectively for the approaching stressor (surgery) than the students who reported low levels of preoperative anxiety.

Unfortunately, Janis's theory positing a curvilinear relationship between preoperative anxiety and postoperative adjustment has not been supported by subsequent research. Several studies using prospective methods, broader samples, and varied outcome measures have instead found a small but significant linear relationship between preoperative anxiety and postoperative adjustment such that lower levels of worry and anxiety before surgery leads to lower anxiety and better adjustment post-surgery, and higher worry and anxiety before surgery leads to higher anxiety and poorer adjustment post-surgery. Researchers have not been able to replicate Janis's curvilinear finding (Anderson & Masur, 1983; Auerbach, 1973; Cohen & Lazarus, 1973; Johnston & Carpenter, 1980).

Although this more recent research on preoperative worry and postoperative adjustment shows that high levels of worry and anxiety predict poorer postoperative adjustment, the findings do not necessarily suggest that worry and anxiety about a health concern will lead to lower levels of preventative health behaviors. Yet there is indeed evidence that high levels of worry and anxiety after medical screening procedures predict intentions to get screened again in the future. A breast cancer study found that women who felt highly worried and anxious after a negative mammogram were more likely to plan to get a mammogram in the future (Lerman, Trock, Rimer, Boyce, Jepson, & Engstrom, 1991a).

Most prospective studies on health worry and anxiety show a positive linear relationship between breast cancer worry and mammography or breast self-exam rates (Calnan, 1984; Harris et al., 1991; Lerman et al., 1994; McCaul & Mullens, 2003; Swansonet al., 1996). Women who report higher levels of worry and anxiety about breast cancer are more likely to get screened for

breast cancer. For example, in one study, researchers surveyed 353 women and asked them how much they worried about breast cancer, how often they worried about breast cancer, and whether breast cancer made them feel upset and frightened. The investigators followed the women over the next year, and found positive linear relationships between the measures of worry and anxiety about breast cancer and rates of mammograms, breast-self exams, and clinical examination (McCaul, Schroeder, & Reid, 1996b).

It thus seems that the more women worry about breast cancer, the more likely they are to get a mammogram or perform breast self-exam. The only research that has found a negative relationship between distress and behavior measured cancer-specific distress through two subscales: intrusion (involuntary thoughts and emotions about cancer) and avoidance (conscious attempts to divert attention away from thoughts and feelings about cancer; Horowitz, Hulley, & Alvarez, 1979). However, these subscales may be measuring avoidant coping, rather than measuring the experience of worry and anxious apprehension. The subscales are different from the face-valid measures that have been used to measure worry and anxiety in studies showing a positive relationship between worry and behavior (e.g., 'How much do you worry about getting breast cancer someday,' and 'How much do worries about breast cancer impact your mood'; Lerman, Trock, Rimer, Jepson, Brody, & Boyce, 1991b). When the two cancer distress measures were used in the same study, the face-valid questions predicted higher mammography rates, whereas scores on the intrusion/avoidance scales predicted lower mammography rates (Hay et al., 2005; Lerman et al., 1994). Although it does seem clear that reported health worry is associated with higher rates of preventative health behaviors, there has been no research that induces a state of worry about a specific health threat to see how that state affects health behaviors. One of the aims of the current study was to induce a state of worry about a specific

health threat, and to measure whether that worried state would make individuals more likely to intend to engage in a preventative health behavior.

Although a great deal of the research on health worry and anxiety measures actual behaviors (i.e. mammography behavior, breast-self-exam rates), some research instead measures intentions to engage in a behavior (Lerman et al., 1991a). According to the theory of planned behavior, intention to perform a volitional behavior is an important and significant predictor of actual behavior (Ajzen, 1991). The theory also incorporates perceived behavioral control, a construct that is very similar to self-efficacy (Bandura, 1977). Perceived behavioral control is thought to influence intentions as well as directly impact behavior. A review of studies testing the theory of planned behavior found significant correlations predicting behavior from both intentions and perceived behavioral control (r = .20 to .78, average of .51; Ajzen, 1991; Eagly & Chaiken, 1993). Thus it seems reasonable to use intention as an outcome measure. Also, given the importance of perceived control/self-efficacy in predicting behavioral intentions, it seems important to study a highly controllable behavior. The current study uses flu vaccination as the target behavior, and provides participants with information on how to get a flu shot in order to control for any effects that perceived control and self-efficacy might have on intentions to get vaccinated. Although research on health worry has focused on worry and anxiety about cancer, the findings from cancer worry research are relevant to other diseases such as influenza. For example, recent research on health worry focused on worry about influenza and found that worry predicted influenza vaccination (Chapman & Coups, 2006).

There has been very little research done to identify the mechanisms that underlie the relationship between the experience of worry about an illness and subsequent health behaviors. One possible mechanism is that the experience of anxious apprehension acts as part of the

problem-solving process, leads worriers to seek out and systematically process information about a health threat, and therefore causes the worrier to engage in preventative health behaviors.

Worry as problem-solving

Worry may be related to adaptive problem-focused coping strategies and an information-seeking cognitive style (Davey, 1994; Davey et al., 1992; Tallis et al., 1994). Worry can be viewed as a constructive, task-oriented activity that leads an individual to engage in active problem-solving. A self-report survey of 128 non-anxious individuals found that 46% of those surveyed reported that worry was an attempt to problem-solve and 83% reported that worrying "sometimes," or "definitely" resulted in a reasonable solution to a recognized problem (Talis et al., 1994). A factor analysis of a related 50-item Likert scale questionnaire on helpful aspects of worry resulted in a two-factor solution. "Motivation" accounted for 43% of the variance, with discriminatory items such as "Worrying acts as a stimulant," and "In order to get something done I have to worry about it." "Preparatory and analytic thinking" accounted for 7% of the variance, with discriminatory items such as "Worrying gives me the opportunity to analyze situations and work out the pros and cons" (Talis et al., 1994). These data come from individuals who are self-reporting their views of how worry functions in their own lives. There has been no objective research examining whether worry is related to active problem-solving, and so the connection between worry and active problem solving should be interpreted cautiously.

The relationship of worry to active problem-solving can be explained by the effect that the cognitive and affective components of worry have on the first step in active problem-solving. According to Barlow (1988), worry is a future-oriented mood state associated with negative affect and attentional focus on threat-related stimuli. So both cognition and affect are influenced during a worried state. The repetitive thoughts and negative emotions that people experience

while worrying may shape the decision-making process and may increase effortful, detail-oriented, analytical information processing, which is called *systematic processing*. Characterized by bottom-up, data-driven processing, systematic processing involves thinking deeply about information, examining the background causes or reasoning of an argument, and carefully forming attitudes based on information (Schwartz, 1990). When people systematically process a persuasive message, they are more influenced by the message's content than if they had processed the information in a more heuristic, or superficial, manner (Bless & Schwarz, 1999; Eagly & Chaiken, 1993; Petty & Cacioppo, 1990). The influence of the cognitive and affective processes that are part of the worry experience on systematic processing might explain the association between worry and active problem-solving.

The cognitive aspect of anxious apprehension and worry may increase systematic processing by priming the individual to be vigilant for potentially helpful information. Worried cognitions might also change a worried person's attentional focus. The alcohol myopia theory provides an analogous example of how worry might function to narrow and focus a worried person's attention. Although the theory does not suggest that alcohol improves systematic processing, it does suggest that alcohol inhibits cognitive processing and leads intoxicated individuals to focus on the most salient aspects of their environment (Steele, Critchlow, & Liu, 1985; Steele & Josephs, 1990; Steele & Southwick, 1985). Similarly, worry may act to direct worried individuals' cognitive processing, thus leading them to focus on aspects of their environment most salient to the worry topic. In the case of worry, this might then lead to increased systematic processing of worry-related material among worried people.

The negative mood state that characterizes the experience of anxious apprehension might also contribute to the problem-solving nature of worry. Affect has a strong effect on people's

decisions. The risk-as-feelings hypothesis suggests that when faced with a decision about the risks of an emotionally-laden topic such as nuclear waste or cancer, people tend to make decisions based on their current emotional state rather than on rational cognitive evaluations (Loewenstein, Weber, Hsee, & Welch, 2001). When people make decisions that involve risk to themselves, they tend to use emotion such as anxiety to guide their decisions. They may be more rational when the decision does not entail risk to themselves, but rather risk to another person. For example, in a study on decision-making, experimenters asked people high in trait anxiety to choose between a series of high risk and low risk options, with the high risk option being more rational. They found that found that although the participants were more likely to choose the low risk option for themselves, they made more rational decisions (choosing the high risk option more frequently) when making decisions on behalf of another person (Eisenberg, Baron, & Seligman, 1995). Research on the affect heuristic also stresses the importance of emotion in decision making and suggests that affect acts as a cue or mental shortcut that people use to guide their judgments or decisions (Slovic, Peters, Finucane, & MacGregor, 2005). Perhaps the affective component of worry and anxious apprehension acts as a cue that alerts the worrier to emotionally salient aspects of the environment such as information about the worry topic.

The emotional discomfort and mild anxiety that accompany worry might motivate people to engage in problem solving or seek out information as a way of reducing their discomfort. Research has shown that negative affect seems to alert people that a problem exists and then prompts a narrowing of attentional focus and leads to systematic rather than heuristic processing (Broadbent, 1971; Bruner, Matter, & Papanek, 1955). Perhaps the negative emotions that accompany worry lead worried people to focus their attention on worry-related material and to process the material in a more systematic manner.

Although both emotion and cognition are clearly important in individuals' information-seeking and processing, decision-making, and attentional focus, there has been very little research that specifically examines how a state of worry influences information processing. Davey (1994) proposed that worry can act as a constructive problem-solving activity, and supported his theory with evidence from correlational studies, but he did not look at what happens to problem-solving when worry is experimentally manipulated. Work in the fear appeals literature examines emotional responses (i.e., fear arousal, worry, emotion-controlling reactions) and cognitive responses (i.e., defensive processing, threat perception) to frightening health messages (Ruiter et al., 2001), but does not look specifically at how worried people process information. Fear appeals researchers are interested in how people react to and process a scary health message after viewing the message, whereas the current study focuses on how people process information while in a specific state of worry. In the current study, participants were already in a state of worry when they were presented with health information, rather than being presented with the information first, as in fear appeals experiments. This study is designed to separate out the emotional and informational components of a health message.

In addition, the experience of worry may be more similar to the anticipation of regret than the feeling of fear. Anticipation of regret is generally measured by asking participants to respond to items such as "If I don't get a flu shot and end up getting the flu, I'd be mad at myself for not getting the shot." Anticipated regret parallels the cognitive focus on possible negative outcomes. Two recent studies on the role of anticipated regret in influenza vaccination both found that anticipated regret was more predictive of vaccination than perceived risk of getting the flu (Chapman & Coups, 2006; Weinstein, Kwitel, McCaul, Magnan, Gerrard, & Gibbons, 2007). Another study found that participants who responded to a question that required them to

anticipate the amount of regret that they would feel were more likely than a control group to report intention to exercise (Abraham & Sheeran, 2004). The worry that participants in the experimental group experienced in the current study may be somewhat similar to anticipated regret in that participants were asked to think about the consequences of getting the flu. However, the previous research on anticipated regret has been correlational or has induced a feeling of anticipated regret with a single questionnaire item. The current study builds on the anticipated regret literature by experimentally inducing an active state of worry rather than looking only at correlational relationships. The experimental nature of the current study will enable a more causal understanding of the effect of an affective and cognitive focus on a health threat.

Worry induction

The current study included a worry induction designed to induce worried cognitions about influenza. Several studies have used procedures designed to induce a worried state. Lang, Levin, Miller, & Kozak (1983) had phobic participants listen to an imagery script describing fearful situations as part of a methodology designed to induce an emotion prototype, or intense emotional state of fear and stress characterized by high coherence among behavior, physiologic activity, and verbal-cognitive activity. Although the emotion prototype identified by Lang is more like fear and panic than anxious arousal and worry, his methodology is very similar to several other studies that were designed to induce a specific worried and anxious cognitive state. Lang's methodology is aimed at inducing a general severe panic and fear experience, whereas the following methods aim at inducing a specific experience of worry.

One study simply asked participants to worry for 10 minutes about a specific topic of personal concern (Carter, Johnson, & Borkovec, 1986). In another study (Borkovec & Hu,

1990), speech-phobic students selected 10 sentences from a list of 22 that characterized worrying about giving a public speech and read the sentences into a tape recorder. A second group of speech-phobic students read and recorded statements about a neutral activity, and a third group read and recorded statements that characterized common ways of relaxing. All participants then read a paragraph about giving a speech, listened to their own tape-recorded voices, and then were asked to visualize the speech scene. This was repeated 10 times, and then participants reported fear ratings.

In a third study, investigators taught participants the difference between imagery and worry, had them practice worrying about an area of concern, then later instructed them to worry about their greatest concern using only thoughts or words (Lyonsfields, Borkovec, & Thayer, 1995). In a fourth study, investigators played a 50-second tape recording of ruminative negative self-statements about public speaking to participants and then asked them to spend 30 seconds thinking about the statements. The outcome variable was distress (Hofman, Moscovitch, Litz, Kim, Davis, & Pizzagalli, 2005). In the last study, researchers asked participants to watch an 8-minute video of an industrial accident and then asked them to worry in verbal form about what they saw in the film. A second group was asked to either imagine in pictorial form the gruesome images they had seen and a third group was asked to settle down for a few minutes. The researchers counted the number of intrusive images experienced by participants in each group over the next week (Butler, Wells, & Dewick,1995).

Hypotheses

The current study explored a possible mechanism that may explain the association between worry about a health topic and preventative health behaviors. Worry was experimentally manipulated in order to explore the processes that occur during a worry episode

that might promote health behaviors. Specifically, the hypothesis was that experiencing worried cognitions about a potential health threat will lead to increased systematic processing of threat-related, non-frightening information. A second hypothesis was that experiencing worried cognitions about a potential health threat will lead to increased intentions to engage in preventative health behaviors. A third hypothesis was that systematic processing would mediate the relationship between worry and health behavior such that increased levels of systematic processing will lead to increased intentions. Although the study was not powered to identify differences in behavior, an additional exploratory hypothesis was that experiencing worried cognitions about influenza will lead to increased rates of actual flu vaccination.

METHODS

Overview

The experiment began with an induction of worried cognition about influenza, after which participants read an essay about the influenza vaccine. Participants' retention and processing of the information in the essay was then measured, and participants completed measures of worry about influenza and intention to get a flu shot. After the study was completed, participants were contacted in January and February and asked to report whether or not they received a flu vaccination.

Participants

The sample was composed of 165 University of Pittsburgh undergraduates fulfilling a research requirement for their introductory psychology course. Follow-up influenza vaccination data were collected from 127 participants (77%). Mean age was 18.5 years (SD = 1.22), 61.8% were female, and 81.2% were White. Students who already had received the season's flu shot before the study began were not eligible to participate. Individuals who could not get a flu shot for any reason (e.g., egg allergies, religious objections) were also not eligible to participate.

Procedure

Prior to their arrival at the lab, participants were randomly assigned to the experimental group or control group. Participants completed the study individually. Upon arrival, they completed an informed consent form and were told that the purpose of the study was to find out

more about how thinking about a specific experience affects thoughts about health. Members of both groups then completed a questionnaire that included a four-item baseline measure of worry and anxiety about getting the flu ("How worried are you about getting the flu?" "How anxious are you about getting the flu?" "How fearful are you about getting the flu? "How concerned are you about getting the flu"; 1 = not at all, 7 = extremely) as well as several questionnaires on other topics in order to avoid highlighting the relevance of worry. These items were based on similar items that have been used in previous research on health worry (Chapman & Coups, 2006; Lerman et al., 1991b; McCaul et al., 1996b).

Next, the experimental group experienced the worry induction, whereas the control group experienced an induction designed to elicit neutral thoughts and emotions. The current study used a worry induction based on the experimental procedure used by Hofmann et al. (2005) because of its large effect size (r = .65). Both the worry and the neutral inductions consisted of a 30-second resting period, a 50-second listening period, and a 20-second period of either worrying or experiencing neutral thoughts and emotions. The 20-second period was shortened from 30-seconds because early testing suggested that participants became distracted after more than 20 seconds. During the listening period, the worry group listened to a recording of the following script:

> You've come down with the flu right before finals. You feel tired and feverish, and your body aches all over. You can't get out of bed and you can't concentrate and study for your finals. You have a terrible headache. You think about what will happen if you can't make it to your finals, and you feel overwhelmed by negative thoughts about getting bad grades in your courses. Your eyes feel hot and painful and you have chills.

You feel achy and tired but you can't sleep and can't concentrate on anything. You feel miserable. Please think about this experience now.

The control group listened to a recording of the following script:

You've run out of bath soap right before finals. You walk to the grocery store to pick some up. As you walk through the entrance of the store, you notice the comfortable temperature inside. You walk to the soap and shampoo aisle and notice the many types of soap on the shelf. You can smell the soap. You think about what it will be like to use the soap later. You select several bars of soap and walk to the front of the store. You pull out your wallet, count out the correct amount of money, and pay for the soap. Please think about this experience now.

Participants spent 20 seconds thinking about the above experiences. As a manipulation check, participants then filled out a brief questionnaire to assess their level of worry about the flu. The questionnaire included a single item measure of flu worry ("How worried do you feel about getting the flu? please mark an X along the line"; scale ranged from *not worried* to *very worried)*, a single item measure of intention to get a flu shot ("How likely is it that you will get a flu shot this Fall? please mark an X along the line"; scale ranged from *not at all* to *definitely plan to do so*) and several distracter questions ("How often do you exercise" and "How often do you consume dairy products?"). Similar items have been used in previous research on health intentions (Chapman & Coups, 2006; Harris et al., 1991; Sutton & Eiser, 1990).

Next, both groups read a 1.5-page single spaced essay about flu vaccination. The essay included information on the history of the flu and flu shot as well as information on how students can get a flu shot at the University of Pittsburgh (e.g. "Dr. Jonas Salk and Dr. Thomas Francis first developed the influenza vaccine for the U.S. Army." "The University provides flu

vaccinations at $18 per shot."). The essay did not include frightening information about the flu (i.e., listing complications or mortality rates) but was a more accessible, informational message about influenza and flu vaccination (see Appendix A). The essay was written to resemble an article that one might find in a newspaper or magazine, and thus was a realistic simulation of what a person who is worried about the flu might read in a natural setting. The essay was pre-tested and found to be clear and grade-appropriate. Participants then spent 8-10 minutes completing distracter questionnaires. Both groups were then asked to recall facts from the flu vaccination essay. Lastly, participants completed a brief questionnaire that included a question about intentions to get a flu shot ("To what extent do you plan to get a flu shot this Fall?"; 1 = not at all, 7 = definitely plan to do so), another measure of worry and anxiety about the flu, demographic information, and measures of prior flu shot behavior.

Retention of information from the flu essay was measured with a free recall test. Participants wrote a response to the statement "Try to recall and write down as much information as you can from the essay that you read earlier." Because individuals who systematically process information are better able to remember the information (Thompson-Schill & Gabrieli, 1999) and focus more on the message content than on peripheral aspects of the message (Chaiken, 1980), responses were coded by first counting the total number of facts recalled from the passage. Each fact was then categorized by content (important or trivial), and accuracy (accurate, partially accurate, inaccurate). To measure how much effort participants put into recalling the essay, the number of words in each participants' response was counted. To measure how well participants paid attention and focused on the message, each written response was coded by overall level of detail (1 = vague, 5 = detailed) and by how closely the order of the

participants' listing of facts matched the original order of the essay (1 = low match, 5 = high match).

The essay and recall task were pre-tested to ensure that there was enough variability in participants' responses. A similar free recall task has been used in previous research to successfully measure systematic processing of information (Isbell, 2004; Martin & Marrington, 2005; Martin, Laing, Martin, & Mitchell, 2005; Reed & Aspinwall, 1998). Because counting the total number of words and total number of facts in each participant's response was an objective task, the counting was done by a single coder. Two coders categorized and coded each fact on the other dimensions and the codes were compared to measure reliability.

RESULTS

Sample

The experimental and control conditions did not differ significantly on age, gender, ethnicity, or rates of previous flu vaccination (*p*s > .20). However, there was a significant difference in reported levels of flu worry between groups at the start of the experiment (experimental: $M = 2.90$, $SD = 1.31$; control: $M = 2.50$, $SD = 1.30$; $t(163) = 2.10$, $p < .05$.) Therefore, baseline flu worry was controlled for in all subsequent analyses.

Flu worry induction

Worry about the flu was measured using both a composite of four measures and a face-valid single item measure. The single item measure was used immediately following the experimental induction (T2) to avoid priming participants about the purpose of the induction. Participants responded to the four flu worry questions at the very start of the study (T1) and at the end of the study (T3). The four variables were later combined into the single composite variable ($\alpha = .91$).[1]

To assess the strength of the manipulation, a mixed-model repeated measures ANOVA was conducted to determine whether participants in the experimental group changed their level of flu worry from T1 to T2. The ANOVA showed main effects of Time, $F(1,163) = 48.30$, $p < .001$, Condition $F(1,163) = 38.29$, $p < .001$, and an interaction between Time and Condition $F(1,163) = 67.12$, $p < .001$). As predicted, participants in the experimental group did show a

significant increase in their level of flu worry from T1 to T2 (*M*s = 2.91 and 4.19; $t(81) = 15.24$, $p < .001$), whereas participants in the control condition showed no change (*M*s = 2.49 and 2.38; $t(80) = 1.06$, n.s). Thus, the manipulation was successful. The level of flu worry in the experimental group remained significantly elevated through the end of the study (T3) when compared with flu worry at T1 (T1: $M = 2.91$, T3: $M = 3.45$; $t(81) = 7.29$, $p < .001$). The level of flu worry in the control group at T3 was also significantly elevated relative to T1 worry (T1: $M = 2.49$, T3: $M = 2.69$; $t(80) = 2.60$, $p < .05$), however the level of flu worry at T3 in the experimental group was significantly higher than the level of flu worry at T3 in the control group ($t(163) = 3.91$, $p < .001$).

Intention outcomes

Intention to get a flu shot was measured twice in the study: immediately after the manipulation ("How likely is it that you will get a flu shot this Fall?") and at the end of the study following the opportunity to read the flu message ("To what extent do you plan to get a flu shot this Fall?"). To assess the effect of the manipulation on intentions to get a flu shot, an ANCOVA was conducted to determine whether participants in the experimental condition showed greater intentions than participants in the control condition. Because the intention measures were highly correlated ($r = .81$) and because analyses showed that there was no differential change by condition in intention over time (as will be explained later when discussing systematic processing), the two items were summed and used as a single measure. As predicted, after controlling for initial flu worry, the experimental group showed greater intentions to get a flu shot ($M = 8.00$, $SD = 3.90$) than the control group ($M = 6.76$, $SD = 3.64$). The difference was significant ($F(1, 162) = 4.93$, $p < .05$).

To test whether the effect of experimental condition on flu shot intentions was mediated by reported worry about the flu (T2), a mediational analysis was conducted. In their comparison of methods of assessing mediation effects, MacKinnon, Lockwood, Hoffman, West, and Sheets (2002), found the Sobel test (Sobel, 1982) and its variants to result in the most accurate Type I error rates and to have greater power than the Baron and Kenney method to detect small and medium effect sizes. Therefore, the Sobel test (1982) was used to assess the indirect effect of condition on intentions through reported worry. A Statistical Package for the Social Sciences (SPSS; SPSS Inc., Chicago, Illinois) macro developed by Preacher and Hayes (2004) was used to test whether the indirect effect of condition on intention through worry was significantly different from zero. The macro tests the indirect effect using the Sobel test (1982), by determining whether there is a significant difference between the total effect (condition predicting intention) and the direct effect (condition predicting intention with the mediator [worry] in the equation). The indirect effect of the mediator (worry) is the difference between the total effect and the direct effect. The indirect effect was significant (β = -2.45, 95% CI = -3.36, -1.53, $p < .001$), suggesting that reported worry after experiencing the manipulation completely mediated the effect of condition on flu shot intentions.[2] The indirect and mediational effects remained significant after controlling for baseline level of flu worry.[3]

Behavioral outcomes

When students who participated in the follow-up portion of the study (N = 127) were compared with students who did not participate in the follow-up (N = 38), no significant differences were found for condition, age, gender, or previous flu vaccination behavior. There was a significant difference between the groups on ethnicity, with African-American students less likely to be in the follow-up group ($t(161) = -2.29$, $p < .05$).

Of those who participated in the follow-up portion of the study in which they reported their flu vaccination status (N = 127), 28 reported having received a flu shot during the fall semester. Seventeen of 64 students in the experimental group received a flu shot (27%), compared with 11 of 63 students in the control group (17%). A logistic regression analysis showed that this difference, which was in the predicted direction, was not significant, β = .50, Wald = 1.28, p= .26.

To assess how well intentions predicted actual flu shot behavior, logistic regression was conducted with the combined intention variable as a predictor, controlling for initial flu shot worry and experimental condition. Intention to get a flu shot did significantly predict actual flu shot behavior, β = -.42, Wald = 25.00, p < .001. Given the significant effect of worry on intentions, the strong relationship between intentions and behavior, and the direction of the difference between conditions in actual vaccination rates, it appears that the study was simply under-powered to detect significant differences in behavior.

Systematic processing of essay

The number of facts participants recalled from the essay and the number of words written during the recall task did not differ between groups (t(157) = .55, n.s., t(157) = 1.02, n.s., respectively; see Table 1 for descriptive statistics), suggesting that the experimental and control groups spent equal amounts of time and effort processing the essay.[3] Experimental and control participants also did not differ in the level of detail of recalled facts and degree to which recalled facts matched the order in which they appeared in the original essay (t (157) = .73, n.s., t(157) = 1.34, n.s.), further suggesting that the groups focused on the essay to the same extent. The level of detail and order match variables showed high inter-coder reliability (α = .92, α = .94, respectively).

The systematic processing variable was computed by dividing the number of accurate facts participants remembered about influenza by the total number of facts that they remembered from the essay. The number of accurate flu facts was counted by two coders with high inter-coder reliability ($\alpha = .89$).

To test the hypothesis that participants in the worry condition would show increased systematic processing of the flu essay, an ANCOVA was conducted with proportion of accurate flu facts recalled as the dependent variable, Condition as the independent variable, and initial flu worry as a covariate. As predicted, participants in the experimental group had higher proportions of accurate flu facts recalled ($M = .40$, $SD = .15$) than the control group ($M = .33$, $SD = .14$). This difference was significant ($F(1,158) = 6.89$, $p = .01$).

To begin to test the hypothesis that systematic processing of flu information would mediate the relationship between flu worry and behavioral intentions, the change in behavioral intentions was examined from Time 1 (immediately after the manipulation, prior to reading the essay) to Time 2 (after participants read the essay) to examine whether the experimental group showed a greater increase in intentions after reading the essay than did the control group.

A mixed model repeated measures ANOVA revealed a main effect of Condition $F(1, 162) = 4.93$, $p < .05$. However, contrary to predictions, the main effect of Time was not significant, $F(1,162) = .93$, n.s., nor was the interaction between Time and Condition, $F(1,162) = 1.57$, n.s. Participants in the worry group reported significantly higher intentions than participants in the control group at both Time 1 and Time 2, but the groups' intentions did not change differentially. Because there was no differential change in intentions between groups from Time 1 to Time 2, a mediational analysis directly testing the hypothesis that systematic processing of flu information would mediate the relationship between flu worry and behavioral

intentions was not conducted. Evidently, the worry manipulation had independent effects on message processing and intentions.[4]

DISCUSSION

The results of the current study provide experimental support for recent evidence showing that health worry leads to an increase in behavioral intentions and preventative health behavior. The worry induction was shown to successfully induce a state of worry about the flu. Participants in the worry condition were significantly more likely to intend to get a flu vaccination, and their reported worry following the induction completely mediated the relationship between condition and intentions. Although condition did not significantly predict actual flu shot behavior, the difference between the groups was in the predicted direction, and the study was probably under-powered to detect significant differences in behavior. Participants' systematic processing of the flu message was assessed by creating a proportion of the number of recalled accurate facts about the flu to the total number of recalled flu facts. Participants in the worry condition showed significantly higher rates of systematic processing of the flu essay, findings that are consistent with work suggesting that negative affect leads to increased systematic processing. However, the results did not support the mediational role that systematic processing was proposed to play in explaining the effect that worry has on behavioral intentions.

Worry, intentions, and health behavior

The results of the current study support the hypothesis that induced worry about influenza will lead to increased intentions to get a flu vaccination. The findings are consistent with previous work on worry and health behavior that shows a positive relationship between

worry about a health concern and preventative health behavior intentions, screening behavior, and vaccination behavior (Chapman & Coups, 2006; McCaul & Mullens, 2003; Weinstein et al., 2007). The finding that worry led to increased intentions even before participants read the flu essay is consistent with the affect heuristic (Slovic et al., 2005) and the risk-as-feelings hypothesis (Loewenstein et al., 2001) that emotional reactions to risk situations, more so than rational cognitive evaluations, often drive behavior.

Previous work has demonstrated a relationship between worry and health behavior using correlational data, but the current study provides the first experimental evidence that manipulating health worry can lead to increased intentions to engage in preventative health behavior. Although the study was underpowered to detect differences in actual behavior, the direction of the results suggests that the worry manipulation may also have affected actual rates of flu vaccination.

It would be worth examining how the observed relationship between manipulated worry and health intentions might generalize to other health behaviors. Flu vaccination is an easy, highly controllable, infrequent behavior with a clear purpose and outcome. Behaviors that have a range of consequences, such as exercise or diet, might not be as affected by a worried state, because the relationship between a specific worry (i.e. heart disease or diabetes) and a preventative behavior may not seem as clear to an individual as the relationship between worry about contracting an infectious virus and a vaccination. In addition, behaviors such as exercise and diet are chronic, daily behaviors, whereas individuals make a flu vaccination decision only once per year. A single worry induction, such as the one used in this study, might be more likely to influence a behavior that requires only one decision, and may be weaker with behaviors that require daily commitment.

Cancer screening behavior decisions are similar to vaccination decisions in that they are controllable and usually made infrequently. A single worry induction may affect cancer screening intentions and behaviors. However, flu vaccination prevents a disease, whereas screening merely detects disease, and the worry manipulation may need to focus more on worry about not detecting a disease rather than on the consequences of the disease itself (as was the current manipulation's focus). It is possible that inducing worry about the more frightening and severe consequences of cancer (e.g. death), might lead to avoidance coping, which has been associated with a reduction in screening behaviors (Horowitz et al., 1979).

Worry and systematic processing

The current findings supported the hypothesis that experiencing worried cognitions about a potential health threat will lead to increased systematic processing of threat-related information. The findings are consistent with research showing that negative affect seems to prompt a narrowing of attentional focus and leads to systematic rather than heuristic processing (Broadbent, 1971; Bruner et al., 1955). They are also consistent with work on worry and coping strategies showing that worry is related to adaptive problem-focused coping and an information-seeking cognitive style (Davey, 1994; Davey et al., 1992; Tallis et al., 1994).

Although the worry manipulation did affect systematic processing such that the participants in the worry group seemed to recall more of the flu essay than did the participants in the control group, information processing did not seem to affect intentions to get a flu shot. Both the experimental group and the control group showed slightly higher intentions to get a flu shot after reading the flu essay (with the experimental group having higher intentions), but the increase from T1 to T2 in the experimental group was no different than the increase in the control group. The experimental effect on intentions seemed to be the direct result of the worry

manipulation without the need for information processing, although information processing was affected as well.

Why did systematic processing of the essay fail to mediate the relationship between worry and intentions? One possible explanation is that the flu vaccine is a very well-known method of preventing the flu. Participants may have already understood how to prevent the flu, and may not have needed the information about influenza and vaccination in the essay. It is possible that systematic processing might be more relevant with a more complex or unfamiliar preventative behavior. Another possibility is that intention may function partly as a way for participants to cope with the worry they experienced during and after the manipulation, rather than as a straight measure of actual plans to get a flu shot. Follow-up data suggest that intention did predict actual behavior, but did not account for 100% of the variance, leaving open the possibility that some part of the intention measure does reflect coping. Although analyses found that systematic processing did not significantly predict behavior (β = -.80, Wald = .21, n.s.), it is possible that the study was under-powered to detect the effect. If coping accounts for some of the reported intentions, it is possible that systematic processing mediates the worry-behavior relationship (albeit to a very small degree), but does not mediate the worry-intention relationship.

Limitations

There are several factors that limit interpretation of the current study's findings. The undergraduate student sample used in the study is not representative and a larger community sample may respond differently to worry. In addition, most of the students in the study were in their first semester of college, and their vaccination decisions may have been influenced by their parents. Also, public health officials often target certain populations for flu vaccination (e.g. young children, pregnant women, the elderly, people with chronic medical conditions), and those

individuals may respond differently to a worry manipulation. The follow-up vaccination was assessed through self-report, and it is possible that students' reporting was biased. Because participants were told about the purpose of the study during the debriefing, participants in the worry condition may have misreported their flu vaccination status as a consequence of experimenter demand.

Future directions

Several researchers have noted that current theories of health behavior and health decision making do not include affective variables (McCaul & Mullens, 2003; Weinstein et al., 2007). Yet recently, research and theory have been more focused on the role that emotion plays in health behavior and decision-making ((Loewenstein et al., 2001; Slovic et al., 2005), and evidence suggests that feelings about risk and disease can sometimes be more predictive than actual thoughts or judgments about risk and disease (Chapman & Coups, 2006; Weinstein et al., 2007). The results of the current study suggest that an induced state of worry and anxious apprehension may have a direct causal effect on intention to engage in health behavior and possibly even on preventative behavior itself. Research should continue to focus on emotional variables such as worry, anticipated regret, and feelings of vulnerability in order to further understand how people make preventative health decisions. This research should address the role that worry might play in predicting health behavior vis-à-vis the more cognitive variables like attitudes and risk perception in conventional health behavior models.

Unfortunately, the current study was unsuccessful in elucidating the "why" of the relationship between worry and behavior. Systematic processing, although it did occur more frequently in the experimental group, did not explain the relationship between worry and behavioral intentions. In fact, the effect on behavioral intentions seemed to be mainly due to the

worry manipulation itself. Despite the lack of support for the mediational hypothesis, the study was successful in experimentally inducing worry about the flu, and the experimental technique used in the current study can now be used in future research on health worry and anxiety.

A possible research direction based on the worry manipulation would be to explore the effect of manipulating different levels of worry. The current study induced a state of mild worry, but it may be possible to increase the level of health worry and anxiety that participants experience by focusing on the more severe consequences of influenza (e.g., severe illness, death). Higher levels of worry may lead to greater behavioral intentions and may have a stronger effect on actual vaccination behavior. Research has consistently found that women with higher rates of breast cancer worry (including women with a 1st degree relative with breast cancer and women who had an abnormal mammogram) had higher rates of breast cancer screening behaviors (Burnett, Steakley, Slack, Roth, & Lerman, 1999; Lipkus, Halabi, Strigo, & Rimer, 2000). Therefore, it is likely that higher levels of worry would result in higher rates of self-protective behavior.

Further research should also focus on clarifying the importance of the specificity of worry and anxious apprehension in predicting behavioral intentions. The current study induced worry about the flu. Perhaps a future study could manipulate worry about the flu and also manipulate worry about a different disease, following up with a measure of participants' intention to get a flu shot, thus clarifying whether it is simply the state of worry and anxious apprehension that leads to intentions, or whether the worry needs to be specifically about the intention-related health behavior.

Additional research could also test possible moderators and mediators of the relationship of health worry and prevention-related intentions. Work in the area of fear appeals

suggests several possible variables that may moderate or mediate the worry-behavior relationship. Perceived efficacy (Witte & Allen, 2000), danger and fear control processes (Leventhal, 1970), and cognitive mediators such as perceived susceptibility and perceived severity (Rogers, 1975) have been shown to impact the effectiveness of fear appeals, and may moderate or mediate the relationship between health worry and health behavior.

Lastly, it is important to explore whether the current manipulation would work with different health behaviors. Flu vaccination is an easy and highly controllable behavior, and inducing worry about a disease with a more complex prevention strategy might lead to confusion or frustration rather than intention to take action.

The current study demonstrates that the experience of worry plays a role in motivating self-protective health behaviors and can influence the way people process health information. The findings support current research that focuses on elucidating the role of emotion in health decisions, and also supports the inclusion of emotion variables in models of health behavior. In addition, the demonstration of an effective technique for inducing health worry gives researchers an additional tool with which to learn more about how and why worry affects individuals' health decisions. The current study also suggests that public health campaigns and health promotion materials aimed at improving vaccination rates may benefit from the inclusion of emotional appeals in addition to factual disease prevention information.

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APPENDIX A

INFLUENZA ESSAY

The flu is a contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness, and at times can lead to death. The best way to prevent this illness is by getting a flu vaccination each fall.

Hippocrates first described the symptoms of influenza in 412 B.C.. Since then, the virus has undergone mutations and shifts and has caused numerous pandemics. The first influenza pandemic was recorded in 1580. Since this time, various methods have been employed to eradicate its cause. The influenza vaccine has become the best way to prevent influenza. It was first developed for the U. S. Army by Dr. Jonas Salk and Dr. Thomas Francis at the University of Michigan.

Influenza reaches peak prevalence in winter, and because the Northern and Southern Hemisphere have winter at different times of the year, there are actually two flu seasons each year. Therefore, the World Health Organization (assisted by the National Influenza Centers) makes two vaccine formulations every year; one for the Northern, and one for the Southern Hemisphere. It remains unclear why outbreaks of the flu occur seasonally rather than uniformly throughout the year. One possible explanation is that because people are indoors more often

during the winter, they are in close contact more often, and this promotes transmission from person to person. Another is that cold temperatures lead to drier air, which may dehydrate mucus, preventing the body from effectively expelling virus particles. The virus may also linger longer on exposed surfaces (doorknobs, countertops, etc.) in colder temperatures. Increased travel and visitation due to the Northern Hemisphere winter holiday season may also play a role.

The reason that so many influenza epidemics seem to begin in Asia is the close contact between human and animal populations in rural China. When people work on or near farms with pigs and chickens, influenza viruses can spread between species, thereby leading to a new form of influenza that may cause an epidemic.

There may be several circulating virus strains that cause regional outbreaks or epidemics. An important characteristic of the influenza virus is that it is complex and constantly changing. This is called "drift," and results in slightly different strains of virus each year. These changes in the virus make it possible for people to become reinfected in subsequent years. Vaccines are produced each year for new strains of influenza so the vaccine will effectively protect individuals each year.

Flu viruses spread in respiratory droplets caused by coughing and sneezing. They usually spread from person to person, though sometimes people become infected by touching something with flu viruses on it and then touching their mouth or nose. Most healthy adults may be able to infect others beginning 1 day before symptoms develop and up to 5 days after becoming sick. That means that you can pass on the flu to someone else before you know you are sick, as well as while you are sick.

The flu shot is an inactivated vaccine (containing killed virus) that is given with a needle. About two weeks after vaccination, antibodies develop that protect against influenza virus infection. Flu vaccines will not protect against influenza-like illnesses caused by other viruses. The best time to get vaccinated is in October and November, but getting vaccinated in December is not too late.

The Student Health Service offers flu shots for $18 throughout the Fall, starting in the beginning of October. You can get a flu shot by going to the student health clinic or by looking for flu shot clinics set up in dorm lobbies. The student health clinic is located in suite 500 of the Medical Arts Building on Fifth Avenue.

Some people should not be vaccinated without first consulting a physician. They include:

- People who have a severe allergy to chicken eggs.
- People who have had a severe reaction to an influenza vaccination in the past.
- People who developed Guillain-Barré syndrome (GBS) within 6 weeks of getting an influenza vaccine previously.
- Children less than 6 months of age (influenza vaccine is not approved for use in this age group).
- People who have a moderate or severe illness with a fever should wait to get vaccinated until their symptoms lessen.

TABLE 1

Table 1. ***Means and Standard Deviations of Variables for Experimental and Control Groups***

Variable	Experimental Grc (N = 83)		Control Group (N = 82)	
	M	*SD*	*M*	*SD*
Worry T1 (composite)	2.9	1.31	2.4	1.29
Worry T2	4.1	1.29	2.3	1.20
Worry T3 (composite)	3.4	1.22	2.6	1.27
Total number of recalled f	10.	3.57	9.7	2.81
Total number of words	14:	60.84	13	60.15
Level of detail	2.9	1.15	2.8	1.09
Degree of order match	3.1	1.16	2.8	1.31
Number of accurate flu fac	3.9	1.97	3.3	1.73

Footnotes

[1] All analyses that included the composite worry variable were also conducted with the single worry question ("How worried are you about getting the flu?") and revealed similar effects.

[2] The more conservative Baron and Kenny (1986) method of assessing mediation was also conducted. Regression analysis found that the association between condition and intentions was significant (β = -1.68, $t(163)$ = -2.86, $p < .01$). Regression analyses also demonstrated that the relationship between condition and reported worry was significant (β = -1.81, $t(163)$ = -9.27, $p < .001$). Lastly, regression analyses showed that reported worry predicts intention when controlling for condition (β = 1.36, $t(163)$ = 6.39, $p < .001$), and that the relationship between condition and intention becomes nonsignificant when worry is included in the equation ((β = .77, $t(163)$ = 1.18, p = ns). The results meet the Baron and Kenny (1986) criteria for complete mediation.

[3] The mediational analyses were repeated with intentions as the mediator and worry as the outcome variable. Although the Sobel method (1982) did find a significant indirect effect (β = -.21, 95% CI = -.39, -.03, $p < .05$), the Baron and Kenny (1986) method did not find a significant mediation effect. Therefore, the mediational findings testing this model were not as strong as the findings testing the model that had worry as the mediator.

[4] Because it is possible that individuals who have never before gotten a flu shot may have responded differently to the worry manipulation procedure, all of the analyses were repeated with participants who had never received a flu shot (N = 89). The analyses revealed similar

effects, but the test of Condition as a predictor of systematic processing became non-significant (F (1,85) = 2.86, p = .09).