AN EVENT-RELATED POTENTIAL (ERP) STUDY OF ATTENTION ALLOCATION IN THE PROCESSING OF A FEAR APPEAL AND ITS RELATION TO HPV VACCINE ACCEPTANCE

By

AARATHI MEENAKSHI VENKATESAN

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ABSTRACT OF THE DISSERTATION

An Event-Related Potential (ERP) Study of Attention Allocation in the Processing of a Fear Appeal and its Relation to HPV Vaccine Acceptance

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The present study had two general aims. The primary purpose was to test whether varying the level of threat content in a fear appeal affects attention allocation to the communication. It was predicted that a high threat fear appeal would capture and sustain more attention than a low threat fear appeal and that this increase would facilitate deeper message processing. The second objective was to examine the effect of dispositional and personal relevance factors on the decision to obtain a vaccine that protects against strains of the Human Papillomavirus (HPV). To test these hypotheses, a sample of college women (n = 72) were randomly assigned to listen to either a high threat or low threat fear communication about HPV. A dual-task paradigm was used to measure attention allocation in real-time wherein participants listened to the fear appeal while completing an unrelated visual stimulus discrimination task. Measures of P300, an event-related potential (ERP) component believed to reflect resource allocation, were obtained during message exposure. A follow-up interview was conducted 6-weeks after the experimental session to assess vaccine uptake, information seeking behavior, and knowledge retention about HPV. Women who expressed intentions to obtain the HPV vaccine were more likely to have made plans to get the vaccine or were already vaccinated at the time of follow-up ($OR = 29.18$, $CI = 1.53$ to 557.53, $p < .05$). The high threat fear appeal was associated with more knowledge retention about HPV at the time of follow-up than the low threat communication, $\beta = .38$, $p < .05$. The results also suggest that attention allocation during message exposure was positively associated with HPV knowledge retention ($\beta = .23$, $p < .05$) and the likelihood of having obtained or made plans to obtain the vaccine ($OR = 1.02$, $CI = 1.004$ to 1.04, $p < .05$). In the high threat condition, number of sexual partners was positively associated with intentions to consult a doctor about HPV ($\beta = .33$, $p < .05$) and to talk to friends about the vaccine ($\beta = .32$, $p < .05$). However, lack of sexual activity, parental disapproval, and concerns over vaccine safety were the most cited reasons for not wanting or being unsure about the vaccine. The present study has made a significant methodological contribution by incorporating a dual-task paradigm and a real-time measure of attention allocation to assess message processing.

Key words: fear appeal, attention, ERP, message processing, HPV, attentional style, personal relevance

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Introduction

A Primer on Human Papillomavirus (HPV)

HPV infection is one of the most common sexually transmitted infections (STI) among women in the United States (Weinstock et al, 2004). There are approximately 30 strains of HPV that are sexually transmitted (CDC, 2006). The most recent estimates suggest a HPV prevalence of 26.8% (approximately 24.9 million) in the general female population between 14-59 years (Dunne et al., 2007). The highest prevalence of these infections (44.8%) was observed among 20-24 year old women (Dunne et al., 2007). HPV prevalence also appears to increase every year between ages 14-24 years (Dunne et al., 2007).

Genital HPV strains are classified based on their association with cervical cancer risk. High-risk HPV types 16 and 18 account for approximately 70% of cervical cancers worldwide (Bosch et al., 2003), while low-risk types 6 and 11 cause over 90% of genital warts (Friedman et al., 2006). Spread through genital contact, HPV infection can be asymptomatic or cause visible genital warts (CDC, 2006). Although there is no cure for HPV, in most cases the infection resolves on its own. In a study of college-aged women, Ho et al. (1998) found that the average duration of HPV infection was 8 months. However, persistent HPV infection, lasting more than 6 months, was observed in women who were infected with multiple types of HPV or with a high-risk type of HPV (Ho et al., 1998).

Condoms are the not the most effective method of HPV prevention because transmission can occur through any form of genital contact and unlike HIV transmission, HPV infection does not require the exchange of bodily fluids (CDC, 2006). Recent advances have led to the development of a vaccine that prevents against four types of HPV. In June 2006, the Food and Drug Administration (FDA) approved a vaccine named Gardasil® that protects against HPV types 6, 11, 16 and 18 (FDA, 2006). The vaccine is recommended for women between the ages of 9 to 26 years (Friedman et al., 2006). In October 2009, the vaccine was also approved for men. Gardasil® is administered as three injections over a six month period and costs approximately $360 for the full course (CDC, 2006). Vaccine cost coverage varies by health insurance plans. Since the vaccine does not protect against all types of HPV, annual cervical cancer screening and PAP tests are still required.

Among women who had never been infected with HPV-types 16 or 18, the vaccine was found to have an effectiveness of 98% in preventing cervical lesions associated with the development of cervical cancer, while the effectiveness was reduced to 44% among women who had a history of HPV infection of these two strains (Villa et al., 2007). The vaccine is 100% effective in the prevention of genital warts among women who tested negative for HPV infection during vaccine administration; however, the effectiveness was reduced to 34% when the analysis included women who were infected with HPV at the start of the vaccine trial (Garland et al., 2007).

There have been a handful of studies that have examined attitudes towards the HPV vaccine. Although several of these studies were conducted while the vaccine was still being developed, they do shed light on the important psychosocial factors that influence vaccine acceptance. In trying to determine the types of HPV vaccines preferred, Hoover, Carfioli, & Muench (2000) found women preferred a HPV vaccine described as likely to prevent 70% of cervical cancer and 100% of genital warts compared to a vaccine that only prevented 85% of cervical cancer. In a similar study, Zimet et al. (2000) provided women with descriptions of nine hypothetical HPV vaccines that varied in terms of cost, efficacy, physician recommendation and targeted disease (i.e., cancer and/or genital warts). Vaccines described as highly effective (90%), inexpensive (either free or $50) and recommended by a physician were the most acceptable, while more expensive ($150), less effective (50%) vaccines that were not recommended by a physician were the least acceptable.

Examining attitudes towards a HPV vaccine among college students, Boehner and colleagues (2003) found students were also more likely to accept the vaccine if it was low cost and safe, and they believed parents would approve of vaccination. Current or future perceived risk of HPV infection and a higher number of lifetime sexual partners also predicted greater willingness to receive the vaccine. These findings are similar to other studies that have found that intentions to get vaccinated were higher as the number of lifetime sexual partners increased (e.g., Kahn, Rosenthal, Hamann, & Bernstein, 2003). Kahn et al. (2003) found that rather than all sexually active individuals, women believed that individuals who had multiple sexual partners, a family history of cancer, or a partner with a STI should receive the vaccine. Taken together these results suggest that evaluations of personal vulnerability to HPV and vaccine efficacy and affordability are significant predictors of vaccine acceptance.

Ever since the vaccine became available, there has been significant information dissemination about the HPV vaccine in the form of advertisements, policy discussions and news stories. Recently, Abdelmutti and Hoffman-Goetz (2009) conducted a content analysis of news coverage of the HPV vaccine in Canada and the United States and found that news stories in both countries emphasized the “fright factor” associated with HPV (e.g., describing cervical cancer as an inescapable consequence of a high-risk HPV strain infection). However, the study also found that, with time, the valence of the news coverage became more negative. While initial news coverage highlighted the vaccine’s high (100%) efficacy rate, later news coverage had emphasized debate over policy mandates on the vaccination of young girls and expressed ambivalence about the vaccine’s effectiveness. In general, it appears that news coverage has highlighted the threats associated with HPV while undermining the overall benefit of the vaccine for women’s health. The dissemination of threatening disease information paired with ambivalence about the effectiveness of the vaccine could be problematic in persuading women to consider the vaccine for themselves or for their daughters. Indeed, in their review of studies examining HPV beliefs and vaccine acceptability, Brewer and Fazekas (2007) found that HPV vaccine acceptability was higher as perceived likelihood of HPV exposure or infection increased. Likewise, a history of HPV infection among parents increased willingness to vaccinate their children (Davis et al., 2004; Dempsey et al., 2006). Several studies have noted that perceptions of vaccine’s effectiveness in preventing HPV were positively associated with intentions to obtain the HPV vaccine among parents of adolescents as well as adults (Davis et al., 2004; Dempsey et al., 2006; Zimet et al., 2000). These findings illustrate the need for vaccine information to highlight susceptibility to HPV vaccination and the vaccine’s effectiveness to promote greater vaccine acceptance.

Another barrier to HPV vaccine acceptance has been its link to sexual activity. For example, although the HPV vaccine is recommended prior to sexual initiation, Gottlieb et al (2009) found a significant number of parents had not had their daughters vaccinated because of beliefs that they were not sexually active. Moreover, vaccination intentions decreased when the vaccine was framed as preventing a STI and cervical cancer compared to a frame describing only cervical cancer prevention (Leader et al., 2009). In other words, the stigma attached to a STI and the implications of sexual promiscuity by obtaining a STI prevention vaccine appear to be significant barriers to vaccine acceptance.

In summary, HPV infection is a sexually transmitted disease with the highest prevalence among young women (Dunne et al., 2007). In 2006, a vaccine that protects against HPV-types 6, 11, 16 and 18 was developed and recommended as safe and effective for women between the ages of 9 to 26 years (CDC, 2006). HPV types 16 and 18 cause approximately 70% of all cervical cancers while types HPV types 6 and 11 account for 90% of genital warts cases (Friedman et al., 2006). Initial studies assessing attitudes towards a potential HPV vaccine have found that women are more likely to accept vaccines that are described as safe, effective and inexpensive. Beliefs about susceptibility to HPV infection and/or number of sexual partners were also positively associated with acceptance. Evaluations of threat and efficacy appear to contribute significantly to the acceptance of a HPV vaccine. On the other hand, beliefs about sexual activity and the vaccine's link to a STI appear to be significant barriers to vaccine acceptance. Although HPV is a relevant health threat for college-aged women, there has been limited work on HPV vaccine acceptance in college-aged women. This is likely because the vaccine is recommended prior to sexual initiation and it is presumed that most college-aged women are already sexually active and therefore likely to have been exposed to HPV. Nevertheless, given the prevalence of HPV infection among 14-24 year olds, it is of timely interest to examine vaccine attitudes in this high-risk (for HPV) population.

Theories of Fear Communication and Persuasion

Commonly known as scare tactics, fear appeals are a type of persuasive communication in which descriptions of one's vulnerability to a serious health threat are paired with a behavioral recommendation portrayed as easy and effective in reducing potential for harm. There are several variations of fear appeals: some contain vivid details of the threat with sparse descriptions of the recommendation, while others emphasize the recommendation with minimal threat content. Fear communications have a rich history in both theoretical and empirical research domains. One established finding from this research is that the most persuasive communications tend to be the ones that are high in threat as well as efficacy content and the least persuasive messages tend to be ones that contain minimal information about the threat and effectiveness of the response (Witte & Allen, 2000; Ruiter et al., 2001).

The current theoretical consensus is that a fear communication elicits an appraisal of threat (e.g., Am I vulnerable? Is the threat serious?) and an appraisal of coping (e.g., Is the recommended response effective in reducing my risk? Am I capable of carrying out the response?) (Leventhal, 1970; Witte, 1998). The models differ slightly on whether these appraisals occur simultaneously or sequentially, but it is generally agreed that they are the key cognitive mediators of persuasion (Rogers, 1983; Witte, 1998). Although it was initially proposed that increases in fear arousal impede persuasion (Janis, 1967), higher levels of fear arousal are typically associated with greater persuasion (Leventhal, 1970; Boster & Mongeau, 1984; Milne et al., 2000; Witte & Allen, 2000). Fear, as conceptualized by these models[1], is aroused following an evaluation of threat. Although fear can amplify evaluations of threat, it is the perception of threat that is believed to motivate action. The motivation is either to control the fear aroused by the threat or control the threat itself. Controlling or regulating the fear involves generating a cognitive distance of sorts from the threat, either through defensive avoidance (e.g., not wanting to think about the threat), message derogation (e.g., finding faults or weaknesses in the message), and/or threat minimization (e.g., the health threat is not as serious) (Leventhal, 1970). On the other hand, motivations to control the danger involve more threat and efficacy-related cognitions and eventually lead to message acceptance. Message acceptance in fear communication theories is synonymous with persuasion, where the individual expresses attitudes, intentions and behavior consistent with the recommendations (Witte, 1998). Thus, according to these models, the route to persuasion is not through affective processes.

The dominant discourse on fear communications has certainly not excluded emotion in its discussions of how a threatening message affects persuasion. What it has done however is characterize the relationship between emotion and cognition as almost entirely antagonistic. In other words, the general assumption has been that cognitive processing of a fear appeal can facilitate persuasion, while emotion processing either inhibits or at best has a limited, indirect effect on message acceptance (e.g., Witte, 1992; Rogers, 1983). The marginalized role of fear and the characterization of the relationship

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[1] The models referred to here are the Parallel Process Model (Leventhal, 1970), Protection Motivation Theory (Rogers, 1975; 1983), and the Extended Parallel Processes Model (Witte, 1992; 1998). Unless otherwise specified, the fear-as-acquired drive models (Hovland, Janis, & Kelley, 1953; McGuire, 1968) are not included in the above theoretical summary because of limited empirical support for the proposed curvilinear relationship between fear and persuasion.

between cognitive and affective processes as primarily antagonistic by fear communication theories warrant closer examination.

Most appraisal theorists view emotion as generated through a combination of automatic and controlled processing across several dimensions (Feldman Barrett et al., 2007). These dimensions include evaluations of novelty, valence, goals (significance or relevance), coping potential, and values/norms (Ellsworth & Scherer, 2003). Emotion theories propose that these dimensions are evaluated across a processing hierarchy where initial sensory-motor level processing leads to visceral, reflex-like responses (e.g., startle) through bottom-up processing involving hard-wired stimulus feature detectors leading to schematic processing, where the stimulus features are matched with learned patterns (Leventhal, 1982; Leventhal & Scherer, 1987). This leads to conceptual processing which is controlled and conscious and involves the recruitment of memory and knowledge. Unlike the view of emotion as a unitary, static response that is adopted by most fear communication theorists, emotion appears to be a dynamic process that can be modified and refined throughout the generation process.

In this thesis, it is argued that fear is generated automatically upon message exposure and prior to comprehensive message processing. The primary rationale for this argument is based on the body of emotion research that suggests that emotion may facilitate processing of the eliciting stimulus/event by recruiting cognitive resources such as attention (LeDoux, 2000; Phelps, 2006; Öhman, Flykt, & Esteves, 2001). It is proposed that fear is evoked automatically upon message exposure and captures and sustains attention for comprehensive message processing (threat and efficacy appraisals).

According to most fear communication theories, the motivation to avert danger or reduce fear follows from a fairly exhaustive and comprehensive evaluation of the message. Given the continual demand for cognitive resources such as the attention and memory needed for stimulus processing (Mangun, 2002), it is unlikely that these resources would be bestowed so lavishly upon processing of a fear appeal without adequate motivation. The dominant fear appeal theories do not seem to address the role of cognitive resources such as attention in message processing,[2] and moreover, are largely silent on how these cognitive resources are allocated to enable appraisals of threat and efficacy in the first place.

Dual process models of attitude change, particularly the Heuristic-Systematic Model (Chaiken, 1980) and Elaboration Likelihood Model (Petty & Cacioppo, 1986), challenge this characterization of message processing as always highly rational and methodical. These models propose that there are two distinct aspects of the processing of a persuasive communication. The first, central or systematic processing, involves considerable message-related cognition and detailed message processing. When one engages in systematic/central processing, significant cognitive resources in terms of attention, comprehension, and learning are invested in evaluating the message, and these content-based cognitions are believed to mediate the effect on persuasion (Chaiken, 1980). The second processing route, heuristic/peripheral processing, involves less cognitive investment in systematic processing, and peripheral source factors such as likeability and attractiveness of the communicator are believed to directly impact

[2] Ruiter et al. (2001) proposed a compelling model wherein systematic message processing occurs through attention allocation, but this model again conceptualizes the relationship between fear control/regulation and message processing as antagonistic and does not specify how attention is initially captured and sustained.

message acceptance with less of a focus on message content. Empirical tests of these models have found that increases in threat content and personal relevance of the communication motivate more systematic processing of the communication (e.g., Liberman & Chaiken, 1992; Das, Stroebe, & de Wit, 2003). Therefore it appears that fear arousal promotes deeper processing, where more attention is allocated towards the message.

Central, systematic processing may not necessarily be unbiased. Dual-process models conceptualize defensive processing as evaluating threatening information in a manner that will support a preferred conclusion (e.g., that one is healthy or has low disease risk) (Liberman & Chaiken, 1992). In general, fear communication theories have viewed defensiveness as a fear-control response that leads to message rejection or less persuasion (Janis & Feshbach, 1953; Leventhal, 1970; Rogers, 1983; Witte, 1992). Indeed in their meta-analysis, Witte & Allen (2000) did find that fear control responses were inversely associated with persuasive outcomes. However, it has been noted that fear control responses in their meta-analysis included both avoidance and threat minimization (de Hoog et al., 2007). Whereas measures of avoidance typically assess an individual's unwillingness to think about a threat, measures of threat minimization explore specific cognitions about the threat. In their recent meta-analysis of fear communications, de Hoog et al. (2007) only included threat minimization as a measure of defensiveness and found that increases in vulnerability to threat and severity of the threat were associated with corresponding increases in threat minimization. However, the extent to which an individual can minimize threat is limited by the strength of the evidence presented in the communication (Kunda, 1987). Furthermore, although the results of the meta-analysis conducted by Hoog et al. (2007) did support a positive relationship between threat and defensiveness, this did not appear to adversely affect persuasion. Increases in threat did lead to more persuasion, suggesting that while individuals who are more threatened are more skeptical and evaluate the message more thoroughly, they are also motivated to reduce their risk.

In the context of persuasive communications, Nabi (1999, 2002) has proposed that emotions serve as frames wherein they guide the nature and depth of message processing. A frame refers to the manner in which information is described or presented. For example, a health communication about drunk driving could emphasize one's susceptibility to being the victim of an accident involving alcohol or focus on drunk driving laws[3]. While the former is likely to evoke fear, the latter public service announcement (PSA) may elicit anger and thus lead to divergent processing goals. Although dual-process models of attitude change and fear communication theories acknowledge the effect of emotion on message processing, Nabi (2003) elaborates on the argument by considering the effect of other emotions in addition to fear (e.g., anger) on information processing and suggests that the nature or depth of processing is influenced by the motivational goals and action tendencies associated with the elicited emotion. While protection motivation is one of the primary motivational goals elicited by fear, retribution and justice are the main motivational goals of anger. These divergent motivational goals can thereby influence message processing through selective attention.

[3] One example of an anger eliciting frame would be the "Man in Wheelchair" PSA used in a study by Dillard & Peck (2000) that shows a clearly inebriated man who has been previously convicted for driving under the influence sitting at a bar denying that he is drunk and rejecting the need for drunk driving laws. By contrast, in their study of attention and avoidance, Nielson & Shapiro (2009) used a fear appeal developed by the AdCouncil that depicts a pair of shoes that are purported to have belonged to the victim of a fatal drunk driving accident. The PSA states that the reader could have just as well have been the victim.

Furthermore, expectations of reassurance, prior knowledge, and coping styles are also expected to moderate the effect of emotion on information processing (Dillard & Nabi, 2006).

Indeed, Gleicher & Petty (1992) posited that fear arousal leads to an expectation of reassurance that determines the depth of message processing. They found that as fear increased and recommendations were unambiguously positive (e.g., endorsed by an expert), the communication was evaluated favorably regardless of whether the recommendations were supported with strong or weak arguments. In other words, when the expectations of reassurance were certain, more fearful individuals engaged in less comprehensive and more heuristic message processing. Nabi (2002) observed a similar effect for anger and fear such that when expectations of reassurance were certain even when the arguments supporting the recommendation were flawed, the anger appeal and fear appeal were associated with more favorable evaluations of the recommendation than when expectations of reassurance were uncertain.

It has been suggested that prior knowledge, both objective knowledge about an issue and subjective knowledge (e.g., how informed one believe him/herself to be about a subject), can moderate the effect of a fear appeal on persuasive outcomes (Dillard & Nabi, 2006). For example, a fear appeal may be less successful in arousing fear in individuals who consider themselves highly informed on a subject. High prior knowledge may also increase defensive message processing because the communication may be seen as manipulative. Nabi, Roskos-Ewoldsen, & Carpentier (2008) found high subjective knowledge was associated with less fear arousal and more comprehensive, defensive processing. While fear was inversely associated with behavioral intentions when subjective knowledge was high, the pattern was reversed among individuals with low subjective knowledge (i.e., positive association between fear arousal and intentions).

In addition to examining the effect of situational factors and message elements on information processing, there has been some empirical attention devoted to the role of dispositional factors in message processing. Coping or attentional style, the extent to which an individual seeks or avoids information, has been described as a dispositional factor that influences the evaluation of threat-related cues (Miller, 1987). When confronted with an aversive or threatening event, monitors seek information about the threat while blunters look to avoid information and distract from the threat. High monitoring/low blunting has generally been associated with more in-depth systematic processing and a negative bias about one's health (i.e., feeling more susceptible to a health threat) (Miller et al., 1999). Due to this cognitive vigilance, high monitors tend to experience more intrusive ideation about the stressor but exhibit higher knowledge retention of threat-related information than low monitors (Schwartz et al., 1995).

Message framing appears to moderate the effect of monitoring on affective and cognitive responses to threat (Miller et al., 1999). Messages can be framed in terms of potential costs (loss-frame) or benefits (gain-frame) of the recommended action (Rothman & Salovey, 1997). Compared to a neutral-frame message about a cervical cancer screening procedure, high monitors who heard a loss-framed message (i.e., health risks of not having the procedure) exhibited more intrusive ideation about their gynecological health (Miller et al., 1999). However, increased intrusive ideation did not affect knowledge retention or behavioral adherence (i.e., appointment maintenance) of high monitors. On the other hand, compared to the neutral frame, the loss-frame message was associated with increased behavioral adherence and knowledge retention among low monitors. In other words, high monitors are inclined to elevate their subjective risk for disease and therefore health communications that emphasize susceptibility appear to elevate negative affect but nevertheless promote vigilant, comprehensive message processing. Due to the cognitive vigilance of high monitors, these findings imply that neutral, less fear-eliciting communications may promote more adaptive affective response without compromising attention allocation and depth of processing. On the other hand, a high threat communication may be more effective in persuading low monitors who are positively biased about their health.

In summary, the basic theoretical framework of most fear communication theories suggests that appraisals of threat and efficacy are the key determinants of persuasion and independent of fear arousal. This perspective suggests that the arousal and regulation of fear comes at the cost of rational and systematic message assessment. Although we have observed empirical support for these cognitive fear communication models (PPM, PMT, and EPPM), the mechanism and the determinants of such detailed comprehensive message processing seem elusive and unclear. The dual process models make distinctions between peripheral and central processing and propose that that depth of message processing is a strong determinant of persuasion. Attempts to explore the relationship between fear arousal and depth of processing have been quite limited. More recently it has been proposed that the action tendencies and goals associated with emotion elicited by a fear communication may serve as a frame in guiding the depth of processing. Prior knowledge, expectations of reassurance, and attentional styles appear to moderate the effect of a fear communication on message processing. The objective of the present study was to examine the effects of threat and fear arousal on the depth of processing. It was expected that increases in fear capture and sustain attentional resources for deeper and more comprehensive message processing that facilitate evaluations of threat and efficacy. The study also explored the effect of attentional styles.

Attention and Event Related Potentials (ERP) Measures

The key construct of interest in this thesis is attention. Attention is defined as the recruitment of cognitive resources to evaluate a stimulus (Hillyard et al., 1995). Attention involves the allocation of processing resources for the elaboration of a selected stimulus while inhibiting further processing of extraneous information (Kok, 1997; Hermann & Knight, 2001). Pre-attentive feature detection is believed to be the earliest stage of stimulus processing where preliminary stimulus information is identified in this stage (Öhman, 2000). This rudimentary level of stimulus segregation in the emotion generation process has been suggested by several emotion theories (e.g., Leventhal & Scherer, 1987). Feature detection involves receiving primarily physical inputs such as a loud sound or a threatening word and the selection of particular environmental inputs for further evaluation by directing attention towards selected stimuli (Öhman, 2000). Pre-attentive feature detection leads to the capture of attentional resources.

Event-related potentials (ERPs) are used to measure phasic attention allocation (Mangun & Hillyard, 1995). ERPs are voltage changes observed in an electroencephalograph (EEG) recording that are elicited upon specific stimulus presentation and are classified based on the direction (positive or negative) and the timing of the deflection (Stern & Quigley, 2001). The strength of ERP lies in the fact that it is time-locked to sensory and cognitive processes and therefore is believed to reflect stages of information-processing from initial sensory processing to high-order, complex cognitive processes (Reinvang, 1999; Mangun & Hillyard, 1995). Moreover, ERP measures of attention can be obtained without explicit instructions to the participant to detect or focus on a specific stimulus. This enables us to study and compare the processing of attended and unattended targets (Mangun & Hillyard, 1995).

The ERP component that is the focus of the proposed research is P300, also referred to as P3. P3 is a positive deflection that peaks approximately 300 ms post-stimulus onset (Kok, 1997). Amplitude and latency are two measures used to assess the P3 component. Amplitude is the difference between the mean pre-stimulus baseline voltage and the largest positive peak within a time window following stimulus onset (e.g., 350 – 600 ms). Latency is defined as the time elapsed between stimulus onset and the maximum positive amplitude (Polich, 2007). It is generally agreed that P3 reflects stimulus evaluation where by an external stimulus is compared to an internal representation of a category of stimuli to categorize the stimulus as a target/ significant (Kok, 2001; Nieuwenhuis, Aston-Jones, & Cohen, 2005). Event categorization therefore involves perceptual as well as memory processes where the physical features of the stimulus are extracted and then compared to an internal representation. It has been recently proposed that P3 reflects the inhibition of extraneous cognitive processes in order to facilitate focal attention and enhance memory operations for stimulus processing (Polich, 2007). P3 is not a measure of attention allocation alone as it is also indicative of the activation of cognitive processes such as memory operations, perceptual processing, response selection and execution. Nonetheless, the generation of P3 is characterized as "attention driven" (Polich, 2007).

Studies of P3 use single-task and dual-task paradigms. In a single-task paradigm, the participant is instructed to detect and respond to an infrequent "oddball" auditory or visual target amidst a series of non-targets, for example detecting a rarely presented target tone among frequent non-target tones. In single-task paradigms, higher P3 amplitude is observed for targets compared to non-targets (Luck & Girelli, 1998). Higher P3 amplitude for targets compared to non-targets is indicative of increased target recognition. In other words, the external target stimulus is compared to an internal representation held in working memory and evaluated as salient or relevant (Polich, 2008). Increases in P3 amplitude thus reflect the activation of neurocognitive processes underlying event categorization (Kok, 2001).

The effect of target detection on P3 is moderated by task difficulty. As task difficulty increases, a reduction in P3 amplitude and an increase in P3 latency are observed. Task difficulty is defined in terms of task characteristics that influence the time taken to perform a task and the efficiency with which the task is performed (Kok, 2001). One example of a target complexity manipulation is altering the target features making it either more distinctive or similar to the non-target. Stimuli that are harder to categorize as a target or a non-target are associated with reduced P3 amplitude and longer P3 latencies compared to targets that are easy to categorize. This effect of increasing target complexity on P3 is believed to reflect a reduction in stimulus/event categorization, i.e., reduced target recognition (Kok, 1997). In other words, when task difficulty is high, it not only takes longer to evaluate a stimulus as a target vs. non-target (increased P3 latency), the stimulus is not as confidently categorized as a target (reduced P3 amplitude).

As noted earlier, the number of task operations also affects P3. Dual task paradigms have observed a decrease in P3 amplitude and an increase in P3 latency compared to a single-task. In dual-task paradigms the participant performs two qualitatively different tasks simultaneously (Kok, 1997). For example, the participant responds to an infrequent target tone while also working on a visual tracking task (e.g., Wickens, Israel & Donchin, 1977). Theoretical models of P3 assume that there are capacity limitations on attentional resources in dual-task paradigms such that there are competing demands for attention. This increase in processing load leads to reduced attention allocation for stimulus evaluation and processing. Attention recruits and activates other cognitive processes such as working memory and perceptual processing that are critical for stimulus evaluation. Polich (2008) has proposed that P3 reflects the inhibition of attentional allocation for extraneous (non-task relevant) processing. To this extent, it is argued that these inhibitory effects on attention are limited in dual-tasks resulting in inadequate allocation of attentional resources for target processing (i.e., attention is divided between tasks). This reduction in attentional allocation therefore limits processes necessary for target recognition. The diminished P3 amplitude and increase in P3 latency observed in dual-task paradigms and in harder versus easier stimulus discrimination tasks reflect reduced target recognition. The effect of task difficulty manipulations on P3 is attributed to a less exact matching of the external target to an internal template (Kok, 2001). In the case of dual-task paradigms, this reduction is attributed to capacity limitations on attentional resources needed for stimulus processing.

Several ERP components other than P3 that are related to attention have also been identified (Luck, Woodman & Vogel, 2000). For example, N100 also referred to as N1 is an exogenous attentional component that is identified as a negative deflection that occurs 100-150 ms after stimulus onset (Kok, 1997). N1 is believed to reflect early perceptual, bottom-up processing (Vogel & Luck, 2000). Sensory components such as N1 are relevant in the context of the proposed model of attention mediated processing, given that one of its central tenets is that fear arousal occurs through early pre-attentive processes involving feature detection. Although N1 would be an indirect measure of such processes, it was not included in the present study because the primary focus of this research is on the role of endogenous attention in message processing. Endogenous attention is a top-down process that is controlled, in which attentional resources are voluntarily directed and sustained (Smith & Kosslyn, 2007; Cheal & Lyon, 1991; Nakayama & Mackeben, 1989).

In the past, fear communication studies have measured attention using a variety of approaches. Attention has commonly been operationalized as memory for message content, following message exposure (e.g., Janis & Feshbach, 1953; Liberman & Chaiken, 1992; Wright et al., 2006). Another approach has been to ask participants how much effort or attention he/she devoted to the task (e.g., Ruiter et al., 2006; Wright et al., 2006). Another approach has been to characterize attentional styles as a dispositional factor where high monitoring is associated with increased cognitive vigilance to threat and more in-depth stimulus processing, while avoidance and attention withdrawal from the threat have been linked to low monitoring/high blunting (Miller, 1987). The study of attentional styles has come the closest to exploring the affective, cognitive and behavioral consequences of attention allocation to a threat communication. However, studies of attentional style have yet to examine the effect of message content (i.e., high threat vs.

low threat) on attention allocation. Moreover, studies of fear communication have yet to examine the competition for attentional resources on the depth of information processing. In the present study, the relative allocation of cognitive resources to a high or low threat communication was measured in real-time while participants completed an unrelated visual stimulus discrimination task. The task consisted of infrequently presented targets that were either easy or difficult to categorize. The primary objective of the present study was to explore the effects of threat on attention allocation. A dual-task paradigm that increased cognitive load enabled us to examine whether an increase in the threat content in a communication reduces the amount of attention allocated to an unrelated stimulus discrimination task. The within subjects manipulation of target difficulty was included to clarify if increasing the processing demands of the visual discrimination task (i.e., easy vs. difficult targets) could alter the allocation of attentional resources in the high threat condition. Such a pattern of results would suggest that increases in threat capture and sustain attention even when extraneous processing demands increase.

In summary, ERPs are voltage changes elicited by external or internal stimuli (Stern & Quigley, 2001). The ERP component of primary interest in the present study is P300, a positive deflection that occurs approximately 300 ms following stimulus onset, interpreted as stimulus detection. P3 is considered a late cognitive component (compared for instance to N1) in that cognitive resources such as working memory have already been recruited for stimulus evaluation. P3 has been utilized extensively as a measure of information processing capacity (Kok, 2001; Nieuwenhuis et al, 2005). Consistent with previous ERP research (see Kok, 1997; 2001; Ruiter et al., 2006), P3 amplitude was operationalized as a measure of allocation of attention resources between two competing tasks.

Study Design and Overview

The study utilized a 2 x 2 mixed model subjects design. Threat level, the between subjects factor, was the nature of susceptibility and prevalence information about HPV, genital warts and cervical cancer included in the communication. Target difficulty, the within subjects factor, refers to the difficulty of target discrimination in a visual rotated heads oddball task (see Figure 1 for a schematic representation). The target stimulus consisted of an aerial view of a stylized head with a nose and an ear drawn in. Participants were instructed to indicate on which side of the head the ear was located by pressing the appropriate button (i.e., the button on the right if the ear is on the right hand side of the head, or the button on the left if the ear is on the left hand side of the head). In the easy target condition, the location of the ear and the button to be pressed were on the same side. In the difficult condition, the target head is rotated 180^0 such that the ear and the correct button to be pressed were on opposite sides. Stimulus presentation (easy, difficult, or neutral) was quasi-random. The outcome variables of interest were attention allocation to the visual task during message presentation, fear arousal, threat and efficacy evaluations, and behavioral intentions to get vaccinated. The study also included a longitudinal component: a follow-up interview 6 weeks after the experimental session to assess efforts to obtain the vaccine and memory for message content.

Statement of Hypotheses

Hypothesis 1 – Fear arousal will be inversely associated with attention allocation to the visual oddball task.

Increases in fear arousal capture and sustain cognitive resources such as attention for further stimulus processing (Phelps, 2006). It is expected that fear arousal will be inversely associated with real-time attention allocation to the oddball task during message presentation. In other words, a smaller P3 effect will be observed as fear arousal increases. Tomkins (1984) suggested that one of the functions of emotions is to amplify its elicitor for further processing. One of the primary functions of the fear system is to detect and respond to potential threats (Lang et al., 2000; LeDoux, 1995). It is proposed that fear arousal precedes deliberative evaluations of threat and in turn influences the nature and depth of message processing. The earliest stages of stimulus processing involve attention and perception, and these mechanisms in turn influence later stages of cognitive processes involving memory and decision-making (Phelps, 2006). The closest empirical research examining the effects of emotion on attention has focused on response latencies in tasks like the emotional Stroop (Mathews & MacLeod, 1994) and the dot probe (MacLeod, Mathews, & Tata, 1986). In both these tasks, emotion-relevant or threat-relevant stimuli appear to capture attentional resources and influence response latencies. This recruitment of attention by emotion, particularly fear, has also been observed by Öhman, Flykt, and Esteves (2001) who found that the detection of a fear-relevant target (e.g., snakes, spiders) among fear-irrelevant distracters (e.g., mushrooms, flowers) was significantly faster than the detection of a discrepant, fear-irrelevant target among fear-relevant distracters. It has been suggested that these effects likely reflect inability to disengage attention from threat once it has been detected (Fox, Russo, Bowles, & Dutton, 2001). Consistent with this research, it is expected that fear arousal will capture and direct attentional resources to the message for more systematic and deliberative processing. Therefore increases in fear arousal will be associated with smaller P3 components associated.

> ***Hypothesis 2*** – Threat level and target difficulty will have an interactive effect on attention allocation during the message presentation.

A main effect of target difficulty on attention was expected. In other words, smaller P3 effects (reduced amplitude and longer latency) were expected for the difficult targets compared to the easy targets. It was expected that threat level would moderate the effect of target difficulty on attention. In the low-threat condition, as target difficulty increases attention allocation to the message is expected to decrease. On the other hand, the magnitude of the difference in attention between the easy and difficult target conditions will be smaller in the groups exposed to the high threat message. Empirical examination of the effect of cognitive and/or perceptual load on the processing of fear appeals appears to be largely absent. Ruiter and colleagues (2006) used a dual-task paradigm to measure real-time attention allocation to health information. In the study, participants read either a tailored or generic, non-tailored health communication about nutrition while completing an unrelated auditory stimulus discrimination task. The study did not manipulate difficulty of the stimulus discrimination task. Although the study did find greater allocation to the tailored message compared to non-tailored message, the competition for attentional resources between the message and the auditory task was consistent across conditions (Ruiter et al., 2006). In the present study, it was expected that the high threat condition would motivate systematic message processing and as a result withdraw attentional resources allocated to the unrelated stimulus discrimination task.

Hypothesis 3a – A main effect of threat level on attention is expected. More attention will be allocated to the high threat message than the low threat. A smaller P3 effect will be observed in the high threat condition compared to the low threat condition.

Hypothesis 3b **–** Personal relevance will moderate the effect of threat level on attention.

Attention is the mechanism by which certain information components are selected for further processing and has often been conceptualized as the gatekeeper for the recruitment of higher-order cognitive resources such as memory for stimulus processing (Anderson, 2005). The mechanism proposed in this study is that fear is aroused automatically upon exposure and recruits attention for further message processing. Attention is withdrawn if more comprehensive processing leads to perceptions of low vulnerability to the threat. On the other hand, as perceived threat increases, attention deployment to the message will also increase in an effort to (a) learn more about the threat and (b) seek means to reduce the threat. Automatic selection of fear-relevant or threatening stimuli for further processing has been observed quite consistently in cognitive research (Anderson, 2005; Öhman & Mineka, 2001). Most researchers agree that this preferential selection is most likely motivated by the need to respond quickly to potential danger (Öhman, 2000).

The allocation of attention to threat information has not been extensively explored in fear communication research. Research testing the dual-process models of attitude change has found differences in type of processing (systematic versus heuristic) as a function of personal relevance such that increasing personal relevance to a health threat facilitates more systematic, comprehensive message processing (Liberman & Chaiken, 1992). However, the most compelling evidence for recruitment of attention by fear-relevant information can be found in emotion research. Examining the effect of emotion on early perceptual processing, Phelps and colleagues (2004) found that when a brief cue of either fearful or neutral facial expressions preceded a stimulus discrimination task, contrast sensitivity (i.e., vision) was enhanced when the cue was a fearful expression as opposed to neutral. Another example of emotion facilitated attention comes from studies of the phenomenon of the attentional blink (Anderson, 2005). Rapid presentation of two stimuli, one followed by another, can result in a phenomenon referred to as attentional blink (AB), where the first target stimulus is successfully reported but not the second (Smith & Kosslyn, 2007). Thought to reflect temporal limitations of attention and encoding in working memory, AB is observed when the time between the two target presentations is less than 500 milliseconds (Anderson, 2005). When the second target was negative or arousing such as “cancer” or “death”, the attentional blink was significantly diminished. Tied together these results suggest that fear-relevant stimuli automatically capture and sustain attention for further processing of a potential threat. Consistent with previous research, it was expected that a high threat message will increase fear and perceptions of vulnerability and motivate a deeper, more comprehensive evaluation of the message.

Personal relevance increases to the extent to which the content or issues raised in the message are personally significant (Johnson & Eagly, 1990). Previous research has observed that increases in personal relevance promote systematic processing of the message (Liberman & Chaiken, 1992; Petty, Cacioppo, & Goldman, 1981). Consistent with this evidence, in the low threat condition, an increase in personal relevance was expected to affect attention in the same way a high threat message captures and sustains attention. It was predicted that attention deployment to the threat will be maximal in the high threat condition because the message objective was to emphasize the personal significance of the threat; therefore, personal relevance was not expected to have an additive effect on attention.

> ***Hypothesis 4*** – Threat level will be positively associated with subjective feelings of fear such that fear will be greater in the high threat condition compared to the low-threat condition.

This is perhaps the most ubiquitous prediction in fear communication theory: fear increases as the amount of threat content in the message increases (Leventhal, 1970; Rogers, 1975, 1983; Witte, 1992, 1998). Indeed, there is ample empirical support for the positive association between threat and fear arousal (e.g., de Hoog, Stroebe, & de Wit, 2007; Witte, 1994; Rogers & Mewborn, 1976; Leventhal & Trembly, 1968). The objective of a high threat communication is to make the threat more vivid and likely to the target audience. Most theories of fear communication propose that increases in the threat content in a message increase perceived vulnerability leading to fear arousal (Rogers, 1983; Witte, 1992; Leventhal, 1970).

> ***Hypothesis 5*** **–** Perceptions of efficacy will be stronger in the high threat condition compared to the low threat condition.

It has been proposed that the detection of a threat motivates individuals to seek ways to avert the danger/threat (Leventhal, 1970). Perceptions of a recommendation as highly effective in threat reduction is one mechanism for fear reduction (Witte, 1992). Based on the empirical evidence reviewed in the previous hypotheses, we note that individuals exposed to a high threat tend to accept action recommendations even if they are supported by weak arguments (Das, de Wit, & Stroebe, 2003; de Hoog, Stroebe, & de Wit, 2005). It has also been observed that evaluations of action recommendations and behavioral intentions are higher and more positive when the threat content in a message is increased (de Hoog et al., 2007). This suggests that as vulnerability to threat increases, motivation to perceive the response as effective in managing or reducing the risk also increases.

Hypothesis 6 – The high threat condition will increase defensive processing of the threat communication.

In the high threat condition, disease consequences of HPV will be perceived as less serious and the message will be evaluated less favorably. Specifically, argument quality, clarity and accuracy of the message will be judged less positively in the high threat condition. Defensive processing has been conceptualized as evaluating threatening information in a manner that will support a preferred conclusion (e.g., that one is healthy or has low disease risk) and can motivate a biased search for errors and inconsistencies in the information describing the threat (Liberman & Chaiken, 1992). For example, Liberman and Chaiken (1992) presented female coffee drinkers and non-coffee drinkers with a high or low-threat message describing a study that found a possible link between caffeine and fibrocystic disease. Methodological flaws were included in both messages.

The study found that coffee drinkers who read a high threat message were less likely to believe in a possible link between caffeine consumption and also observed more flaws in the high threat message. Similar defensive responses have been observed by other studies where information pertaining to susceptibility and severity of a threat is scrutinized more when the threat is high or personally relevant, and this scrutiny is biased towards a preferred conclusion that either the threat is not as serious and/or that the individual may not be as vulnerable (e.g., Ditto & Lopez, 1992; Jemmot, Ditto, & Croyle, 1986). These studies have also observed however that defensive motivation was associated with increased intentions to seek additional information about the threat. Furthermore, the extent to which an individual can minimize threat is limited by the strength of the evidence presented in the communication (Kunda, 1987), therefore individuals are less likely to reject a threat communication supported by strong arguments. While the results of the meta-analysis conducted by Hoog et al. (2007) of fear communications and persuasion did support a positive relationship between threat and defensiveness, this did not appear to adversely affect persuasion. Increases in threat did lead to more persuasion, suggesting that while individuals who are more threatened are more skeptical and evaluate the message more thoroughly, they are also motivated to reduce their risk.

Hypothesis *7* – The high threat condition will be associated with stronger behavioral intentions to obtain the vaccine than the low threat condition.

Once individuals perceive themselves as vulnerable to a serious threat, they are motivated to seek ways to reduce the potential for harm (Leventhal et al., 1983). Meta-analytic reviews have consistently found greater acceptance of the recommendation as measured by attitudes, intentions, and behavior when individuals are exposed to a high threat message compared to a low threat message (Witte & Allen, 2000; Milne et al., 2000; deHoog, Stroebe, & deWit, 2007).

> ***Hypothesis 8*** **–** Increases in threat will be associated with an increase in memory for message content in the six-week follow-up interview.

The pattern of results for memory is expected to be similar to the predicted effects of threat on attention. The association between attention and memory has not been extensively explored in fear communication research. Most often, if memory for content is assessed, it is done so immediately following message presentation and used as an indirect measure for attention (e.g., Liberman & Chaiken, 1992). Attention is an index of message processing depth, and therefore it can be expected that messages that are processed more deeply are also remembered better. It was also proposed earlier that the high threat message will motivate defensive processing of threat information and positively biased processing of the recommendation. It was predicted that overall, the high-threat condition would be associated with greater memory for message content than the low-threat condition.

Methods

Participants and Setting

The study sample consisted of 73 women with an average age of 19.03 years (*SD* = 2.49) drawn from the undergraduate Psychology subject pool at a large state university. All participants received course credit in exchange for their participation. In addition, a raffle for an iPod Nano was conducted for participants who took part in the 6-week telephone follow-up interview. 48 women (65.75%) completed the 6-week follow-up interview. Participants were screened for vaccination status over the phone or using the pre-screening function in the undergraduate Psychology subject pool database. Only participants who had not received the cervical cancer vaccine were eligible to participate in the study. Due to incomplete electroencephalograph (EEG) and questionnaire data, one participant was excluded from all analyses. Three additional participants for whom EEG data was either missing or incomplete were excluded from analyses that required measures of attention that were extracted from the EEG data. The sociodemographic characteristics of the study sample are presented in Tables 1 and 2. The final sample consisted of 72 participants (White/Caucasian, 37.5%; Asian/Pacific Islander, 36.1%; Black/African American, 11.1%; Hispanic/Latino, 13.9%; Other, 1.4%).

Prior to the experimental session, all participants were emailed a brief overview of the EEG set-up procedure. They were informed that some washable gel may get into their hair and that sensors would be placed on their face. Participants were also requested to remove any make-up before arriving at the session. This was done to maximize participant cooperation during the session. All study sessions were conducted within the Rutgers Psychophysiology Laboratory. Experimental condition was determined by coin toss. There were 37 (51.4%) women in the low threat condition and 35 (48.6%) in the high threat condition.

The laboratory consisted of a data recording room in which the participant was seated and a control room used by the experimenters for data acquisition and questionnaire completion. The oddball task was presented using a ViewSonic E90FB 19-inch CRT monitor with a refresh rate of 16.67 ms. Senheisser HD-280 Professional headphones were used to present the audio threat communication. A second computer monitor was used by the experimenters to examine signal quality when the participant was being fitted with the cap for EEG recording. The second monitor was turned off during data acquisition. Participants were seated in a stationary office chair facing the computer monitor.

Materials

Threat Communication. The fear communication was presented over headphones. The high and low threat communications were of roughly equivalent length. The high threat communication was 16 min 45 sec in length and the low threat communication was 16 min 31 sec in length. A female graduate student provided the voice for the recordings. The tone of voice and the manner of speaking were held constant across conditions so that the only variation between conditions was the content. Information about the HPV vaccine was held constant across conditions and followed the threat communication. The content of the communications is presented in Appendix A.

The communications were developed primarily using government publications (Centers for Disease Control, 2007a, 2007b, 2008a, 2008b, 2009; National Institute for Allergies and Infectious Diseases 2007; National Cancer Institute, 2004; Ho et al, 1998).

Several passages and symptom descriptions were used verbatim from these pamphlets and government publications. The high threat message was crafted to emphasize susceptibility to HPV among college-aged women by using personalized language (e.g., “you”) and highlighting the prevalence and incidence of HPV infection in young college women. The high threat message also described the findings of Ho et al. (1998), a longitudinal study of HPV prevalence among undergraduate women at Rutgers. This three-year study found that 60% of the women participating in the study were infected during the course of the study (Ho et al., 1998).

On the other hand, the low threat message described susceptibility to HPV among women in general, with minimal reference to increased prevalence rates among young women. Other risk factors (e.g., a weak immune system, sex at an early age) for HPV were mentioned to further de-emphasize susceptibility. The low threat message included low prevalence rates for cervical cancer (1% - 4%) and referenced a report from the CDC that observed a decline in cervical cancer rates in the United States (Espey et al, 2007). Message content describing the seriousness, consequences, treatment and timeline of genital warts and cervical cancer was held constant across conditions. The vivid and graphic description of the disease symptoms were the same across conditions, except that in the high threat condition, the symptoms were described as happening to the individual (e.g., “They [warts] can also develop in your mouth or throat if you have oral sex with an infected person.”). On the other hand, in the low threat condition the symptoms were described in more passive, neutral terms (e.g., “they [warts] can also develop in the mouth or throat by engaging in oral sex with an infected person”).

Information about the HPV vaccine was held constant across conditions (see Appendix A). The message included vaccine efficacy rates for genital warts and cervical cancer, vaccine safety information and endorsements for vaccination from experts and the CDC. The message also included information on the vaccine cost, how to obtain the vaccine (i.e., offered at the university health center and/or gynecologist's office), and how to obtain a PAP test.

The communications were pilot tested in a sample of 39 undergraduate females with an average age of 18.62 years (*SD* = 2.73) who were drawn from the undergraduate Psychology subject pool. Participants were recruited for pilot testing regardless of HPV vaccination status. There were 18 women (46.2%) who had not received the vaccine and 21 (53.8%) who had received the HPV vaccine. Experimental condition was determined by way of coin toss. In the final sample there were 20 participants in the high threat condition and 19 in the low threat condition. Following message presentation, all participants completed the Risk Behavior Diagnostic scale (RBD; Witte et al., 1996) and questionnaires assessing mood and message cognitions (see Appendix C for questionnaires).

The results of the pilot test revealed that after controlling for vaccination status and sexual activity status (i.e., current/past sexual experience or no sexual experience), women in the high threat condition reported being significantly more scared ($M = 2.35$, $SD = 1.35$) than those in the low threat condition ($M = 1.37$, $SD = 0.96$), $\beta = 0.94$, $p < .05$. Participants who listened to the high threat communication also reported feeling less calm ($M = 2.8$, $SD = 1.24$) than those in the low threat communication ($M = 3.95$, $SD = 1.22$),

$\beta = -1.11$, $p < .05$. The high threat communication also produced more worry ($M = 2.65$, $SD = 1.27$) than the low threat message ($M = 1.89$, $SD = 1.15$), $\beta = .89$, $p < .05$.

Perceived severity was computed as a composite score of items 1-3 of the RBD scale. Controlling for vaccination status and sexual experience status, experimental condition had a significant effect on perceived severity. HPV was considered more serious in the high threat condition ($M = 4.82$, $SD = 0.3$) than in the low threat condition ($M = 4.14$, $SD = 0.76$), $\beta = 0.64$, $p < .05$. Items 4-6 were used to create a composite score for perceived vulnerability. Vaccination appeared to moderate the effect of experimental condition on perceived vulnerability ($\beta = -1.28$, $p < .05$). Women who had not received the HPV vaccine, reported stronger threat perceptions in the high threat condition ($M = 3.12$, $SD = 0.64$) than in the low threat condition ($M = 2.48$, $SD = 1.38$). The pattern was reversed in the vaccinated group, where the low threat condition was associated with stronger threat evaluations ($M = 2.5$, $SD = 1.15$) than the high threat condition ($M = 2.0$, $SD = 0.94$). Overall, the results of the pilot study showed that the communications produced the desired effects. In other words, the high threat communication produced significantly stronger threat perceptions and fear responses than the low threat communication.

An additional 8-item measure of threat perception and optimistic bias was also included. This scale was adapted from McGregor et al (2004) and assessed perceived susceptibility to HPV in relation to other women. Participants were asked to rate their chance of being infected with either high or low risk HPV types in comparison to most women, with a response choice ranging from 1 (*much lower than average*) and 5 (*much higher than average*). The scale also asks participant to rate other women's chances of becoming infected with HPV as well as their own chances on a scale of 0 (0%) to 10 (100%). The reliability (α) of the measure was .895.

Measures

All measures used in the study are presented in Appendix C.

Primary Variables

Fear. Immediately following the presentation of the communication, participants were asked to indicate the extent to which each item on a list of 17 mood adjectives described how they felt “at the present moment” on a 5-point scale (1 = *not at all* to 5 = *extremely*). This measure also assessed the arousal of other emotions such as anger, shame, or disgust as it has been suggested that fear appeals may elicit other emotions in addition to fear (Witte & Allen, 2000). The key items assessing fear included. 'nervous', 'tense', 'jittery', 'anxious', 'scared', 'worried', 'frightened', 'upset', and 'distressed' (Cronbach’s α = .84). Overall negative affect was computed as a composite of 'angry', 'ashamed', 'disgusted', 'nauseous' and the items used to calculate the fear composite score (Cronbach’s α = .86). This scale is derived from previous fear communication research that has used mood checklists extensively to assess fear arousal (Leventhal et al., 1965; Rippetoe & Rogers, 1987; Mewborn & Rogers, 1979; Witte, 1994; and Ruiter et al, 2001).

Perceived Threat and Efficacy. The Risk Behavior Diagnosis (RBD) scale developed by Witte et al. (1996) was used to measure dimensions of threat and efficacy. This is a 12-item measure with 4 subscales assessing perceived susceptibility, perceived severity, perceived self efficacy, and perceived response efficacy. In the present study, the scale was expanded to 19-items to incorporate efficacy evaluations pertaining to cervical cancer, genital warts, and HPV. Perceived severity was calculated as the mean of items 1-3 of the RBD (α = .78). The mean of items 4-6 comprised the score for perceived vulnerability (α =.85). Perceived response efficacy was calculated as the mean of RBD items 7-15 (α = .88) and the mean of items 16-19 represented perceived self-efficacy (α = .83).

Attitude. Derived from Witte (1994), attitude towards the HPV vaccine was assessed using a 6-item semantic differential scale (α = .9). An additional 23-item measure of message cognition was included to assess the extent to which participants felt that the threat communication was manipulative, overblown, and accurate. Items 15-23 assessed threat visualization: the extent to which the descriptions of HPV were perceived as graphic and vivid (α = .84).

Intentions. Intentions to receive the HPV vaccine was measured with the following item: “I intend to get the HPV vaccine”. Participants were also asked to provide a rationale for their response. Three additional measures to assess protection motivation included: “I plan on talking with my doctor about the HPV vaccine”, “I intend to always use a condom when I have sex”, and “I intend to talk with my friends about the HPV vaccine” with responses ranging from 1 (definitely no) to 7 (definitely yes).

Behavior. A 6-week follow up was completed over the phone (see Appendix D). Participants were asked if they had received the HPV vaccine and/or spoken to a doctor since the experimental session. In order to assess information seeking, participants were asked the extent to which they used various resources (e.g., internet, magazines, family) to get more information about HPV. Lastly, participants were asked if they had heard or read anything about the symptoms resulting from the HPV vaccine.

HPV Knowledge. Developed by Kahn et al. (2003), this measure was administered at the start of the experimental session to determine baseline knowledge about HPV. The measure consists of a series of True/False statements pertaining to HPV. The original 11-item measure was expanded to include four statements about the HPV vaccine.

Memory. Memory for message content was measured during the 6-week follow-up. The measure consisted of 14 True/False statements about HPV and the vaccine (see Appendix D). The items were based on information presented in the threat communication. Two free-response questions about the vaccine dosage and cost were also included.

Psychosocial Measures

Personal Relevance and Sociodemographic Characteristics. Previous research has shown that sexual history, such as number of lifetime sexual partners predicted willingness to receive the HPV vaccine (Kahn et al., 2003). Sexual experience, history of sexually transmitted infections (STIs), and sexual health behaviors such as condom use and annual gynecological exams were assessed. Participants were also asked about a family history of cancer. Demographic information such as age, sexuality, household income, and insurance status was also obtained

Attentional Style/Information Seeking. The Miller Behavioral Style Scale (MBSS; Miller, 1987) measures individual inclinations for information seeking along two dimensions: monitoring and blunting. In a stressful situation, high monitors and low blunters seek and prefer information about the threat as a coping response. Threat avoidance, on the other hand, is the preferred coping response of high blunters and low monitors. The MBSS describes 4 naturalistic stress-inducing scenarios such as being held hostage by terrorists. Each statement is followed by a series of eight statements, each describing a way of responding to the situation. Four of the statements describe information seeking (e.g., "I would watch every movement of my captors and keep an eye on their weapons") and four statements represent blunting or information avoidance (e.g., "I would try to sleep as much as possible"). For each scenario, the respondent is asked to check all the statements that might apply to how she might respond. A total score for blunting was determined by summing all selected information-avoidance statements (α = .60). Likewise, the sum of all information seeking statements that were endorsed represented a total monitoring score (α = .64).

Personality. The Big Five Inventory (BFI; John, Donahue, & Kentle, 1991) was included to examine possible moderating effects of personality dimensions on the relationship between the threat manipulation and vulnerability and efficacy evaluations. The BFI consists of 44-items with a 5-point Likert-type agree/disagree response scale. The five subscales that comprise the BFI are believed to measure the personality dimensions of extraversion, agreeableness, conscientiousness, neuroticism, and openness. Reliabilities (α) were .87, .76, .81, .79, and .75 respectively

Emotion Regulation. The Emotion Regulation Questionnaire (ERQ) developed by Gross & John (2003) was used to measure habitual use of reappraisal. The reappraisal subscale consists of 6-items that assess an inclination for changing one's cognitive orientation in order to regulate positive and negative emotion. The 7-point response scale is anchored at 1 (strongly disagree) and 7 (strongly agree). Cronbach's α for the scale was .75.

Measures of Attention

ERP Attention Task. A dual-task paradigm was used to measure attention. Participants completed a stimulus discrimination task while listening to the threat communication. The rotated heads visual "oddball" task as described by Begleiter et al (1984) was used as an indirect measure of attention allocation to the HPV message. Robust P300 effects have been observed in previous research where the task has been utilized (e.g., Patrick, Bernat, Malone et al., 2003; Katsanis, Iacono, McGue et al., 1997). Schematic representation of the task is presented in Figure 1.

The task involved the presentation of a frequent, neutral stimulus to which the participant was instructed to not respond and an infrequent, "oddball" target stimulus to which the participant had to respond with an appropriate button press. There are significant individual differences in the P3 component and neuro-anatomical factors such as cortical area contribute to this variability (Polich, 2007). To control for these individual differences, the visual oddball was administered as a single-task (i.e., no threat communication) to obtain a baseline measure of P3 that was used as a covariate in the analyses. The task was then repeated, except in a dual task paradigm where participants listened to the HPV communication while completing the oddball task.

The neutral stimulus consisted of a simple oval at the center of the screen. The target stimulus presented a superior/aerial view of an oval, representing a head, with a nose and an ear drawn in. The head was rotated in four possible configurations: nose up and ear on the left, nose up and ear on the right, nose down and the ear on the left, and nose down and the ear on the right. The former two configurations represented the easy condition and the latter two the difficult condition. Using a button box, participants were instructed to press the left button when the ear appeared on the left side of the head and the right button when the ear appeared on the right side of the head. In the easy discrimination condition (nose up), the head was facing forward and the location of the ear corresponded with the button position (i.e., when the ear is on the right side of the head, the participant must respond by pressing the button on her right). The targets in the difficult condition were the equivalent of a mirror image (i.e., the ear appeared on the left side of a nose down face) and the participant had to press the button on her right to indicate that ear was located on the right side of the head.

The task was designed and conducted using the software DMDX (3.2.6.3). Instructions for the task were presented on the computer and were self-paced. Participants went through a brief practice trial during which they were given feedback after each trial. No feedback was provided during baseline and message presentation.

During baseline, there were a total of 240 stimulus presentations with 160 presentations of the neutral stimulus, 40 presentations of the easy target stimulus, and 40 presentations of the difficult target stimulus[4]. The stimulus duration on the computer screen was 100 ms with an inter-trial interval (ITI) of 2 sec. The order of stimulus presentation was quasi-random such that no two targets were presented consecutively. A target was always preceded and followed by the standard, neutral stimulus. However, the number of neutral stimuli that were presented between targets was random. This was done to ensure that the P3 components had diminished prior to the start of another target trial and limit carry-over effects. The baseline oddball task lasted approximately 10 minutes. The oddball task during message presentation lasted the entire length of the communication. There were 304 trials of the neutral stimulus during message

[4] There were two pairs each of easy targets and hard targets. There were 20 trials of each type of target.

presentation. There were 76 trials each of easy and difficult targets in the high threat condition and 68 trials each of easy and difficult targets in the low threat condition. This was done to account for a 14 sec difference in length between the high and low threat communications.

The oddball task and its variations have been used extensively as a measure of attention allocation in over 1000 studies largely due to the reliability and robustness of the P300 effect (Huetell & MacCarthy, 2004). Examination of the reliability of P300 amplitude and latency in the oddball task has revealed good test-retest reliability (r = .62 to .81) suggesting that it is a stable measure (Segalowitz & Barnes, 1993; Williams, Simms, Clark & Paul, 2005). EEG recordings, reaction time and accuracy measures were obtained during baseline and message presentation.

EEG and ERP Measures. EEG was recorded using the 10-20 system with the reference electrodes linked to the mastoids (Thomas et al., 2007). The ground electrode was located between FP1 and FP2. The electrode cap was made of tin electrodes (Electro-Cap International, OH). Eye movement was measured using electrodes placed 1 cm above and below the left eye. Impedances were kept below 5 Ω. Data was recorded using a Synamps 2 amplifier and Scan 4.3 software (Neuroscan Systems, TX). Since movement of any kind, including eye blinks, can introduce noise and artifact into the EEG recording, participants were requested to move as little as possible during data recording.

The raw EEG data was first passed through a 15 Hz low-pass filter following which a regression-based blink correction procedure as described by Semlitsch et al. (1986) was applied to the data. For each trial of the oddball task, a 1000-ms epoch of

EEG signal data, beginning with stimulus onset, was selected. The 500-ms pre-stimulus interval for each epoch served as the baseline. Baseline correction was done by subtracting the average voltage occurring during the pre-stimulus interval from the 1000 ms epoch. The analyses were restricted to only accurate trials. The threshold for artifact rejection was initially set at ± 75 µV. If for a given participant more than 10% of the total trials were rejected, then the data for that participant was re-submitted for analysis with a more liberal rejection threshold of ± 50 µV (Luck, 2005).

ERP data was collected from the midline: Fz, Cz, and Pz . The amplitude measurements obtained at Pz were the focus of analyses in the present study because the target stimulus in the oddball task elicits a parietally distributed P300 and the largest P3 effects are observed at Pz (Debener, Kranczioch, Herrmann, & Engel, 2002). Visual inspection of the event-related potential waveforms elicited by the target stimuli at each of the midline electrodes indicates that the P300 effect occurred between approximately 296 ms and 515 ms after stimulus onset (see Figure 2). Pair-wise comparisons revealed that the difference in amplitude between target and the neural stimulus was significant at each of the midline electrodes during baseline. This difference in amplitude appeared to be strongest at Pz, $t(68) = 14.17$, $p < .05$ for hard vs. neutral targets and $t(68) = 16.6$, $p < .05$ for easy vs. neutral targets during baseline and $t(68) = 14.09$, $p < .05$ for hard vs. neutral targets and $t(68) = 14.67$, $p < .05$ for easy vs. neutral targets during message presentation. Table 4 and Figures 2 and 3 show that the difference in amplitude between the target and non-target was largest at Pz and smallest at the frontal electrode, Fz.

Amplitude was calculated as the difference between the mean pre-stimulus baseline voltage (i.e., -500 ms to 0 ms) and the largest positive peak within a time window following stimulus onset. The time window was based on peak activity in the grand average calculated across participants and targets for Pz. Using the approach, mean amplitude for each of the midline electrodes was obtained using the following time windows. 296 ms-496 ms for baseline, 315-515 ms for high threat, and 314-514 ms for low threat.

The latency of an ERP component is typically defined as the time between stimulus onset and the maximum positive amplitude (Polich, 2007). However, this approach to calculating latency is problematic because local peaks can be misidentified as the point of the maximum voltage and the shape of the waveform (broad versus narrow) can complicate the identification of a “true” peak (Luck, 2005). The 50% area method is considered a more robust approach for calculating latency (Luck, 2005) and was used in this study. For each stimulus presentation, the area of entire waveform starting from stimulus onset (i.e., 0 ms to 1,000 ms) was calculated. Latency of the P300 wave for each trial was the time that corresponded to 50% of the area under the curve.

P3 amplitude and latency scores were calculated for each of the electrode sites and for all stimulus types. As noted earlier, a reduction in P3 amplitude and an increase in P3 latency have been observed when task difficulty increases as well as in dual-task paradigms (Polich, 2007). P3 indexes the activation of stimulus evaluation and response set processes such that target identification is associated with higher P3 amplitude (Kok, 2001). When target identification is difficult or attentional resources are divided between two tasks it has been proposed that there is reduced activation of target recognition processes and as a result a reduction in P3 amplitude (Kok, 1997). P3 latency is interpreted as indexing the speed of stimulus evaluation and therefore latency increases in tasks where the targets are hard to discriminate and/or attentional resources are divided (Polich, 2007; Kok, 1997). In other words, stimulus processing takes longer when there is an increase in processing load and/or target complexity.

Procedure

Participants were scheduled for experimental sessions individually. The experimental session lasted approximately 90 minutes. Most of the sessions were run with a primary experimenter and an assistant. Following informed consent, participants completed a questionnaire packet that included the HPV knowledge test, sociodemographic and sexual health history measures, and personality scales (BFI, ERQ, and MBSS). Upon questionnaire completion, the experimenter briefly described the set-up procedure for obtaining EEG recordings. All participants washed their face and removed any make-up before being fitted with the cap. Alcohol wipes and an exfoliating gel were used to further clean the skin prior to attaching the electrodes. The appropriate sized EEG cap for each participant was determined based on her nasion-inion (i.e., bridge of the nose to base of the skull) and head circumference measurements. Water based electrode gel (Electro-Cap International, OH) was inserted into each of the electrode cups to improve signal conductance. Before the start of any data collection, participants were shown a recording of their EEG data and how even slight facial and body movement impaired the quality of the EEG signal. This was done to emphasize to the participant the importance of limiting her movements during data acquisition.

Participants completed a short practice for the rotated heads oddball task. The oddball task was described as a visual discrimination test that measure speed and accuracy. Self-paced instructions for the oddball task were presented on the computer screen. After the practice trial, participants went through the test version of the oddball task which served as the baseline measure of P300. Upon completion of the baseline, participants were told that they would work on the same oddball task while also listening to an audio presentation and would answer questions based on the presentation at the end of the session. The instructions emphasized that listening to the audio presentation was the primary task. The purpose of these instructions was to ensure that participants did not ignore the threat communication in preference for the oddball task because the oddball task was active and required a response, while the health communication was received passively. The verbal instructions presented by the experimenter were reiterated on the computer screen before the start of audio communication.

At the end of the dual-task, participants completed a questionnaire packet that included a mood measure, the RBD scale, optimistic bias, message cognitions, vaccine attitudes and intentions. The EEG cap and electrodes were then removed. Participants were then asked if they were would be willing to participate in a brief 6-week follow-up interview over the phone. If the participant agreed to participate, they were asked to fill out a contact form with their phone number and email address. The opportunity to win an iPod Nano® music player was offered as an incentive to participate in the follow-up. A total of 68 (89.5%) women agreed to take part in the follow-up and 48 women (65.75%) successfully completed the follow-up interview.

During debriefing, participants were told that the purpose of the study was to examine how young women think about sexually transmitted diseases such as HPV. All participants were given a print-out of the correct answers to the HPV knowledge test and a list of websites where they could obtain additional information about HPV. The resource sheet also listed the location and phone numbers for the student health centers on campus and stated that the GYN exam was free for all full-time students.

All women who agreed to participate in the follow-up were contacted 6 weeks after their respective experimental session. The follow-up interview lasted less than 5 minutes. If a participant could not be reached for the follow-up, no more than six phone call attempts were made over a 2-week period.

Results

Descriptive Statistics

Participant characteristics are presented in Tables 1 and 2. The final sample consisted of 72 participants (White/Caucasian, 37.5%; Asian/Pacific Islander, 36.1%; Black/African American, 11.1%; Hispanic/Latino, 13.9%; Other, 1.4%) with an average age of 19.03 years ($SD = 2.49$). There were no baseline differences in socio-demographic characteristics between the experimental groups ($p > .05$). Less than half the sample, $n =$ 30 (41.7%), had a family history of cancer of any type, of which two women reported having a family history of cervical cancer. The majority of the women in the sample, $n =$ 38 (52.8%), described themselves as dating or in a serious, committed relationship. More than half the women in the sample, $n = 45$ (63.4%), identified themselves as having been or currently sexually active. Seven women (9.7%) disclosed having had a sexually transmitted infection (STI). Less than half of the sexually active women, $n = 21$ (46.67%), reported getting annual PAP tests. Among women who reported getting annual PAP exams, the incidence of an abnormal PAP test result was 12.5%.

The summary of the results from the HPV knowledge test from pilot testing and the present study is presented in Table 3. The test was administered at the start of the experimental session and served as a baseline measure of HPV knowledge. Sexual activity status and sexual health behaviors such as condom usage and getting annual PAP tests were not associated with knowledge about HPV, $p > .05$. Although there appears to be some degree of familiarity with the HPV vaccine as evidenced in the high accuracy rates for test items about the vaccine, most women did not seem to know that the vaccine prevents genital warts. There also appeared to be a lack of knowledge about the effectiveness of condoms in preventing HPV. Table 3 also includes results from the pilot study. In examining the responses from the pilot study, it is interesting to note that there was no difference in accuracy between the vaccinated and un-vaccinated groups, $p > .05$. In other words, women who had received the HPV vaccine were no more knowledgeable about HPV and the vaccine than those who had not received the vaccine.

Bivariate Associations between Outcome Variables

Mood, Threat, and Efficacy Evaluations. Self-reported worry was positively associated with perceived likelihood of HPV infection, $r = .24$, $p < .05$, and perceived risk of HPV, $r = .25$, $p < .05$. Higher perceived likelihood of HPV infection was associated with the evaluation of HPV as less harmful, $r = -.26$, $p < .05$. Self-reported fear was not associated with perceived disease severity or with efficacy evaluations, $p > .05$. However, less positive affect (i.e., calm, relaxed, and restful) was correlated with stronger evaluations of vaccine efficacy, $r = .28$, $p < .05$. Vaccine efficacy evaluations were positively associated with evaluations of self-efficacy, $r = .27$, $p < .05$. Perceived vulnerability was not correlated with efficacy evaluations, $p > .05$. Nevertheless, the vaccine was also seen as more effective in preventing cervical cancer when HPV was evaluated as more serious, $r = .30$, $p < .05$.

Message Cognitions. As expected, derogatory, negative message cognitions (e.g., communication manipulative, misleading, exaggerated) were inversely associated with positive message cognitions (e.g., message accurate, objective, and learned a lot), $r = -.62$, $p < .05$. Higher perceived risk of HPV infection was associated with more negative message cognitions, $r = .26$, $p < .05$, and fewer positive message cognitions, $r = -.24$, $p < .05$. This pattern of association was reversed for perceived disease seriousness. Higher evaluations of disease seriousness were associated with fewer negative message cognitions, $r = -.24$, $p < .05$, and more positive message cognitions, $r = .37$, $p < .01$. The communication was also evaluated more positively when vaccine efficacy evaluations were higher, $r = -.24$, $p < .05$. Higher self-reported worry and fear were associated with a decrease in derogatory message evaluations, $r_{\text{worry}} = -.26$, $p < .05$; fear, $r_{fear} = -.23$, $p = .051$. The HPV symptoms described in the fear appeal were judged as more vivid, $r = .40$, $p < .01$, detailed, $r = .61$, $p < .01$, and graphic, $r = .3$, $p < .05$ when positive message cognitions were higher. Threat visualization (e.g., picturing warts, imagining the texture of warts, experiencing genital pain) was also positively associated with positive message cognitions, $r = .41$, $p < .01$.

Vaccine Attitudes and Intentions. Higher disease severity evaluations were associated with more favorable vaccine attitudes, $r = .24$, $p < .05$. Women who rated the possibility of getting a HPV infection as higher judged the vaccine to be less effective, $r = -.25$, $p < .05$, and less important, $r = -.28$, $p < .05$. The vaccine was rated as more desirable by those who felt more worried, $r = .24$, $p < .05$. More favorable vaccine attitudes were also associated stronger intentions to talk to a doctor, $r = .47$, $p < .01$, and to talk with friends about the vaccine, $r = .50$, $p < .01$. Increased perceived risk of HPV strengthened intentions to talk with a doctor, $r = .29$, $p < .05$. The more scared participants reported feeling, the stronger their expressed intentions to speak to a doctor about HPV, $r = .25$, $p < .05$. Stronger perceived self efficacy also appeared to increase intentions to talk with a doctor, $r = .35$, $p < .01$, and to talk with friends about the vaccine, $r = .26$, $p < .05$. Intentions to talk with friends about HPV were positively associated with intentions to use a condom in the future, $r = .29$, $p < .05$.

Favorable evaluations of the threat communication were associated with more positive attitudes towards the vaccine, $r = .47$, $p < .01$, stronger intentions to visit a doctor, $r = .27$, $p < .05$, and stronger intentions to talk with friends, $r = .47$, $p < .01$. On the other hand, message derogation was inversely correlated with favorable vaccine attitudes, $r = -.5$, $p < .01$, intentions to meet a doctor, $r = -.33$, $p < .01$, and to talk with friends, $r = -.45$, $p < .01$. Greater threat visualization was correlated with stronger intentions to talk with friends, $r = .36$, $p < .01$, and marginally correlated with intentions for future condom use, $r = .23$, $p = .08$.

Women who felt at greater risk for HPV wanted to get the vaccine as opposed to expressing ambivalence or rejecting the vaccine[5], $r = .24$, $p < .05$. Likewise, self-reported fear was positively associated with intentions to get the HPV vaccine, $r = .28$, $p < .05$. Evaluations of disease severity, vaccine efficacy, and self-efficacy were unrelated to vaccination intentions, $p > .05$. More favorable vaccine attitudes were positively correlated with vaccination intentions, $r = .48$, $p < .05$. While an increase in positive message cognitions was modestly associated with vaccination intentions, $r = .29$, $p < .05$, an increase in message derogation was associated with rejection of the HPV vaccine, $r = -.38$, $p < .05$.

In summary, fear was positively associated with perceptions of vulnerability but unrelated to evaluations of disease severity, response efficacy, and self-efficacy. More fearful individuals discredited the threat communication less and held more favorable attitudes towards the HPV vaccine. An increase in self-reported fear was associated with

[5] Participants could respond "Yes", "No", or "Not sure" when asked about if they intended to receive the HPV vaccine. A series of nested dichotomies were created to represent vaccination intentions (i.e., Yes = 1, No and Not sure = 0; Yes = 1, Not sure = 0, Yes = 1, No = 0; and Not sure = 1, No = 0). The correlations reported here are for the dichotomy Yes versus No and No sure.

stronger intentions to obtain the HPV vaccine and talk to a doctor. Perceived vulnerability to HPV was inversely associated with evaluations of disease severity and unrelated to perceptions of efficacy. Message derogation was positively associated with evaluations of susceptibility, while favorable attitudes towards the HPV vaccine and the threat communication were inversely associated with perceived risk. Nevertheless, intentions to obtain the HPV vaccine and to talk to a doctor were higher when women felt at greater risk for HPV. Attitudes towards the HPV vaccine were more favorable when HPV was seen as more serious. When perceptions of disease severity were higher, the threat communication was evaluated more positively and message derogation decreased. Evaluations of disease severity were however, unrelated to behavioral intentions to obtain the HPV or talk to a doctor or friends about the vaccine. Perceived self-efficacy was positively associated with perceived vaccine efficacy. Intentions to speak with a doctor and friends about the vaccine were positively associated with perceived self-efficacy. However, efficacy evaluations were unrelated to vaccination intentions. An increase in message derogation reduced behavioral intentions to obtain the HPV vaccine and to talk to a doctor or friends. By contrast, positive evaluations of the threat communication were associated with more favorable vaccine attitudes and stronger vaccination intentions.

Attention Allocation

Target Sub-types. The rotated heads oddball task consisted of two levels of target difficulty (easy and difficult) and within each of these levels there were two additional sub-types. As shown in Figure 1, there were two sub-types each of the easy and difficult target. Measures of attention were not expected to differ within the target sub-type. In other words, no differences in P300 were expected between the easy-right and easy-left target. Likewise, measures of attention for the hard-right and hard-left sub-types were not expected to differ. ERP data analysis was first conducted by treating each of the sub-types as unique. The summary of the relevant attention measures as a function of target difficulty sub-types is presented in Table 5. A series of repeated measures ANOVA were conducted with target sub-type as the within subjects factor. As expected, there were no significant differences in P300 amplitude, reaction time, or accuracy between the target sub-types during baseline or message presentation, $p > .05$. In other words, there were no significant differences between easy target type 1 and easy target type 2. Similarly, there were no differences between hard target types 1 and 2. Therefore ERP data reduction procedures were repeated after merging the sub-types within each level of task difficulty. The descriptive data after the target sub-types were merged is presented in Table 6.

Patterns of Attention Allocation. Compared to baseline, there was an increase in accuracy and a reduction in reaction time, P300 amplitude, and latency during message presentation on oddball task performance (see Table 6). A series of repeated measures ANOVAs with attention measures at baseline and message presentation serving as the within-subjects factor confirmed this trend. For P300 latency, there was a significant reduction in latency from baseline to message presentation for the easy target, $F(1, 68) = 17.8$, $p < .05$, hard target, $F(1, 68) = 5.47$, $p < .05$, and neutral stimulus, $F(1, 68) = 6.89$, $p < .05$. Likewise, there was a reduction in P300 amplitude from baseline to message presentation for the easy target, $F(1, 68) = 84.95$, $p < .05$, hard target, $F(1, 68) = 38.9$, $p < .05$, and neutral stimulus, $F(1, 68) = 142.38$, $p < .05$. Although a decrease in reaction time for the hard target from baseline to message presentation was observed, $F(1, 71) = 7.39$, $p < .05$, there appeared to be no significant difference in reaction time for the easy target between baseline and task, $F(1, 71) = .45$, $p > .05$. There was also no significant change in accuracy between baseline and task for the easy target, $F(1, 71) = 3.87$, $p > .05$. Nevertheless, accuracy in responding to the hard target did improve from baseline to message presentation, $F(1, 71) = 4.13$, $p < .05$. Overall the results appear to suggest that performance on the oddball task improved from baseline to message presentation. It is important to note here that, as is the convention with the oddball task, all analyses of attention measures were confined to only accurate trials. Therefore, a reduction in P300 amplitude, latency, and reaction time during message presentation likely implies that possibly due to task habituation, overall fewer attentional resources were required to make an accurate response.

Bivariate Associations. Correlations between the attention measures during baseline and message presentation are presented in Table 7. The patterns of association between attention measures were similar to a large extent for baseline and message presentation. During baseline, there was a strong, positive association between P300 latency for the easy and hard target, $r = .76$, $p < .01$. A strong, positive correlation between P300 amplitude for the easy and hard target was also observed, $r = .87$, $p < .01$. Longer reaction times for the easy target were associated with longer reaction times for the hard target, $r = .84$, $p < .01$. Likewise, there was also a strong positive association between accuracy for the easy and hard target, $r = .69$, $p < .01$. Longer P300 latencies were associated with larger P300 amplitudes for easy targets, $r = .46$, $p < .01$ and hard targets, $r = .53$, $p < .01$. Larger P300 amplitudes were associated with shorter reaction times for easy targets, $r = -.39$, $p < .01$. A similar inverse association between P300 amplitude and reaction time was also observed the hard target, $r = -.29$, $p < .05$. As can be seen in Table 7, the aforementioned bivariate associations for baseline were also significant during message presentation. In fact, the strength of the association in most cases appeared to increase. For example, during message presentation, the correlation between accuracy for the hard and easy target was $r = .8$ ($p < .01$) as compared to the observed correlation of $r = .69$ ($p < .01$) during baseline.

Certain associations that were absent during baseline emerged during the presentation of the threat communication. During message presentation but not during baseline, faster responses to an easy target were associated with a longer P300 wave (latency) in response to the hard target, $r = -.33$, $p < .01$. While accuracy was not significantly associated with other attention measures during baseline, better accuracy in responding to the easy target was associated with longer reaction time to respond to the hard target during message presentation, $r = .29$, $p < .05$. There was also a marginally significant positive association between accuracy and P300 amplitude for the hard target, $r = .2$, $p < .10$.

As shown in Table 8, it also appears that the pattern of associations between measures of attention differ as a function of threat level. While correlations between several of the attention measures seem to mirror each other during low threat and high threat, in the case of accuracy, the associations appeared to be reversed. In the low threat condition, accuracy and reaction time were positively associated for the easy target, $r = .39$, $p < .05$, for the hard target, $r = .33$, $p < .05$. The exact opposite trend is observed in high threat. Accuracy was inversely associated with reaction time for the easy target, $r = -.58$, $p < .01$, and the hard target, $r = -.24$, $p < .05$.

In summary, the rotated heads oddball task consisted of two sub-types each of the hard and easy target. Preliminary ERP data analysis revealed no significant differences between the target sub-types. Therefore data were averaged across target sub-types to create measures of attention (i.e., reaction time, accuracy, P3 amplitude, and latency) for the easy and difficult target. Compared to baseline, P300 latency amplitude appeared to decrease during presentation of the threat communication. While there was no change in accuracy and reaction time for the easy target between baseline and message presentation, responding to the hard target seemed to improve during message presentation as evidenced by an increase in accuracy and a decrease in reaction time.

Correlational analyses revealed strong, positive associations between each of the attentional measures for the easy and hard target during baseline and message presentation (see Table 7). In other words, an increase in P300 amplitude for the easy target was associated with a corresponding increase in P300 amplitude for the hard target. Increases in P300 amplitude and latency were also associated with shorter reaction times to respond to target. The relationship between certain measures of attention appeared to differ as a function of threat level (see Table 8). In the low threat condition, there was a positive association between accuracy and reaction time. In other words, the more accurate a participant in the low threat condition was, the longer she took to respond to both types of targets. By contrast, accuracy and reaction time were inversely related in the high threat condition. A participant in the high threat condition was more accurate the faster she responded to either of the target types.

Taken together, the results suggest that the demand for attentional resources directed towards the oddball task may have decreased from baseline to message presentation. Increases in P300 amplitude and latency are believed to reflect an increase in the allocation of attentional resources. The observed reduction of P300 during message presentation could therefore imply an overall withdrawal of attentional resources from the oddball task. However, these findings must be qualified by the findings that performance in responding to the hard target improved during message presentation suggesting that perhaps because of task habituation or practice effects, fewer attentional resources were required to make an accurate response. The purpose of the preceding analyses was to assist in interpreting the results pertaining to attention described in the following sections. The strength of using a dual-task paradigm is that it introduces a competition for processing resources that leads to the selection of one task for more elaborate processing at the cost to the other task. In the context of the present study, it was expected that the high threat communication would capture attentional resources away from the rotated heads oddball task. However, the observed pattern of attention allocation suggests that performance on the oddball task improved during message presentation, therefore the competition for attentional resources exerted by the oddball task during message presentation may not have been as potent. In other words, attention allocation to the threat communication and good performance on the oddball take may not have been mutually exclusive.

Analytic Plan

A series of hierarchical multiple regression analyses were used to test the hypotheses. Logistic regression was used to predict vaccination intentions and behavioral outcomes (Hypothesis 3). All continuous predictors were centered to reduce multicollinearity. The score on the HPV quiz was used as a covariate and represented baseline HPV knowledge on relevant analyses. All main effects were tested in Step 1 of the analysis: experimental condition, personal relevance factors, and personality variables. The personality variables included neuroticism, monitoring, and blunting. Personal relevance factors consisted of the sexual activity status and family history of cancer. Sexual activity status was a dichotomous variable (not sexually active = 0, sexually active = 1). Participants who described themselves as never having had any sexual contact were categorized as not sexual active. Women who described themselves as sexually active either currently or in the past coded as being sexually active[6]. STI history and family history of cancer were also represented as dichotomous variables. Product terms representing 2-way interactions and 3-way interactions were entered in steps 3 and 4 respectively. The exact model used to test specific predictions is specified with the findings for each hypothesis. A significant F-test for R^2 change for the step, a squared semi-partial correlation (sr^2) of .03 or greater[7], and the individual results for a given predictor were all considered in determining whether an observed effect was statistically meaningful.

Evaluations of Threat

Analyses pertaining to threat evaluations were to primarily serve as a manipulation check. It was expected that the high threat condition would be associated stronger evaluations of threat than the low threat condition. However, there was no significant main effect of threat level on threat evaluations. The dependent variable,

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[6] Preliminary exploratory analyses revealed no significant differences on the focal outcome variables between women who had been sexual active in the past but not currently and those who were currently sexually active.

[7] The squared semi-partial correlation (sr^2) represents the proportion of unique variance explained by a specific predictor

perceived vulnerability, was regressed on to threat level, sexual experience status, family history of cancer, neuroticism, and monitoring in Step 1 of the analyses. The 2-way interaction term of Cancer family history x Monitoring and the 3-way interaction term Threat Level x Cancer family history x Monitoring were entered in Steps 2 and 3 respectively. A second regression analysis with the same predictors was conducted with perceived severity as the dependent variable. The results of the analyses are presented in Table 9.

There was no significant main effect of threat level on perceived susceptibility to HPV infection. However, perceptions of disease vulnerability were stronger among sexually active women than women who were not sexually active, $B = .43$, $sr^2 = .19$, $p < .05$. This main effect was qualified by a significant 3-way interaction between threat level, family history of cancer, and monitoring, $\beta = .40$, $sr^2 = .14$, $p < .05$. The plots of the interaction effect are presented in Figure 4. In the high threat condition, having a family history of cancer appeared to strengthen perceptions of vulnerability. Disease susceptibility evaluations were also positively associated with monitoring. In other words, high monitors felt more vulnerable to HPV compared to low monitors. On the other hand, in the low threat condition, monitoring moderated the effect of cancer family history on perceived vulnerability. Among women with no family history of cancer, high monitors felt more vulnerable than low monitors. The pattern was reversed for women with a family history of cancer such that vulnerability evaluations were inversely associated with monitoring. Monitoring and cancer family history also appeared to have an interactive effect on perceived disease severity, $\beta = .33$, $sr^2 = .08$, $p < .05$. As can be seen in Figure 5, the presence of a family history of cancer increased evaluations of disease severity. While cancer family history did not appear to affect the severity ratings of low monitors, having a family history of cancer elevated the disease severity ratings of high monitors. Threat level did not affect evaluations of disease severity.

In summary, information seekers (i.e., high monitors) felt at greater risk for HPV and rated HPV as more serious when they heard a communication that emphasized disease susceptibility. In the low threat condition, information seeking was positively associated with greater perceived risk among those with no family history of cancer. However, the pattern was reversed among women with a family history of cancer. Perceptions of risk were stronger among low information seekers/avoiders (i.e., low monitors) with a family history of cancer.

Although threat level did not have an independent affect on evaluations of *self*-susceptibility, it did affect the perceived likelihood of *others* become infected. Compared to the low threat condition, participants who heard the high threat communication evaluated the average woman's risk of acquiring low-risk HPV as significantly higher, $M_{\text{low threat}} = 4.93$, $SD_{\text{low threat}} = 1.95$; $M_{\text{high threat}} = 6.04$, $SD_{\text{high threat}} = 1.93$, $B = .29$, $sr^2 = .09$, $p < .05$. The same trend emerged when participants rated the average woman's likelihood of acquiring a high-risk HPV infection, $M_{\text{low threat}} = 4.93$, $SD_{\text{low threat}} = 1.95$; $M_{\text{high threat}} = 6.04$, $SD_{\text{high threat}} = 1.93$, $B = .27$, $sr^2 = .08$, $p < .05$. There was also a modest positive association between disease severity evaluations and the perceived likelihood of others getting infected, $r_{\text{low-risk HPV}} = .29$, $p < .05$; $r_{\text{high-risk HPV}} = .26$, $p = .05$. In other words, the more serious and harmful participants thought HPV to be, the more likely they thought other women, but not themselves, would get it. Although women who heard the high threat communication may not have uniformly felt more susceptible to HPV than those who heard the low threat communication, they did evaluate the average woman as more susceptible to HPV.

Hypothesis 1 - Fear arousal, as measured by self-reported fear, will be inversely associated with attention allocation to the visual oddball task.

Correlational analyses revealed an inverse relationship between reaction time for hard targets and self-reported fear. Participants who took longer to respond to the hard target reported being more scared, $r = -.26$, $p < .05$, and frightened, $r = -.24$, $p < .05$. Accuracy, P300 amplitude, and P300 latency were not significantly associated with self-reported fear. Nevertheless, there was a non-significant positive association between P3 amplitude for easy targets and self-reported upset, $r = .21$, $p = .09$. A positive association between accuracy and self-reported calm approached significance, $r_{\text{easy target}} = .21$, $p = .08$, $r_{\text{hard target}} = .22$, $p = .06$. The analysis also suggests a marginally significant inverse association between self-reported fear and accuracy for easy targets, $r_{\text{frightened}} = -.23$, $p = .05$, $r_{\text{scared}} = -.21$, $p = .08$. Taken together, these results suggest that as participants became more fearful, oddball task performance measures of reaction time and accuracy worsened. In other words, as fear increased, attentional resources may have been directed away from the oddball task and possibly to the threat communication.

Hypothesis 2 – Threat level and target difficulty will have an interactive effect on attention allocation during the message presentation.

A series of mixed model ANOVAs were conducted with target difficulty as the within-subjects factor, threat level as the between-subjects factor, and corresponding baseline measures as the covariate. As expected, there was an effect of target difficulty on attention allocation. The covariate adjusted means are presented in Table 10. Mean P300 amplitude was lower for difficult targets than for easy targets, $F(1, 65) = 5.73$, $p < .05$. Likewise, participants took significantly longer to respond to the difficult target as compared to easy target, $F(1, 68) = 552.51$, $p < .05$ and were also less accurate in categorizing the difficult target, $F(1, 68) = 87.22$, $p < .05$. Although the effect failed to reach significance, a similar trend was observed for P300 latency, such that the latency of the P300 wave was longer for the difficult target when compared to latency for the easy target, $F(1, 65) = 1.82$, $p = .18$.

A marginally significant interactive effect of experimental condition and target difficult on accuracy was observed, $F(1, 68) = 3.63$, $p = .06$. Accuracy for the easy target was higher in the high threat condition ($M = 90.9\%$, SD =1.4) compared to low threat condition ($M = 88.5\%$, SD =1.4). However, accuracy did not appear to differ as much across conditions for the difficult target (M_{hard}= 79.4%, SD_{hard} =1.9; M_{easy}= 80.9%, SD_{easy} =1.8). Although only approaching significance, the interactive effect on P300 amplitude suggests the predicted trend of lower P300 amplitude for the difficult target under high threat ($M_{\text{High threat}}$= 12.42 µV, $SD_{\text{High threat}}$ = .54; $M_{\text{Low threat}}$ = 13.4 µV, $SD_{\text{Low threat}}$ = .55) but no difference in P3 amplitude between conditions for the easy target ($M_{\text{High threat}}$= 13.78 µV, $SD_{\text{High threat}}$ = .54; $M_{\text{Low threat}}$ = 13.7 µV, $SD_{\text{Low threat}}$ = .54), $F(1,65) = 2.28$, $p = .14$.

In summary, there was a significant effect of target difficulty on attention allocation to the oddball task during presentation of the fear appeal. Overall, the hard target was associated with reduced P300 amplitude, longer reaction time, and less accuracy than the easy target. There was limited support for the predicted interactive effect of threat level and target difficulty on attention. While performance on the oddball task did not differ by threat level for the hard target, accuracy appeared to be higher in the high threat condition than in the low threat condition for the easy target.

> ***Hypothesis 3a*** – A main effect of threat level on attention is expected. More attention will be allocated to the high threat message than the low threat. A smaller P3 effect will be observed in the high threat condition compared to the low threat condition.

Hypothesis 3b **–** Personal relevance will moderate the effect of threat level on attention.

A series of hierarchical regression analyses were conducted with each of the attention measures as the dependent variable. In step 1 of the analyses, the corresponding baseline measure of attention, threat level, sexual experience status, family history of cancer, and monitoring were entered. The 3-way interaction term of threat level, sexual experience status, and monitoring was entered in Step 2 of the analysis. The results are presented in Tables 11 and 12.

The results revealed no significant effect of threat level on attention, $p > .05$. As expected, baseline measures of attention had a significant positive association with corresponding attentional measures during message presentation, $p < .05$. For example, higher P3 amplitude during baseline was associated with higher P300 amplitude during message presentation ($\beta_{hard} = .83$, $sr^2_{hard} = .68$, $p < .05$; $\beta_{easy} = .9$, $sr^2_{easy} = .8$, $p < .05$). A similar trend was observed for P300 latency ($\beta_{hard} = .73$, $sr^2_{hard} = .52$, $p < .05$; $\beta_{easy} = .76$, $sr^2_{easy} = .55$, $p < .05$), reaction time ($\beta_{hard} = .9$, $sr^2_{hard} = .77$, $p < .05$; $\beta_{easy} = .9$, $sr^2_{easy} = .75$, $p < .05$), and accuracy ($\beta_{hard} = .75$, $sr^2_{hard} = .58$, $p < .05$; $\beta_{easy} = .74$, $sr^2_{easy} = .55$, $p < .05$).

For easy targets, there was a significant main effect of cancer family history on P300 amplitude, $\beta = .12$, $sr^2 = .07$, $p < .05$ suggesting that P3 amplitude was higher for those with a family history of cancer. A similar positive, marginally significant association was observed between cancer history and P300 latency ($\beta = .17$, $sr^2 = .06$, $p = .05$) and accuracy for easy targets ($\beta = .14$, $sr^2 = .01$, $p = .09$). The results also revealed a significant 3-way interaction effect (Threat level x Sexual activity status x Monitoring) on P300 amplitude, $\beta_{hard} = .22$, $sr^2_{hard} = .13$, $p < .05$; $\beta_{easy} = .17$, $sr^2_{easy} = .12$, $p < .05$, and latency, $\beta_{hard} = .21$, $sr^2_{hard} = .08$, $p < .05$. As shown in Figure 6, monitoring was positively associated with P300 amplitude and latency among sexually active women in the high threat condition. This trend was reversed in the low threat condition for all three attention measures. The pattern of responding among women who were not sexually active appeared quite similar across experimental conditions for P300 amplitude and latency. For hard targets, there was an inverse association between P300 amplitude and monitoring among those who were not sexually active during high and low threat. Likewise, monitoring did not appear to significantly affect P300 amplitude for easy targets and P300 latency for hard targets in either experimental condition in the non-sexually active group.

In summary, sexually active information seekers appeared to allocate more attention to the oddball task than their low monitoring counterpart in the high threat condition. By contrast, in the low threat condition, information seekers appeared less attentive to the hard target in the oddball task regardless of sexual activity status. The effect of monitoring on attention allocation among women who were not sexually active was similar across experimental conditions for each of the attention measures.

> ***Hypothesis 4*** – Threat level will be positively associated with subjective feelings of fear such that fear will be greater in the high threat condition compared to the low-threat condition.

The dependent variable was a composite fear score that included: ‘nervous’, 'tense', 'jittery', 'anxious', 'scared', 'worried', and 'frightened' (Cronbach’s $\alpha = .82$). There was no significant main effect of the threat manipulation on subjective feelings of fear. There were significant main effects of monitoring, $\beta = .27$, $sr^2 = .08$, $p < .05$, and neuroticism, $\beta = .24$, $sr^2 = .07$, $p < .05$, such that higher scores on monitoring and neuroticism were associated with stronger feelings of fear. R^2 change for the step was significant, $p < .05$. The main effects on fear were qualified by a significant 3-way interaction (see Figure 7). A family history of cancer moderated the interactive effect of experimental condition and monitoring on fear, $\beta = -.28$, $sr^2 = .08$, $p < .05$. R^2 change for the step was significant, $p < .05$. In the low threat condition, high monitors reported more fear than low monitors irrespective of family history. By contrast, in the high threat condition, high monitors were more fearful than low monitors only when they had no family history of cancer. Among women in the high threat condition with a family history of cancer, low monitors were more fearful than high monitors.

In summary, high information seekers who heard the low threat fear appeal were more fearful than low information seekers. When presented with a personalized fear appeal (i.e., high threat), high monitors with no family history of cancer were more fearful than their low monitoring counterparts. By contrast, monitoring was inversely associated with fear among women with a family history of cancer in the high threat condition. It is worth noting here that the interactive effect of threat level, cancer history and monitoring on self-reported fear appears to be the opposite of what was seen for perceived susceptibility to HPV (see Figure 4 vs. 6). In the high threat condition, information seekers with a family history of cancer felt more susceptible to HPV but less fearful. However, in the low threat condition, information seekers were overall more fearful but felt less vulnerable to HPV when they had a family history of cancer.

Hypothesis 5 **–** Perceptions of efficacy will be stronger in the high threat condition compared to the low threat condition.

There was no significant effect of threat level on perceptions of efficacy, $p > .05$. However, an increase in the number of sexual partners was significantly associated with a decrease in perceptions of self-efficacy ($\beta = -.3$, $sr^2 = .10$, $p < .05$). Attention also appeared to have a significant effect on perceived self-efficacy. P300 amplitude for hard targets was positively associated with self-efficacy, $\beta = .30$, $sr^2 = .10$, $p < .05$.

There was a significant 3-way interaction effect of threat level, monitoring and sexual activity status on perceived effectiveness of the HPV vaccine, $\beta = -.34$, $sr^2 = .11$, $p < .05$. As can be seen in Figure 8, vaccine efficacy ratings did not appear to differ in the low threat condition. On the other hand, sexually active women who were low monitors rated the vaccine as more effective than their high monitoring counterparts in the high threat condition. Monitoring did not appear to affect vaccine efficacy ratings of women who were not sexually active in the high threat condition.

In summary, an increase in the number of sexual partners was associated with lower ratings of perceived ability to obtain the HPV vaccine. Increased attention allocation to the oddball task was associated with higher self-efficacy. Monitoring appeared to moderate the effect of threat level and sexual activity status on perceived vaccine efficacy. In the high threat condition, monitoring was inversely related to perceived vaccine efficacy among sexually active women but did not seem to affect the ratings of women who were not sexually active. Evaluations of vaccine efficacy did not appear to differ between groups in the low threat condition.

Hypothesis 6 – The high threat condition will increase defensive processing of the threat communication.

The results of the hierarchical regression analyses are shown in Table 13. Defensive message processing has been described as a fear control response and typically involves message derogation and/or threat minimization. More recently, de Hoog et al. (2007) found that although motivated to reduce their risk, individuals who feel more vulnerable to a threat are also more skeptical and evaluate the message more thoroughly. Message cognition measures of defensive processing were regressed on to threat level, number of sexual partners, neuroticism and family history of cancer in Step 1 of the analysis. The product representing the interactive effect of threat level and cancer family history was entered in Step 2 and the 3-way interaction effect of Threat level x Family history of cancer x Neuroticism was entered in Step 3.

There was a significant main effect of threat level on measures of message derogation. In the high threat condition, participants felt that the communication was more exaggerated, $\beta = .31$, $sr^2 = .09$, $p < .05$. There was also a marginally significant effect of threat level on perceived manipulation, $\beta = .2$, $sr^2 = .04$, $p = .08$, such that the high threat communication was regarded as more manipulative than the low threat communication. Higher neuroticism was also associated with increased perceived message exaggeration, $\beta = .24$, $sr^2 = .06$, $p < .05$.

Cancer family history moderated the effect of threat level on perceived manipulation (β = -.47, sr^2 = .10, p < .05). As shown in Figure 9, cancer family history appeared to have no effect on perceived manipulation in the low threat condition. However, in the high threat condition, participants with no family history of cancer perceived the communication as far more manipulative than those with a family history of cancer. Threat level and cancer history also had a significant interactive effect on perceived argument quality, β = -.41, sr^2 = .07, p < .05. As can be seen in Figure 10, the quality of the arguments in the high threat communication were evaluated as superior by participants with no family history of cancer than those with a family history of cancer. In the low threat condition, the trend is in the opposite direction. Argument quality ratings were slightly higher among women with a family history of cancer.

In summary, more defensive processing was observed in the high threat condition than the low threat condition. Neuroticism was positively associated with an increase in message derogation. These main effects were qualified by a significant 2-way interaction of family history of cancer and threat level. Women with no family history of cancer judged the high threat communication as far more manipulative than women a history of cancer in the family. Although women with a family history of cancer judged the high threat communication as less manipulative, they evaluated the communication as having poorer argument quality. On the other hand, evaluations of the low threat communication did not appear to differ as a function of cancer history.

***Hypothesis** 7* – The high threat condition will be associated with stronger behavioral intentions to obtain the vaccine than the low threat condition.

The following analyses test the predicted effects for vaccination attitudes, intentions and behavioral outcomes.

Attitude. The mean of the 6-items in the vaccine attitude measure were used to create a composite score for overall attitudes towards the HPV vaccine. A higher number indicates a more favorable attitude towards the vaccine. In Step 1 of the regression analysis, vaccine attitude was regressed on threat level, sexual activity status, neuroticism, family history of cancer, and P300 latency. The interaction terms, Threat level x Cancer history and Threat level x Cancer history x Neuroticism, were entered in Steps 2 and 3 respectively. Results of the analyses are summarized in Table 14.

There was a significant 3-way interaction such that cancer family history moderated the interactive effect of experimental condition and neuroticism on vaccine attitude ($\beta = -.37$, $sr^2 = .10$, $p < .05$). R^2 change for the step was significant, $p < .05$. As shown in Figure 11a, the groups do not appear to differ on overall attitudes towards the HPV vaccine in the low threat condition. Similarly, in the high threat condition, the vaccine ratings of high and low neurotics with no family history of cancer do not seem to differ. By contrast, high neurotics with a family history of cancer rated the vaccine far less favorably than their low neurotic counterparts. It is also worth noting that there was a significant main effect of mean P300 latency for easy targets on vaccine attitudes such that longer latencies for easy targets were associated with a stronger endorsement of the vaccine, $\beta = .31$, $sr^2 = .09$, $p < .05$. This would suggest that the more participants attended to the message, the more favorable their impressions of the vaccine.

Intentions. A summary of the vaccination intentions is presented in Table 15. Forty participants (55.6%) indicated that they planned to get the HPV vaccine, 11 participants (15.3%) did not want the vaccine, and 21 (29.2%) were unsure about their vaccination plans. Participants were also asked to provide a rationale for their vaccination intentions. The majority of participants who planned to get the vaccine (77.8%) said it was for health protection and/or disease prevention reasons, (e.g., "*Worth the time to get vaccine now than be sick later"*; *"Not worth the risk of cancer")*. Generic, less specific reasons such as "*It ain't hurt to get it done*" and "*It's important*" made up 16.7% of the reasons given for wanting to get the HPV vaccine.

Sexual activity status was the most common explanation (36.4%) provided by women who did not want the vaccine (e.g., *"I'm not sexually active and don't plan on being sexually active until marriage"*; *I'm not a strong believer of pre-marital sex. I will probably have only one partner."*). The rationale for ambivalence about vaccine intentions appeared to be evenly split across concerns about vaccine safety and affordability (35.3%), sexual activity status (29.4%), and advice from doctor or family (29.4%). For example, *"my mom doesn't like me getting shots not mandatory*" and *"Family and primary care doctor are against it"*.

Logistic regression was used to test the effect of experimental condition on vaccination intentions. The predictors in the model were threat level, number of sexual partners, neuroticism, and a family history of cancer. A series of nested dichotomies were constructed to represent vaccination intention (i.e., Yes vs. No and Not sure, Yes vs. Not sure, No vs. Not sure, and Yes vs. No). Threat level was not a significant predictor of any of the nested vaccination intention dichotomies, $p > .05$. However, closer examination of the vaccination intention dichotomies revealed that the model predicting Yes vs. Not sure responses approached significance ($\chi^2 = 8.48$, $df = 4$, $p = .076$). There was a marginally significant effect of number of sexual partners such that women with more sexual partners were more likely to want the vaccine rather than express ambivalence about vaccination (*OR* = 1.47, *CI* = .99 to 2.17, $p = .053$).

Lifetime number of sexual partners also moderated the effect of experimental condition on intentions to talk a doctor ($\beta = .33$, $sr^2 = .10$, $p < .05$) and intention to talk to friends about the HPV vaccine ($\beta = .32$, $sr^2 = .09$, $p < .05$). R^2 change for the step for the respective analyses was significant, $p < .05$. As can be seen in Figures 12 and 13, an increase in the number of sexual partners strengthened intentions to speak to a doctor and friends in the high threat condition. By contrast, number of sexual partners did not appear to affect doctor intentions in the low threat condition. However, in the low threat condition, intentions to talk to friends were inversely associated with the number of sexual partners. There was also a significant main effect of attention on behavioral intentions. Reduced accuracy in responding to the hard target was associated with stronger intentions to talk to a doctor, $\beta = -.29$, $sr^2 = .08$, $p < .05$, and with friends, $\beta = -.25$, $sr^2 = .07$, $p < .05$. In other words, the worse women performed on the oddball task, the stronger their behavioral intentions.

There was a significant main effect of condom usage on future intentions to use a condom, $\beta = .56$, $sr^2 = .31$, $p < .05$. Participants who reported using a condom the last time they had sex expressed stronger intentions to use a condom in the future. There was a significant main effect of attention on intentions for condom use such that a decrease in accuracy was associated with stronger intentions to use a condom in the future, $\beta = -.36$, $sr^2 = .17$, $p < .05$. The aforementioned analysis only included sexually active women since information on past condom usage was not applicable to women who had never been sexually active. A 2-way ANOVA was conducted with threat level and relationship status (i.e., single, dating, or in a serious relationship) as the between-subjects factors. Although there was no main effect of threat level on plans for future condom use, there was a main effect on relationship status, $F(2, 72) = 6.1$, $p < .05$. The results of the post-hoc Tukey test suggest that women in a serious relationship were less inclined to use condoms in the future ($M = 4.85$, $SD = .33$) than women who were just dating ($M = 5.85$, $SD = .53$) or single ($M = 6.42$, $SD = .3$).

Behavior. The behavioral outcome measure was whether or not the HPV vaccine was obtained. During the follow-up interview, some participants indicated that they had an appointment to see the doctor about the vaccine in the future or expressed intentions to make an appointment at the end of semester or after final exams. These participants were coded as 'intending' to distinguish them from participants who indicated that they had not received the vaccine and did not intend to do so in the future. At the time of the follow-up interview, 3 women (6.25%) had obtained the vaccine, 7 women (14.58%) expressed intentions to meet a doctor, and 38 women (79.17%) had not received the vaccine. Logistic regression analyses revealed that a predictive model that included experimental condition, vaccination intentions (Yes vs. No and Not sure), perceived vulnerability, and P300 latency was a significant predictor of vaccination status ($\chi^2 = 17.23$, $df = 4$, $p < .05$). Closer examination of the individual predictors revealed that women who expressed intentions to obtain the vaccine were significantly more likely to have received the vaccine or made specific plans to get the vaccine ($OR = 29.18$, $CI = 1.53$ to 557.53, $p < .05$). Although threat level and risk perceptions did not predict vaccination uptake, attention allocation during message presentation appeared to be positively associated with vaccine uptake, *OR* = 1.02, *CI* = 1.004 to 1.04, $p < .05$. In other words, more attention allocation to the oddball task was associated with an increased likelihood of obtaining the HPV vaccine.

Hypothesis 8 **–** Increases in threat will be associated with an increase in memory for message content in the six-week follow-up interview.

The results from the HPV knowledge test administered during the follow-up interview are summarized in Table 16. The content of the HPV test was based on information presented in the threat communications. The test included two open-ended questions about the vaccine dosage and cost. No single participant was entirely accurate on her recollection of the vaccine dosage. Partially accurate responses specified that there were 3 doses but no one accurately recalled the actual vaccination schedule. These responses were given half-credit. Out of a possible score of 16, the average score on the test was 11.51 (*SD* = 1.46).

Threat level, baseline HPV knowledge, perceived vulnerability to HPV, and P300 latency were regressed on to the total quiz score. There was a significant main effect of threat level on HPV knowledge during the follow-up, $\beta = .38$, $sr^2 = .15$, $p < .05$. Participants who heard the high threat communication were more accurate (*M* = 11.95, *SD* = .22) than those who heard the low threat message (*M* = 11.03, *SD* = .36). Baseline HPV knowledge was positively associated with accuracy, $\beta = .30$, $sr^2 = .09$, $p < .05$. The results also revealed a significant main effect of attention on memory such that longer P300 latencies for the easy target, $\beta = .23$, $sr^2 = .06$, $p < .05$, and hard target, $\beta = .30$, $sr^2 = .09$, $p < .05$, were associated with better memory. Perceived risk for HPV was not a significant predictor of memory.

In conclusion, the high threat condition was associated with better memory for the content of the HPV communication than the low threat condition. Although increases in perceived risk for HPV did not improve memory for message content, attention allocation to the oddball task was positively associated with better performance on the HPV knowledge test.

Discussion

The primary objectives of the present research were to (a) examine if varying the level of threat content in a fear appeal affects message processing depth (i.e., attention allocation) and (b) examine the effect of attention allocation on appraisals of threat, efficacy, and persuasive outcomes. The present research sought to assess one central element of message processing: attention. In addition to a real-time measure of attention allocation, we also sought to examine the relationship between attentional style (i.e., monitoring) and the affective, cognitive and behavioral outcomes following exposure to a fear communication. The secondary objective of the present research was to examine factors influencing HPV vaccine acceptability among college-aged women, a population at high-risk for HPV infection but insufficiently studied in recent HPV vaccination acceptance research.

Attention and Message Processing

At first glance, it appears that the observed effects for attention were in the opposite direction than what was expected. One of the focal hypotheses of the present research was that threat level would moderate the effect of target difficulty on attention allocation. Although there was limited support for this prediction, the marginally significant trend that emerged was better response accuracy for the hard target in the high threat condition compared to the low threat condition and no difference in accuracy between conditions for the easy target. Although no difference in accuracy was expected for the easy target, the opposite effect was expected for the hard target (i.e., worse accuracy in the high threat condition). It was predicted that due to competition for attentional resources from the high threat fear appeal, participants would be less accurate in responding to the difficult stimulus because it required more processing resources. These results taken together with the positive association observed between accuracy and P300 amplitude under high threat (see Table 8) suggest that attention was withdrawn from the fear appeal and devoted to the oddball task under high threat. This would support a defensive avoidance argument such that participants in the high threat condition diverted their attention away from the fear-eliciting message and towards the oddball task; however, closer examination of the results suggested a more complex pattern of attention allocation.

First, we note that performance on the oddball task improved from baseline to message presentation (see Table 6). This is evidenced in the significant increase in accuracy and decrease in reaction time for the hard target from baseline to message presentation. We also note that there were significant reductions in P300 amplitude and P300 latency from baseline to message presentation. These results may appear counter-intuitive at first. Improved performance implies more attention allocation to the oddball task; however, there was a reduction in P300 during message presentation suggesting withdrawal of attentional resources from the oddball task. As suggested in the previous section, one way to reconcile these contradictory findings is that the oddball task became easier due to task habituation resulting in a decrease in demand for attentional resources from the oddball task.

Given that cognitive processing resources such as attention have capacity limitations, an inverse association was expected between attention allocation to the oddball task and attention directed towards processing the fear appeal. In other words, it was assumed that participants would not be able to attend equally to both tasks at the same time. However, the findings from the present study suggest otherwise--comprehensive message processing and attention allocation to oddball task may have in some cases been positively associated. The strongest support for this assertion comes from the main effect of P300 latency on memory for message content wherein longer P300 latencies (i.e., more attention allocation to the oddball task) during message presentation were associated with greater knowledge about HPV in the 6-week follow-up interview. Similarly, longer P300 latencies were associated with more favorable vaccine attitudes and shorter reaction times were inversely associated with favorable message cognitions, $r = -.24$, $p < .05$, and threat visualization, $r = -.30$, $p < .05$. Higher P300 amplitude during message presentation was associated with increased perceived self-efficacy. Taken together these results suggest that greater attention allocation to the oddball task can be interpreted to a certain extent as indicative of deeper, more comprehensive message processing.

Indeed, Ravden and Polich (1998) observed habituation of P300 amplitude in a visual discrimination oddball task when the interval between trial blocks was very short and a large number of trial blocks were used (i.e., parameters similar to those used in the present study). It is believed that habituation of P300 occurs because the stimulus discrimination process becomes automated resulting in a reduction in the utilization of the attentional resources (Polich, 1989; Donchin et al., 1986). As can be seen in Tables 6 and 7, although there was a reduction in P300 amplitude and latency, the pattern of bivariate associations between attentional measures remained consistent from baseline to message presentation (e.g., P300 amplitude was inversely associated with reaction time during baseline and message presentation). Therefore, the results suggest that responding to the oddball task may have been largely automated during exposure to the fear communication and a result, an increase in attention may reflect processing of both the fear appeal and the oddball task.

Even if we accept the premise of automated responding to the oddball task during exposure to the fear appeal, the pattern of findings for attention is not readily interpretable. The 3-way interactive effect (Threat level x Sexual activity status x Monitoring) on attention indicates that monitoring was inversely associated with P300 amplitude and latency during exposure to the low threat communication (see Figure 6). This could be interpreted as low monitors (i.e., distracters) directing attention away from the threat communication to the oddball task while monitors withdrew attentional resources from the oddball task to the fear appeal. The pattern of results observed for low threat are consistent with the present study's hypotheses as well as the empirical literature on monitoring that suggests high monitors are inclined towards cognitive vigilance to threat while low monitors seek to avoid it. However, if we were to apply this interpretation to the results observed under high threat, it would suggest that sexually active, high monitors directed attention away from the fear appeal to the oddball task, while sexually active, low monitors directed attention towards the fear communication and away from the oddball. These results would imply that when a threat is highly salient (i.e., being sexually active and listening to a personalistic fear appeal about a STI), high monitors engage in cognitive avoidance while low monitors engage in deeper processing. However, there is limited empirical support for the argument that high monitors, when presented with detailed and fear-eliciting information about a threat, avoid it and that low monitors would seek to elaborate on the threat. The empirical research on monitoring appears to support the perspective that high monitors tend to engage in more in-depth processing indicated by knowledge retention. By contrast, content appears to affect depth of processing for low monitoring such that greater knowledge retention and more behavioral adherence is observed when health and/or risk communications are brief and contain minimal information about the threat (Miller et al., 1999; Williams-Piehota et al., 2005).

Another competing interpretation of these findings could be that measures of attention (i.e., P300, reaction time and accuracy) reflect overall effort. Indeed, P300 has been positively associated with the amount effort invested in a task (Luck, 2005). In the context of the present study, an increase in P300 may be interpreted as an increase in resource allocation for the purpose of message processing and target identification. The effort hypothesis is consistent with the attention effects observed for memory (i.e., positive association between P300 and HPV knowledge retention).

Personal Relevance, Fear and Risk Perception

The study findings highlight the impact of personal relevance factors on affective and cognitive outcomes related to fear appeal exposure. Although threat level did not independently have an effect on risk perceptions, the analyses revealed a significant 3-way interactive effect of Threat level x Family history of cancer x Monitoring on perceived vulnerability for HPV infection. Independent of threat level, high monitors were more fearful and felt more susceptible to HPV than low monitors when they had no family history of cancer. However, when they had a family history of cancer, high monitors were more fearful but felt less vulnerable to HPV than low monitors in the low threat condition. The exact opposite pattern emerged in the high threat condition. High monitors with a family history of cancer reported less fear but higher risk perceptions than their low monitoring counterparts. The results also revealed that while low monitors' ratings of HPV severity were similar irrespective of cancer family history, high monitors rated HPV as far more serious when they had a family history of cancer. To summarize, having a family history of cancer did not uniformly increase fear and perceptions of risk and severity. Moreover, contradictory to research findings on attentional styles in clinical settings, the relationship between monitoring and risk perceptions was not monotonic. It is unclear why high monitors with a family history were less fearful but felt more vulnerable in the high threat condition. It is possible that although high monitors felt more vulnerable, they were reassured to an extent by the efficacy information (i.e., the vaccine). The pattern also emerged in the low threat condition for low monitors. Low monitors with a family history of cancer felt at greater risk for HPV but were still less fearful than their high monitoring counterparts. Previous research has noted that low monitors tend to experience less negative affect (Miller & Mangan, 1983). It is possible that the low threat communication matched the needs of low monitors since the threat was described using more neutral language with fewer statistics. Recent work has found that tailored health risk information can motivate deeper processing and health promoting behavior among low monitors (Williams-Piehota et al., 2004).

Sexual Activity Status and Behavioral Intentions

Women who were sexually active, either in the past or currently sexually active, felt at greater risk for a HPV infection than women who had never had sex. Although this effect was qualified by a significant 3-way interaction effect (Threat level x Monitoring x Family history of cancer), sexual activity status appeared to exert considerable influence on motivations to reduce risk. While the number of sexual partners did not affect intentions to talk to a doctor about the HPV vaccine in the low threat condition, women who had more sexual partners indicated stronger intentions to talk to a doctor in the high threat condition than women who had fewer sexual partners. Likewise, number of sexual partners was positively associated with intentions to talk with friends following exposure to the high threat communication. However, in the low threat condition, women with fewer sexual partners expressed stronger intentions to talk with friends than women with more sexual partners. It is likely that women with fewer sexual partners assessed the risk of HPV infection as low and therefore the need to talk with a doctor or friends as irrelevant. Moreover, a high number of sexual partners and sexual initiation at an early age were listed as risk factors for HPV in the low threat message. As a result, the low threat communication may have held implications of sexual promiscuity for women with more sexual partners making them less inclined to speak with friends about the HPV vaccine. Despite the positive association between number of sexual partners and behavioral intentions in the high threat condition, women who had more sexual partners had lower perceived self-efficacy about obtaining the HPV vaccine.

Nevertheless, there was a marginal increase in the likelihood of intending to get the HPV vaccine as the number of sexual partners increased. Exploring rationales women gave for their vaccination intentions provides insight into beliefs about who should get the HPV vaccine. Although cancer family history was a significant moderator of threat-related cognitions, having a family history of cancer was never explicitly mentioned as a reason for wanting the vaccine. By contrast, approximately one-third of the participants who did not intend to get the vaccine or were unsure about it listed not being sexually active as their rationale. Indeed, Kahn et al. (2003) found that women believed that individuals with multiple sexual partners represented one of the populations for whom the HPV vaccine was intended. More recently, Caskey, Lindau and Alexander (2009) observed that lack of sexual activity was the primary reason provided by younger women (13-17 years) for not receiving the HPV vaccine. Parental disapproval also accounted for approximately a third of the reasons given for not wanting or expressing ambivalence about the HPV vaccine in the present study. These findings are also consistent with previous research that found college-students were more willing to receive the HPV vaccine if they believed parents would approve of vaccination (Boehner et al., 2003).

Vaccine Attitudes and Defensive Processing

Attitudes towards the HPV vaccine were overall extremely favorable, with one notable exception. In the high threat condition, neuroticism was inversely associated with favorable attitude towards the vaccine among women who had a family history of cancer. Although, neuroticism was positively associated with self-reported fear, it was unrelated to evaluations of threat and efficacy. High neurotics also endorsed more derogatory evaluations of the fear communication (e.g., message exaggerated). The strong, positive association between neuroticism and trait hostility (Carmody, Crossen, & Wiens, 1989; Hart & Hope, 2004) might explain the overall skeptical evaluation of the fear appeal by high neurotics. However, it remains unclear why high neurotics who evaluated the communication poorly held favorable attitudes towards the vaccine, except when they were exposed to the high threat communication and had a family history of cancer. One potential explanation could be that high neurotics who heard the high threat fear appeal felt particularly at risk for HPV but were nevertheless negatively biased about the vaccine's effectiveness in helping them (e.g., "It may not work for me"). Indeed, Vollrath, Knoch and Cassano (1999) observed that even though neuroticism was inversely related to engaging in risky health behaviors (e.g., smoking, drunk driving, unprotected sex), individuals high in neuroticism still felt more susceptible to health risks. However, since neuroticism was unrelated to risk perception there is limited support for this hypothesis in the present study.

Risk perceptions and fear were both positively associated with message derogation. Evaluations of vulnerability were also inversely associated with evaluations of disease severity, and women who felt at greater risk for HPV also judged the vaccine to be less effective and less important. Taken together these findings would be indicative of threat minimization and defensive processing; however, susceptibility evaluations and self-reported fear were positively correlated with intentions to consult a doctor about the vaccine. Although women with a family history of cancer did not perceive one fear appeal as more manipulative than the other, they judged the high threat communication as having weaker arguments than the low threat communication. On the other hand, women with no family history of cancer indicated that the high threat communication was more manipulative than the low threat communication but nevertheless rated the quality of arguments presented in the high threat appeal as superior to the arguments in the low threat message. The evidence for threat minimization and defensive processing from the present study supports an interpretation similar to the findings of the meta-analysis by De Hoog et al. (2007) that observed a positive relationship between threat and defensiveness that did not appear to adversely affect persuasion. In other words, motivations to reduce risk may not necessarily preclude skepticism about the validity of threat and the communication.

Vaccine Uptake, Information-Seeking and HPV Knowledge Retention

Threat level and risk perceptions did not predict vaccine uptake. On the other hand, women who expressed intentions to obtain the vaccine after the experiment were more likely to have obtained the first dose of the HPV vaccine or expressed specific plans of making an appointment with the doctor to obtain the vaccine, when contacted six weeks later. Vaccination uptake was also positively associated with information-seeking behavior. Women who got the vaccine were more likely to have talked with friends about the HPV vaccine, $r = .45$, $p < .05$. The same positive association between vaccination status and information-seeking was observed for talking to family and using the internet to learn about HPV, but the effect only approached significance, $r_{family} = .24$, $p = .10$, $r_{internet} = .24$, $p = .11$. These results are consistent with a recent study by Nielson and Shapiro (2009) that found that exposure to a high threat, high efficacy fear appeal about drunk driving biased processing resources to threat-related information (e.g., alcohol-related advertising). It appears that vaccination uptake was associated with a cluster of other information-seeking behaviors that perhaps served as cues to action. Women who obtained the vaccine appeared to have consulted friends and family in addition to their doctor. Although several studies on HPV vaccination have noted the importance of parental approval in HPV vaccine uptake (.g., Caskey et al., 2009; Boehner et al., 2003; Brewer & Fazekas, 2007), there has been little work on other sources of social support. The present study did not measure subjective norms but it is also possible that perceived social acceptability of getting the HPV vaccine may have motivated action.

It was expected that the high threat condition would be associated with better knowledge retention about HPV because of deeper message processing. Indeed, women exposed to the high threat fear appeal knew more about HPV at the follow-up than women exposed to the low threat appeal. Information-seeking behaviors measured at the follow-up (i.e., internet, talking with family, friends or doctor) were unrelated to HPV knowledge. In other words, seeking information about HPV did not increase knowledge. However, as mentioned earlier, attention allocation was positively associated with memory for content. Longer P300 latencies during message exposure were associated with increased likelihood of obtaining the vaccine. Longer latencies were also associated with better memory for message content. Furthermore, longer P300 latencies were associated with vaccination uptake. These results lend further support to the effort hypothesis—that the observed increase in P300 coupled with the improvement in overall performance on the oddball during message presentation may reflect increased processing resource allocation to both the oddball task and the fear appeal.

Lastly, another intriguing finding in the study was that not a single participant who completed the follow-up interview was able to accurately recall all the specifics about vaccination dosage and cost. This finding may be indicative that the cognitive processing (i.e., attention, comprehension and memory) for threat and efficacy information were different. Indeed, research on dual-process models of attitude change have noted that efficacy information is processed less thoroughly when behavioral recommendations that follow a fear appeal are presented with certainty (e.g., expert endorsement) (Nabi, 2002). The fear appeals used in the present study contained high efficacy content, so it is possible that the efficacy information was evaluated less thoroughly. Another factor that could have contributed to less effortful processing of the vaccine information is the length of the fear appeal. The communications used in the present study exceeded 10 minutes and therefore participants may have fatigued.

It is also worth noting that women who had received the vaccine were no more knowledgeable about HPV at the follow-up. These findings mirror the results from the pilot test of the fear communications that found that vaccination status did not predict knowledge about HPV. Caskey et al. (2009) also observed a similar effect in their national survey about HPV knowledge and vaccination; however, they found that vaccinated women were more likely to know that the vaccine prevented cervical cancer and that condoms should be used regardless of vaccination status. Nevertheless, these findings do suggest that women are getting the HPV vaccine while not necessarily learning more about HPV or the vaccine.

Limitations

Most often fear appeals are brief. The fear appeals presented in the study were long and detailed, and as a result, this raises concerns about the generalizability of the findings. It can also be argued that the experimental set-up with the EEG recording and the oddball task does not represent the contexts in which people are typically exposed to a fear communication. While this is certainly a valid argument, there are real-life situations where elaborate risk information is presented to a captive audience (e.g., a sex education class in school). The dual-task paradigm, while an artificial set-up, may also capture real-life situations such as driving and listening to a news story about the swine flu or HIV where processing may have to be divided between the news story and a task that may be relatively automated (i.e., driving).

The dual-task paradigm was a measure of relative attention allocation, but due to task habituation effects, it appears that resource allocation between the two tasks may not have been wholly reciprocal. The task habituation effect was seen largely because the oddball task remained unchanged from baseline to message exposure. It is possible that varying the oddball task (e.g., longer intervals between targets, different types of targets) may have captured the expected inverse relationship between message processing and oddball task performance. However, since the oddball task was response-focused and listening to the fear appeal was a passive task, it is likely that task modifications may have uniformly directed attention away from the more passive task.

Another limitation of the study was the longitudinal component which was a telephone follow-up interview conducted six weeks after the experimental session. This may have not provided adequate time for vaccination uptake because women typically meet their gynecologists and doctors during a routine annual visit. Indeed, approximately 15% of the participants who completed the follow-up indicated that they were scheduled to see a doctor only after final exams or at the end of the semester. It is possible that we may have observed more vaccine adoption six months following the experimental session because more participants may have visited a doctor. Nevertheless, the present study did find vaccine uptake despite the relatively brief period between message exposure and the follow-up, suggesting that the fear appeal did motivate protective action and women may have chosen to not wait till an annual visit.

In addition to encouraging HPV vaccination, the fear appeal also recommended annual PAP exams. During debriefing, participants were also provided with detailed information on how to obtain a free GYN exam at the University health center. However, we did not measure intentions or behavioral outcomes related to PAP testing. It is possible that women may have been more willing to get the PAP exam than the vaccine because they could get it free. Moreover, women who had concerns about vaccine safety but nevertheless felt susceptible to HPV, may have been motivated to get a PAP test as a health protective measure.

Significance and Future Directions

Over half a century of research on fear communications has shed considerable light on the role of message elements in facilitating persuasive outcomes. For instance, fear appeals with potent threat information tend to be more effective than those with minimal information about the threat. Somewhat less understood are the mechanisms by which a fear appeal affects persuasion. The present study used a novel methodological paradigm to examine message processing in the context of fear communications. Specifically, the study sought to examine the cognitive, affective and behavioral consequences of attention allocation to a fear appeal. The relevance of studying attention in the context of fear communications stems from a robust body of emotion research that has observed a facilitatory effect of fear arousal on attention capture and sustained allocation to the eliciting threatening stimulus. Although the effect of fear arousal on attention, perception and higher-order cognitive processing is not new to emotion research, it is a novel empirical question in the domain of fear communication. Indeed, a novel finding of the present study was that increased attention allocation was associated with more fear arousal, greater HPV knowledge retention, and vaccine uptake. The present study has contributed a novel experimental paradigm for studying fear communications that extends beyond studies that rely exclusively on questionnaire survey data following exposure to a fear appeal.

Using the dual-task paradigm, future studies can examine other ERP components such as the novelty P300, an ERP component observed when an unexpected non-target stimulus (e.g., a briefly flashed image of Mickey Mouse during the rotated heads oddball task) is detected. It would be of interest to examine if attentional effects change as a function of the relevance or salience of the novelty to the threat. For example, in the context of the present study, would novelty stimuli related to HPV (e.g., picture of a condom or a needle) capture more attention than a neutral, novelty target? Similarly, research on fear has suggested that the detection of threat activates or primes attentional and cognitive processing systems for further, future detection of threat. Most recently, Nielson and Shapiro (2009) found that exposure to a high efficacy fear appeal facilitated attention to threat-related stimuli, while a low efficacy fear appeal reduced or suppressed detection of threat-related stimuli. In light of these findings, it would be of interest to examine if systematic message processing is antecedent to the observed attention suppression effects following exposure to a high threat, low efficacy fear appeal, or if attention is withdrawn at the level of message processing.

The findings of the present study also help further clarify factors that influence HPV vaccine acceptability in college-aged women. Parental disapproval, concern over vaccine safety, and beliefs about sexual promiscuity and the need for the vaccine were the main barriers to vaccine adoption among women. Since the HPV vaccine has also recently been approved men, it would be of interest to examine if there are gender differences in the perceived barriers to vaccine adoption. HPV is a unique health threat in that it has both immediate and distal health consequences (i.e., genital warts and cervical cancer respectively). While genital warts are benign in terms of their health impact, they have the potential to increase feelings of shame and embarrassment, and have adverse effects on social functioning. It may also be of greater relevance to a younger population. Cervical cancer, on the other hand, is a severe threat to one's physical integrity. It would be of interest to examine if the proximal and distal consequences of HPV and benefits of vaccination differentially influence motivation to get vaccinated.

Moreover, health and risk communications about the HPV vaccine that target women emphasize protection of one's own health with little or no mention of protecting future sexual partners from being infected. The HPV vaccine offers men protection from genital warts but a vaccinated male can also help reduce the risk of cervical cancer in his female sexual partners by not infecting them with high-risk HPV strains. It would be informative to examine if framing a threat communication to focus on self vs. other protective benefits of the HPV vaccine influences vaccine acceptability and uptake.

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Table 1.

Participant characteristics

Characteristic (*n* = 72)	n (%)	Mean ± SD
Age		19.03 (2.49)
Race/Ethnicity		
Asian/Pacific Islander	26 (36.1%)	
Black/African American	8 (11.1%)	
White	27 (37.5%)	
Hispanic/Latino	10 (13.9%)	
Other	1 (1.4%)	
Year in School		
Freshman	52 (73.2%)	
Sophomore	8 (11.3%)	
Junior	6 (8.5%)	
Senior	5 (7.0%)	
Relationship Status		
Single, not dating	34 (47.2%)	
Dating	12 (16.7%)	
In a serious relationship	25 (34.7%)	
Married	1 (1.4%)	
Annual Family Income		
< $50,000	14 (19.4%)	
$50,000 - $100,000	31 (43.1%)	
$100,00 - $400,000	24 (33.3%)	
> $500,000	3 (4.2%)	
Health Insurance		
Not insured	2 (2.8%)	
Rutgers student health insurance	8 (11.1%)	
Private insurance	59 (81.9%)	
Medicaid	2 (2.8%)	

Table 2.

Sociodemographic characteristics

Characteristic (n = 72)	n (%)	Mean ± SD
Sexual Orientation		
Heterosexual	68 (94.4%)	
Bisexual	4 (5.6%)	
Age of first sexual intercourse		16.56 (2.98)
Number of sexual partners (lifetime)		2.08 (2.93)
Number of sexual partners (past 6 months)		0.84 (0.79)
Sexual Experience		
No history of sexual contact	26 (36.6%)	
Sexual contact in the past, not currently active	14 (19.7%)	
Sexually active	31 (43.7%)	
Condom use during last sexual intercourse		
No	19 (42.2%)	
Yes	26 (57.8%)	
Frequency of condom usage		
Always	21 (44.7%)	
Sometimes	18 (38.3%)	
Rarely	3 (6.4%)	
Never	3 (6.4%)	
Annual Pap smear gynecological exams		
No	48 (66.7%)	
Yes	24 (33.3%)	
History abnormal pap test	3 (4.2%)	
History sexually transmitted infections (STIs)	7 (9.7%)	
Family History		
Cervical cancer	2 (2.8%)	
Any cancer	30 (41.7%)	

Table 3.

Baseline knowledge about Human Papillomavirus (HPV) during pilot testing and in the present study

	n (%) answering correctly		
	Present Study (*n* = 72)	**Pilot Study** (*n* = 43)	
Item		Not received HPV vaccine (*n* = 20)	Received HPV vaccine (*n* = 23)
1. A person may be infected and not know it	70 (97.2%)	20 (100%)	23 (100%)
2. Those with HPV may need Pap smears more often	58 (80.6%)	10 (50%)	15 (65.2%)
3. HPV is spread by sexual intercourse	58 (80.6%)	15 (75%)	17 (73.9%)
4. Pap smears detect HPV	57 (79.2%)	18 (90%)	17 (77.9%)
5. HPV can be cured with antibiotics	61 (84.7%)	17 (85%)	16 (69.6%)
6. HPV causes abnormal menses	52 (72.2%)	15 (75%)	18 (81.8%)
7. Smoking increases chance of cancer	69 (95.8%)	19 (95%)	22 (95.7%)
8. Condoms do not help protect you from HPV	22 (30.6%)	8 (40%)	7 (30.4%)
9. HPV goes away with right treatment	52 (72.2%)	13 (65%)	13 (56.5%)
10. Certain types of HPV always cause cancer	20 (40.3%)	8 (40%)	10 (43.5%)
11. HPV can cause problems with pregnancy	63 (87.5%)	19 (95%)	20 (87%)
12. HPV types 16 and 18 cause 50% of cervical cancer cases	7 (9.7%)	2 (10.5%)	3 (13%)
13. The HPV vaccine prevents against all types of HPV	59 (81.9%)	15 (75%)	21 (93.5%)
14. The HPV vaccine is administered over 6 months	59 (81.9%)	17 (85%)	20 (87%)
15. PAP tests are not needed once you get the HPV vaccine	70 (97.2%)	20 (100%)	23 (100%)
16. The HPV vaccine prevents against genital warts	15 (20.8%)	5 (25%)	5 (21.7%)
Average Score	**10.68 ± 1.59 (66.75%)**	**10.56 ± 1.54 (65.97%)**	**10.38 ± 1.36 (64.88%)**

Table 4

Mean difference in P300 amplitude (µV) between targets and the non-target during baseline and message presentation.

	Baseline (n = 69)				**Message Presentation** (n = 69)			
	Easy target vs. Non-target		Hard target vs. Non-target		Easy target vs. Non-target		Hard target vs. Non-target	
Electrode	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Fz	3.56	4.68	3.41	4.45	1.21	4.35	1.43	5.1
Cz	8.71	5.47	7.72	5.38	6.81	5.64	6.43	6.05
Pz	12.32	6.16	11.15	6.56	11.24	6.36	10.40	6.13

Table 5

Summary of attention measures as a function of subcategories of target difficulty during baseline and message presentation

	Baseline – Mean (SD)				**Message Presentation – Mean (SD)**			
	Easy Target		Hard Target		Easy Target		Hard Target	
	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2
P300 Amplitude (µV) n = 69	16.8 (6.6)	16.77 (6.2)	16.14 (7.2)	16.13 (6.9)	13.39 (6.93)	13.58 (6.94)	12.40 (6.00)	13.00 (6.48)
Reaction Time (ms) n = 72	583.9 (107.9)	568.4 (103.4)	686.6 (111.0)	669.1 (102.4)	580.3 (96.9)	569.7 (104.7)	671.6 (102.7)	661.1 (100.6)
Accuracy n = 72	.86 (.16)	.87 (.17)	.77 (.17)	.76 (.19)	.89 (.13)	.9 (.14)	.8 (.18)	.81 (.18)

Note. Variation in sample size is due to missing or incomplete EEG data for 3 participants.

Table 6

Measures of attention as a function of threat level and target difficulty during baseline and message presentation

	Baseline – Mean (SD)			Message Presentation – Mean (SD)		
	Easy Target	Hard Target	Neutral	Easy Target	Hard Target	Neutral
P3 Amplitude (μV) *n* = 69	17.17 (6.4)	16.00 (7.0)	4.85 (2.6)	13.74 (6.9)	12.91 (6.3)	2.5 (2.4)
P3 Latency (ms) *n* = 69	389.41 (83.8)	383.78 (98.6)	304.47 (43.4)	356.76 (83.8)	364.35 (87.3)	292.51 (38.5)
Reaction Time (ms) *n* = 72	578.60 (98.1)	681.51 (97.8)		574.7 (97.7)	665.57 (99.1)	
Accuracy *n* = 72	0.87 (.14)	0.77 (.16)		0.90 (.13)	0.80 (.17)	

Note. Since no response was required for the neutral stimulus, reaction time and response accuracy data is not meaningful and therefore not reported here. Variation in sample size is due to missing or incomplete EEG data for 3 participants.

Table 7

Correlational matrix of associations between measures of attention during baseline and message presentation

Measure	P3 Latency (Easy)	P3 Latency (Hard)	P3 Amplitude (Easy)	P3 Amplitude (Hard)	Reaction Time (Easy)	Reaction Time (Hard)	Accuracy (Easy)	Accuracy (Hard)
P3 Latency (Easy)	--	.76**	.46**	.34**	-.21†	-.14	-.04	-.17
P3 Latency (Hard)	.83**	--	.54**	.53**	-.23†	-.15	.14	-.01
P3 Amplitude (Easy)	.56**	.53**	--	.87**	-.39**	-.31**	.19	.13
P3 Amplitude (Hard)	.53**	.59**	.90**	--	-.34**	-.29*	.22†	.23†
Reaction Time (Easy)	-.15	-.33**	-.40**	-.35**	--	.84**	-.16	.06
Reaction Time (Hard)	-.11	-.23†	-.32**	-.27*	.89**	--	.14	.21†
Accuracy (Easy)	-.08	.08	.18	.16	.06	.29*	--	.69**
Accuracy (Hard)	-.04	.12	.17	.20†	.002	.14	.80**	--

Note. Intercorrelations for baseline (n = 69) are above the diagonal and intercorrelations for message presentation (n = 69) are shown below the diagonal. **$p < 0.01$, * $p < .05$, † $p < .10$.

Table 8

Correlational matrix of associations between measures of attention as a function of threat level

Measure	P3 Latency (Easy)	P3 Latency (Hard)	P3 Amplitude (Easy)	P3 Amplitude (Hard)	Reaction Time (Easy)	Reaction Time (Hard)	Accuracy (Easy)	Accuracy (Hard)
P3 Latency (Easy)	--	$.85^{**}$	$.56^{**}$	$.53^{**}$	-.13	-.08	-.2	-.06
P3 Latency (Hard)	$.82^{**}$	--	$.58^{**}$	$.60^{**}$	$-.37^{*}$	$-.38^{*}$	-.13	.09
P3 Amplitude (Easy)	$.58^{**}$	$.51^{**}$	--	$.91^{**}$	$-.43^{*}$	$-.35^{*}$	.03	.19
P3 Amplitude (Hard)	$.52^{**}$	$.58^{**}$	$.90^{**}$	--	$-.30^{\dagger}$	-.26	-.05	.16
Reaction Time (Easy)	-.17	$-.31^{\dagger}$	$-.38^{*}$	$-.39^{*}$	--	$.93^{**}$	$.39^{*}$	$.30^{\dagger}$
Reaction Time (Hard)	-.13	-.14	$-.31^{\dagger}$	-.27	$.83^{**}$	--	$.52^{**}$	$.33^{*}$
Accuracy (Easy)	.01	.22	$.29^{\dagger}$	$.33^{\dagger}$	$-.58^{**}$	-.30	--	$.81^{**}$
Accuracy (Hard)	-.02	.14	.19	.24	$-.47^{**}$	-.24	$.82^{**}$	--

Note. Intercorrelations in the high threat condition (n = 35) are shown below the diagonal. Intercorrelations in the low-threat condition (n = 34) are shown above the diagonal. $^{**}p < 0.01$, $^{*}p < .05$, $^{\dagger}p < .10$.

Table 9

Hierarchical regression analyses of threat evaluations following a threat communication about HPV (n = 67)

	Perceived vulnerability				Perceived severity			
Predictor	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2
Step 1	.24*				.23*			
Threat level		0.22	0.09	0.01		0.24	0.19	0.04
Sexual activity status		1.08	0.43*	0.19		-0.03	-0.02	0.00
Family history of cancer		0.42	0.17	0.04		-0.07	-0.06	0.00
Monitoring		0.05	0.10	0.01		0.09	0.40*	0.16
Neuroticism		0.03	0.09	0.01		0.00	0.02	0.00
Step 2	.07*				.06*			
Cancer family history x Monitoring		-0.26	-0.36*	0.09		0.12	0.33*	0.08
Step 3	.10*				.01			
Threat level x Monitoring x Cancer family history		0.47	0.40*	0.14		-0.06	-0.10	0.01

Note. Variations in sample size due to missing or incomplete questionnaire data on specific measures.
* $p < .05$.

Table 10

Covariate adjusted means of attention allocation to the oddball task as a function of target difficulty during message presentation (n = 69)

	Easy Target		**Difficult Target**	
	Mean	S.E.	Mean	S.E.
P3 Amplitude (µV)	13.74	0.38	12.91	0.38
P3 Latency (ms)	356.77	6.92	364.37	7.10
Reaction Time (ms)	574.65	5.67	665.56	5.76
Accuracy	.89	0.01	.80	0.01

Table 11

Hierarchical regression analyses predicting P300 amplitude and latency on the rotated heads oddball task (n = 66)

	P300 Amplitude (µV)								**P300 Latency (ms)**							
	Hard target				Easy Target				Hard Target				Easy Target			
Predictor	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2
Step 1	.68*				.82*				.53*				.57*			
Baseline measure		0.75	0.83	0.68		0.96	0.89	0.81		0.65	0.73	0.52		0.70	0.76	0.55
Threat level		-0.29	-0.02	0.00		0.20	0.01	0.00		-4.09	-0.02	0.00		-0.99	-0.01	0.00
Monitoring		-0.26	-0.11	0.03		0.03	0.01	0.00		-2.36	-0.01	0.00		-4.70	-0.03	0.00
Sexual activity status		-1.22	-0.09	0.03		0.96	0.07	0.02		-1.86	-0.06	0.01		2.87	0.09	0.02
Cancer family history		0.32	0.03	0.00		1.63	0.12*	0.07		-3.48	-0.02	0.00		29.07	0.17*	0.06
Step 2	.04*				.02*				.04*				.01			
Threat level x Monitoring x Sexual experience status		1.24	0.22	0.13		1.01	0.17	0.12		16.18	0.21*	0.08		7.67	0.10	0.02

Note. Variations in sample size due to missing or incomplete questionnaire or EEG data. * $p < .05$.

Table 12

Hierarchical regression analyses predicting reaction time and accuracy on the rotated heads oddball task (n = 69)

	Reaction Time (ms)								**Accuracy**							
		Hard target				Easy Target				Hard Target				Easy Target		
Predictor	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2
Step 1	.78*				.77*				.59*				56*			
Baseline measure		0.89	0.88	0.77		0.88	0.89	0.75		0.80	0.75	0.58		0.69	0.74	0.55
Threat level		-0.54	0.00	0.00		-1.94	-0.01	0.00		-0.02	-0.05	0.01		0.03	0.11	0.03
Monitoring		-7.59	-0.04	0.01		3.90	0.02	0.00		-0.03	-0.08	0.02		-0.03	-0.10	0.02
Sexual activity status		-4.33	-0.12	0.06		-1.85	-0.05	0.01		0.00	-0.04	0.00		0.00	-0.08	0.01
Cancer family history		-3.79	-0.02	0.00		-3.73	-0.02	0.00		0.03	0.09	0.02		0.04	0.14	0.04
Step 2	0				.01				.01				.01			
Threat level x Monitoring x Sexual experience status		-1.28	-0.01	0.00		-8.61	-0.10	0.03		0.02	0.12	0.03		0.01	0.11	0.02

Note. Variations in sample size due to missing or incomplete questionnaire or EEG data. * $p < .05$.

Table 13

Hierarchical regression analyses of defensive processing of the threat communication (n = 66)

	Perceived Manipulation				Argument Quality				Perceived Exaggeration			
Predictor	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2	ΔR^2	B	β	sr^2
Step 1	.22**				.09							
Threat level		0.65	0.20*	0.04		-0.28	-0.11	0.01	.13*	0.92	0.31**	0.09
Family history of cancer		-1.17	-0.36**	0.13		-0.45	-0.17	0.03		-0.12	-0.04	0.00
Neuroticism		0.09	0.19*	0.03		-0.07	-0.19	0.04		0.11	0.24**	0.06
Number of sexual partners		-0.10	-0.18	0.03		0.05	0.11	0.01		0.04	0.08	0.01
Step 2	.08**				.06**				0			
Threat level x Family history of cancer		-1.83	-0.47**	0.08		-1.28	-0.41**	0.06		-0.30	-0.08	0.00
Step 3	.03				0				.04*			
Threat level x Family history of cancer x Neuroticism		0.23	0.21	0.03		-0.05	-0.06	0.00		0.23	0.23*	0.04

Note. Variations in sample size due to missing or incomplete questionnaire data. *$p < .10$. ** $p < .05$.

Table 14

Hierarchical regression analyses predicting attitudes towards the HPV vaccine (n = 67)

		Attitude towards HPV vaccine		
Predictor	*Δ* R^2	*B*	*β*	sr^2
Step 1	.14*			
Threat level		-0.24	-0.13	0.02
Family history of cancer		-0.17	-0.09	0.01
Sexual activity status		-0.12	-0.06	0.00
Neuroticism		-0.06	-0.24*	0.06
P300 latency [easy target]		0.004	0.31**	0.09
Step 2	.02			
Threat level x Cancer family history		-0.60	-0.25	0.02
Step 3	.10**			
Threat level x Neuroticism x Cancer family history		-0.24	-0.37**	0.10

Note. A positive *β* indicates more a favorable attitude towards the HPV vaccine. Variations in sample size due to missing or incomplete questionnaire data on specific measures. * p < .10. **p < .05 .

Table 15

HPV vaccination intentions and provided rationale

Vaccination Intentions	**Yes**	**No**	**Not sure**
	40 (55.6%)	11 (15.3%)	21 (29.2%)
Rationale			
Health protection/disease prevention	28	1	0
Vaccine affordability and/or safety	0	1	6
Family and/or doctor advice	1	2	5
Sexual activity status	1	4	5
Generic	6	2	1
No rationale given	4	1	4

Table 16

Responses to the HPV knowledge test administered at the 6-week follow-up telephone interview

Item	n (%) answering correctly: Total (*n* = 48)	Low Threat (*n* = 22)	High Threat (*n* = 26)
1. HPV infection can be prevented by using condoms	19 (39.6%)	9	10
2. High-risk strains of HPV cause 70% of all cervical cancer cases	44 (91.7%)	19	25
3. In the United States, HPV is most common among 15-24 year olds	44 (91.7%)	20	24
4. There is no real treatment for HPV	22 (45.8%)	6	16
5. Warts caused by HPV can also appear around the mouth or the anus	39 (81.3%)	18	21
6. The HPV vaccine is most effective in preventing cervical cancer only in woman who have had no previous history of HPV infection	32 (66.7%)	13	19
7. The vaccine prevents against all types of HPV	39 (81.3%)	17	22
8. The vaccine was found to be 100% effective in preventing genital warts among all women	39 (81.3%)	16	23
9. Annual pap tests are not needed once you get the vaccine	45 (95.7%)	19	26
10. Genital warts are only contagious when they are visible	47 (97.9%)	22	25
11. HPV symptoms can appear several years after infection	47 (97.9%)	21	26
12. Once you have had HPV, you cannot get the infection again	42 (87.5%)	20	22
13. Abnormal periods are one of the symptoms of the later stages of cervical cancer	41 (85.4%)	17	24
14. The vaccine is recommended only for women who have never had a history of HPV infection or abnormal Pap test results	34 (70.8%)	16	18
15. Do you recall when or how frequently is the vaccine administered?			
15a. Number of doses	22 (45.8%)	11	11
15b. Dosage	0	0	0
16. Do you recall the cost of the vaccine?	8 (17%)	4	4
Quiz Total	**11.51 ± 1.44 (71.94% ± 9.1)**	**11.03 ± .36 (68.9% ± 10.5)**	**11.92 ± .22 (74.5% ± 6.8)**

Figure 1. Schematic of the rotated heads oddball task adapted from Begleiter et al (1984). Participants indicated on which side of the head the ear was located with the appropriate button press. Stimulus was presented for 100 ms followed by a inter-trial interval (ITI) of 2 sec. Target was always preceded and followed by at least one presentation of the neutral stimulus

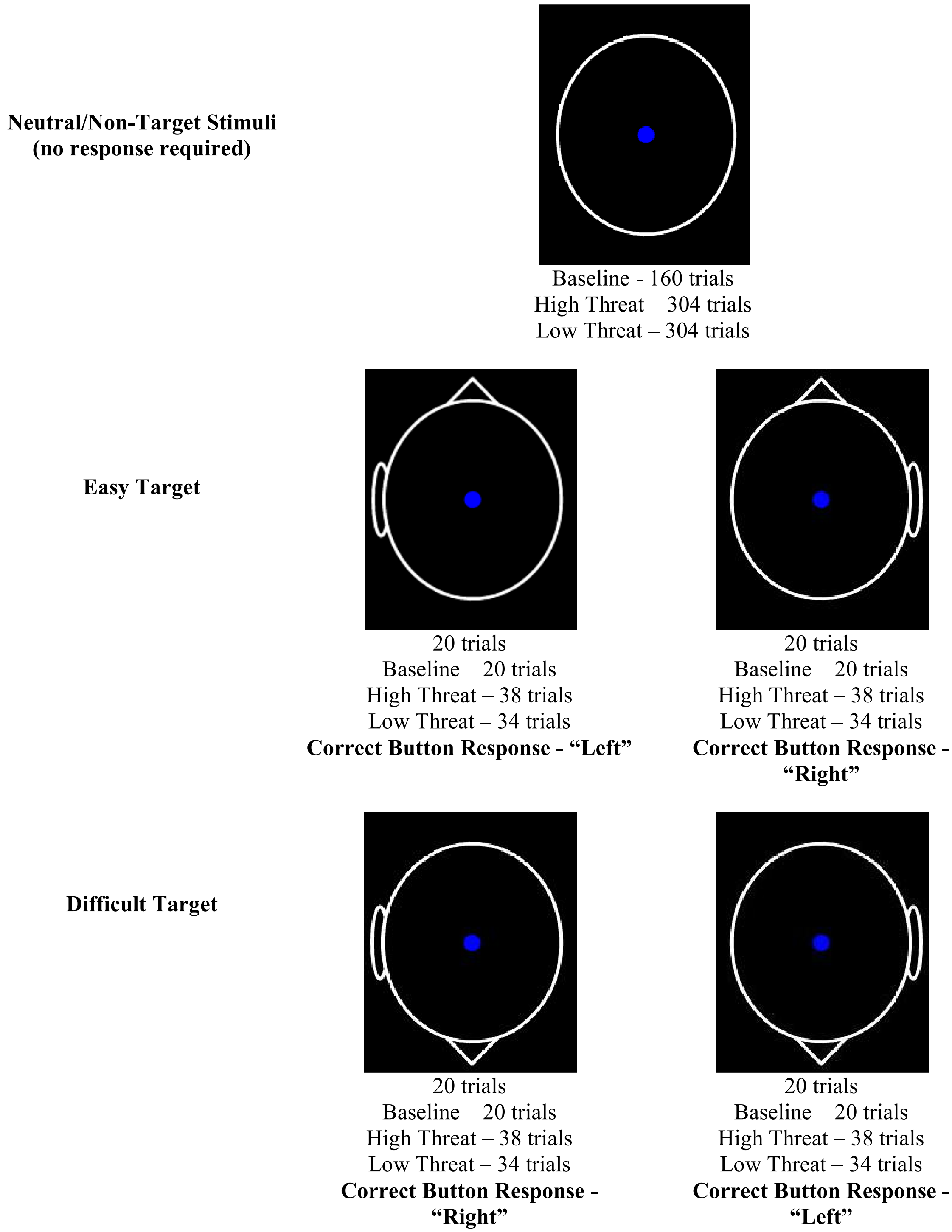


Figure 2. Grand average event-related brain potential (ERP) waveforms elicited during baseline and presentation of low threat and high threat communications. Data presented for all 69 participants from the midline sites Fz, Cz, and Pz for neutral, easy, and difficult stimuli

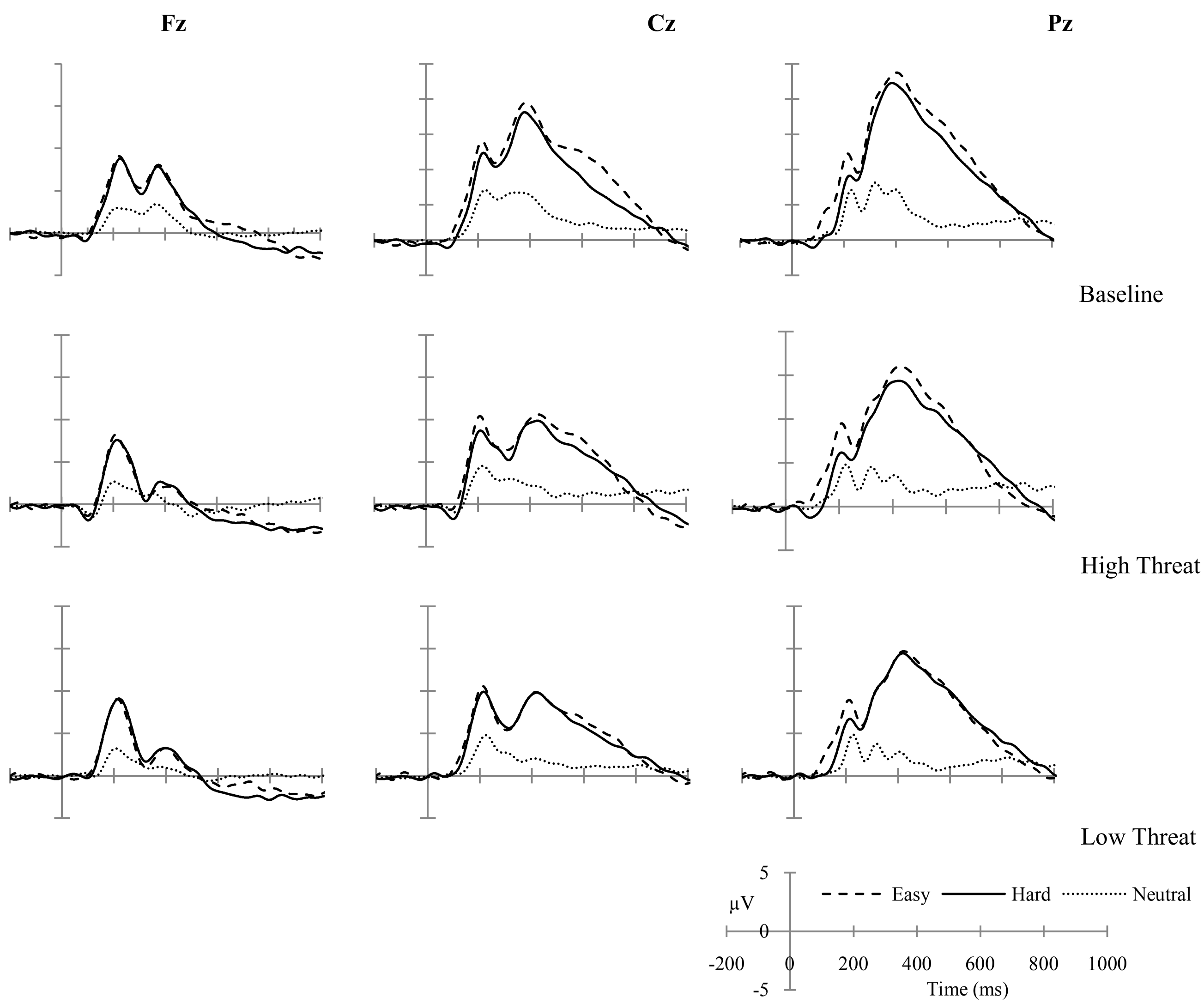
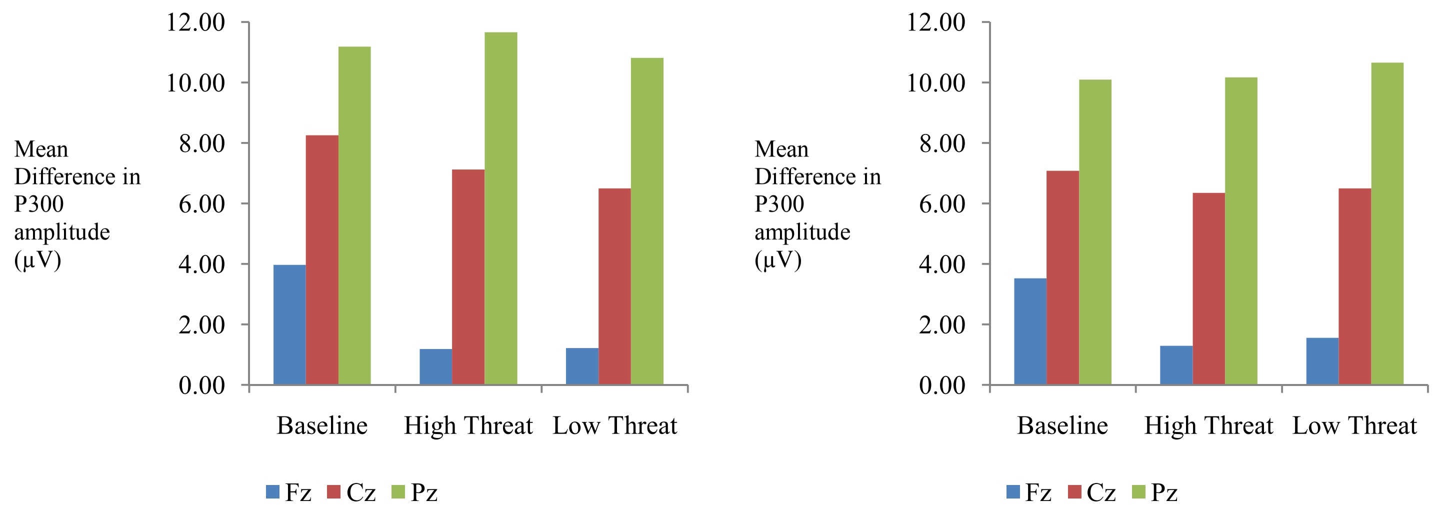


Figure 3. Mean difference in P300 amplitude during baseline and message presentation between (a) easy target and neutral stimulus and (b) hard target and neutral stimulus for each of the midline electrode sites

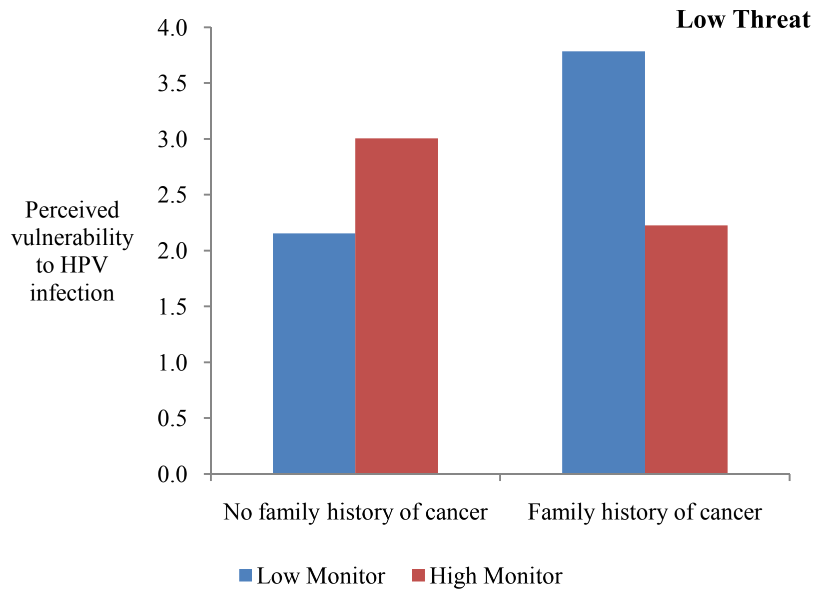


A (Easy target versus Non-target)

B (Hard targets versus Non-target)

Figure 4. The interactive effect of family history and monitoring on perceived vulnerability to HPV infection under (a) low threat and (b) high threat

a.



b.

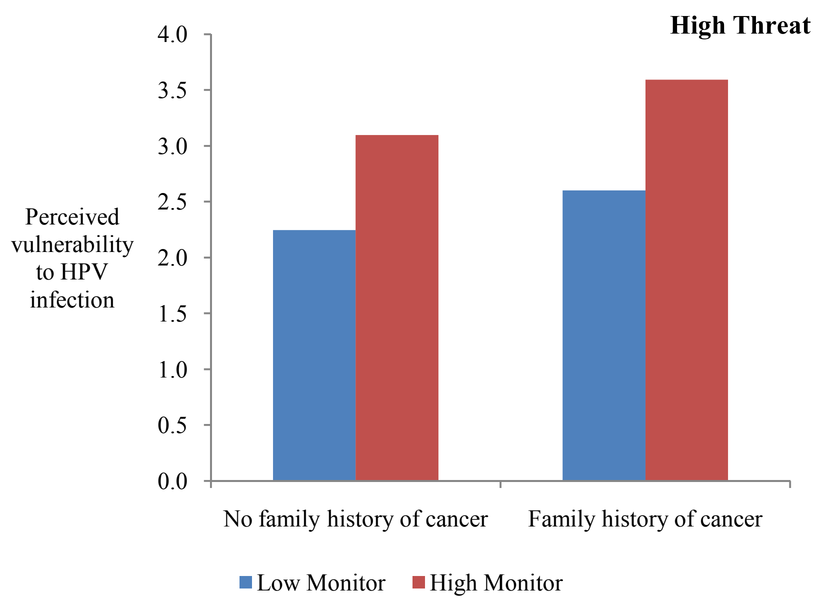


Figure 5. The interactive effect of monitoring and family history of cancer on perceptions of HPV severity

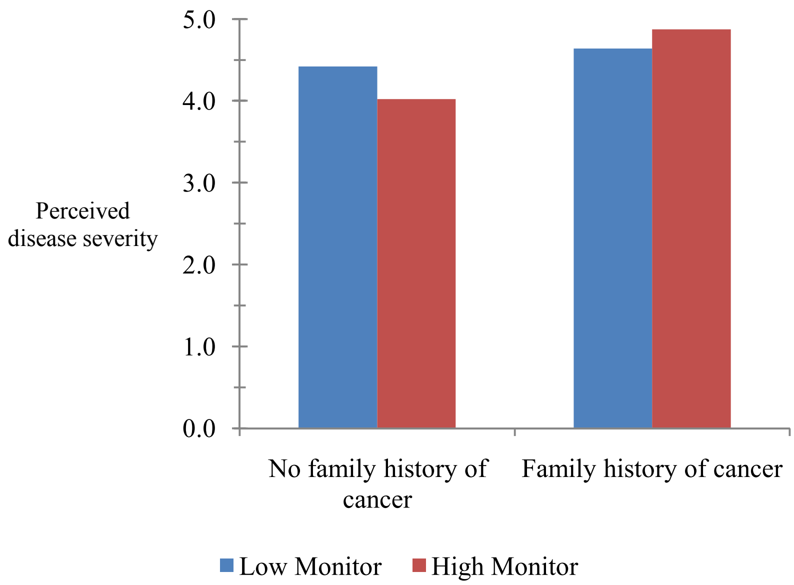
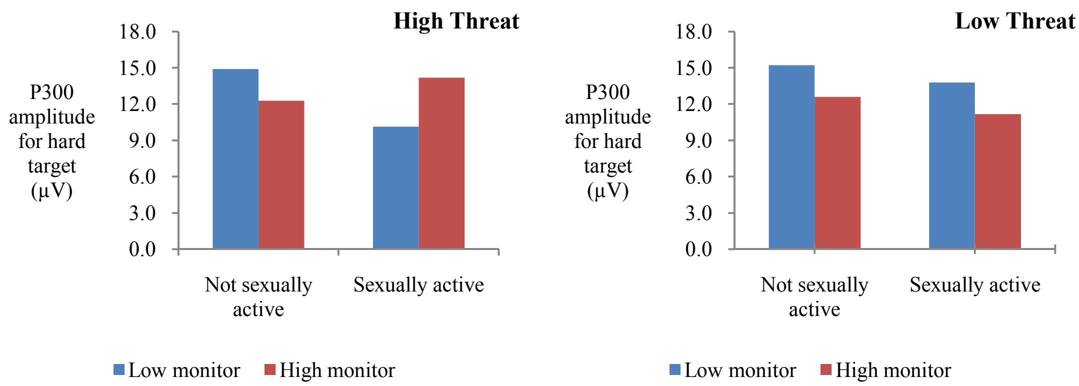
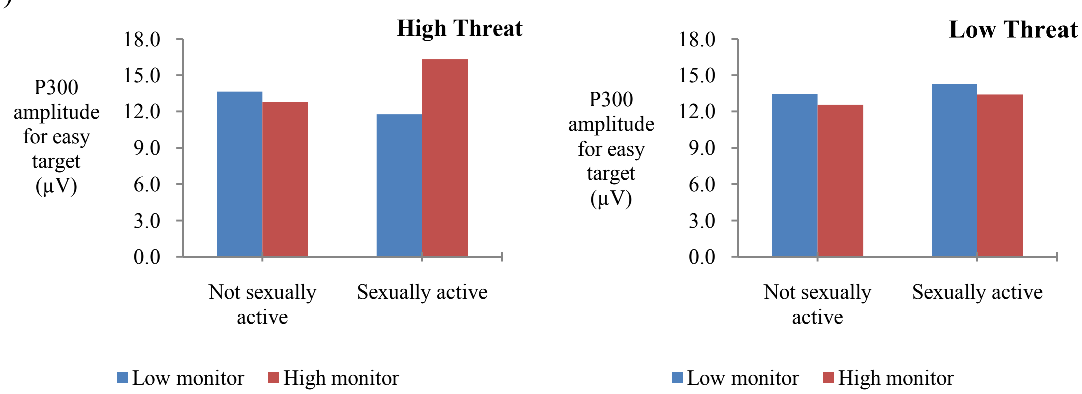


Figure 6. 3-way interaction effect of threat level, monitoring, and sexual activity status on ERP measures of attention during the rotated heads oddball task

(a)



(b)



(c)

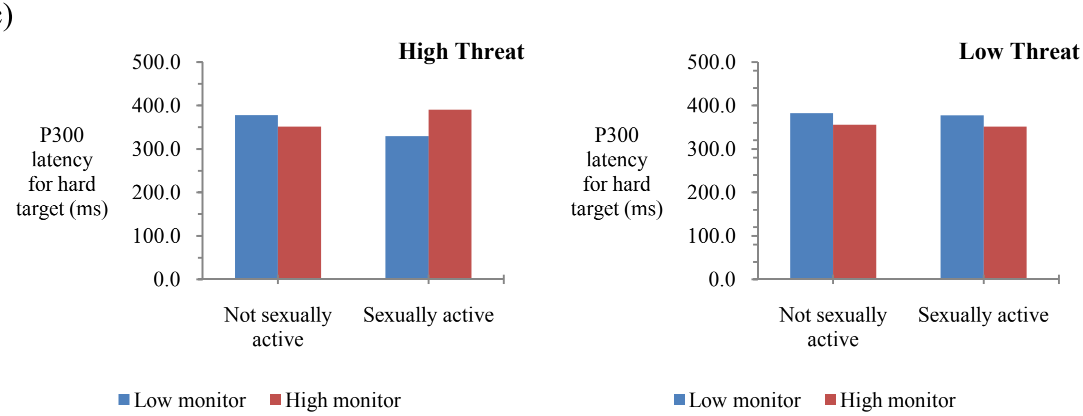
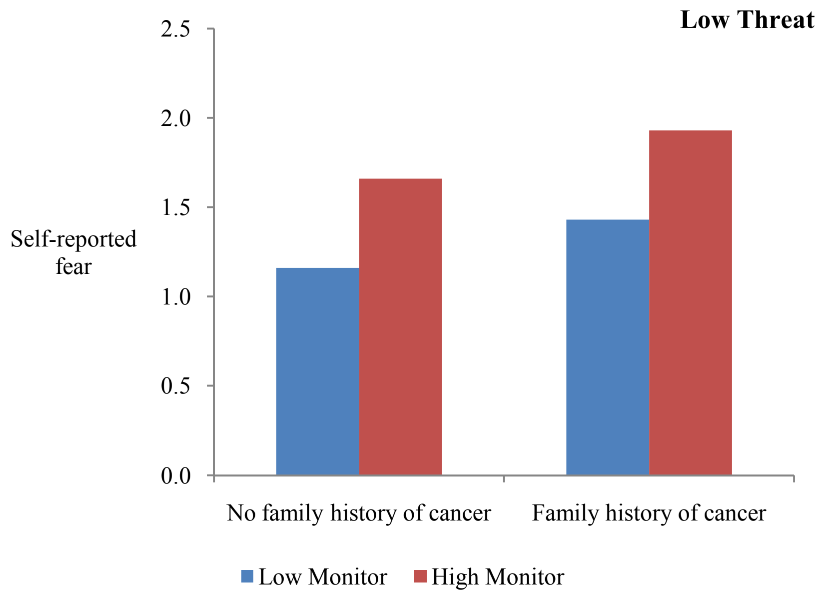


Figure 7. The 3-way interaction effect of threat level, family history of cancer, and monitoring on self-reported fear

(a)



(b)

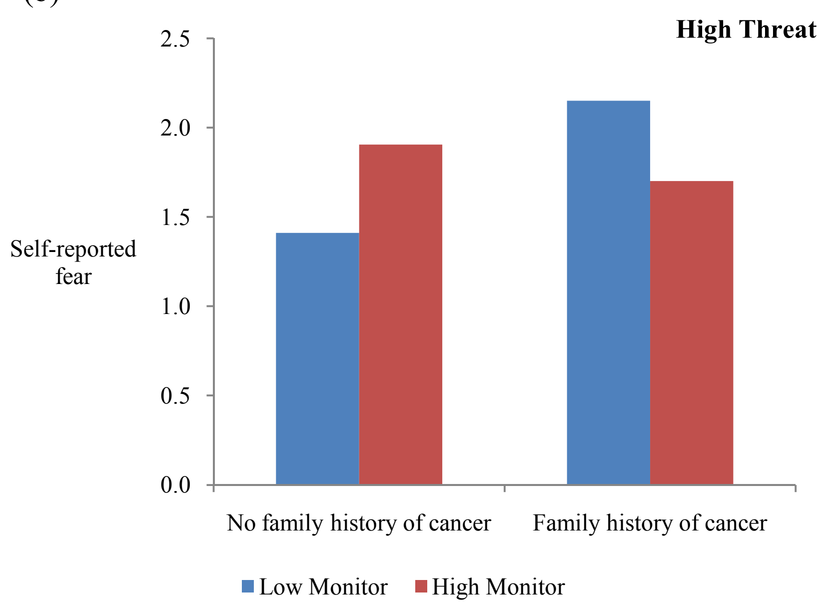
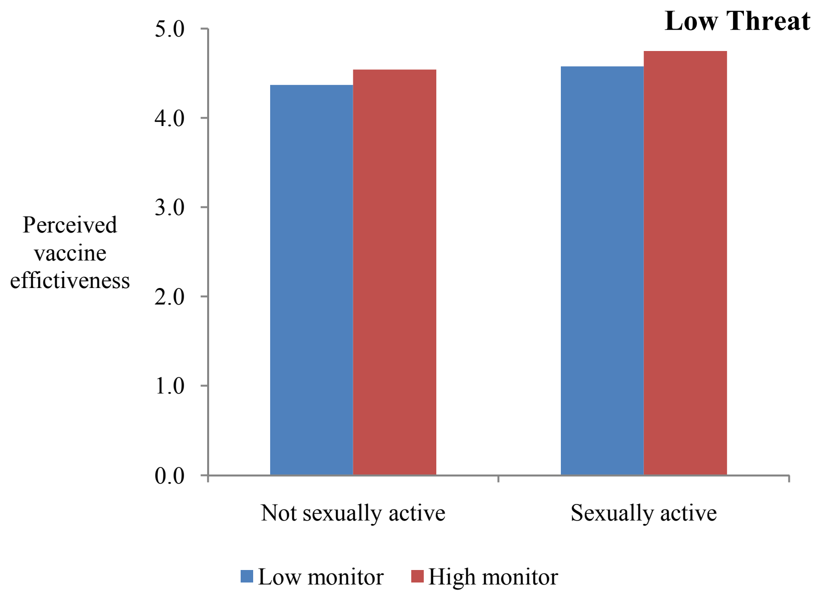


Figure 8. The 3-way interactive effect of threat level, monitoring, and sexual activity status on perceived vaccine efficacy

(a)



(b)

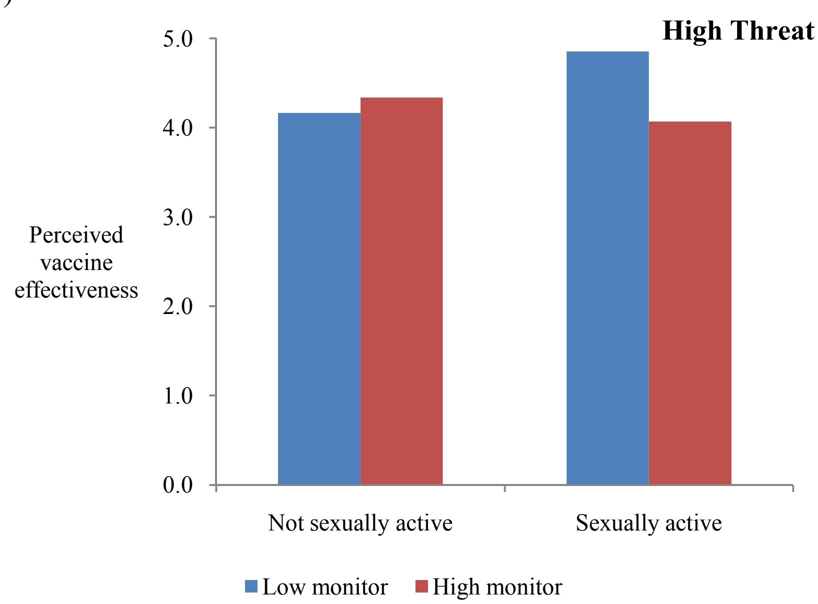


Figure 9. The effect of threat level and a family history of cancer on defensive processing of the fear appeal

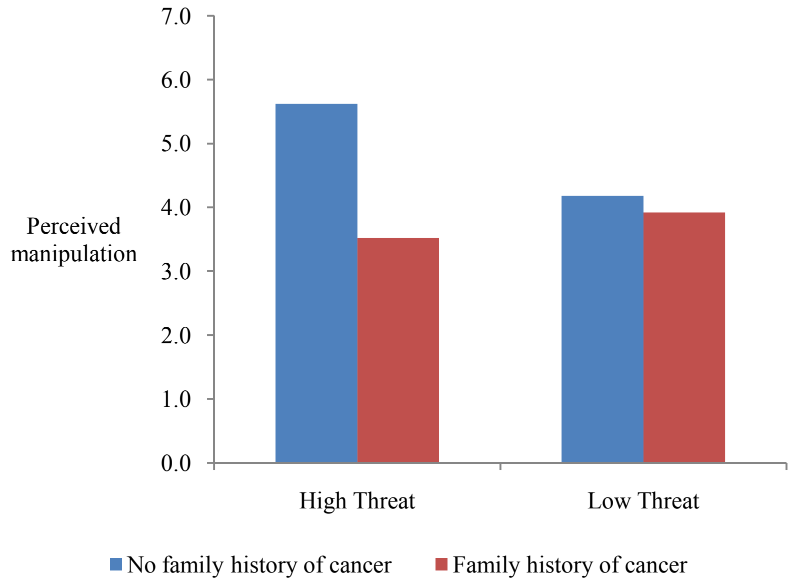


Figure 10. The 2-way interactive effect of threat level and cancer family history on evaluations of argument quality

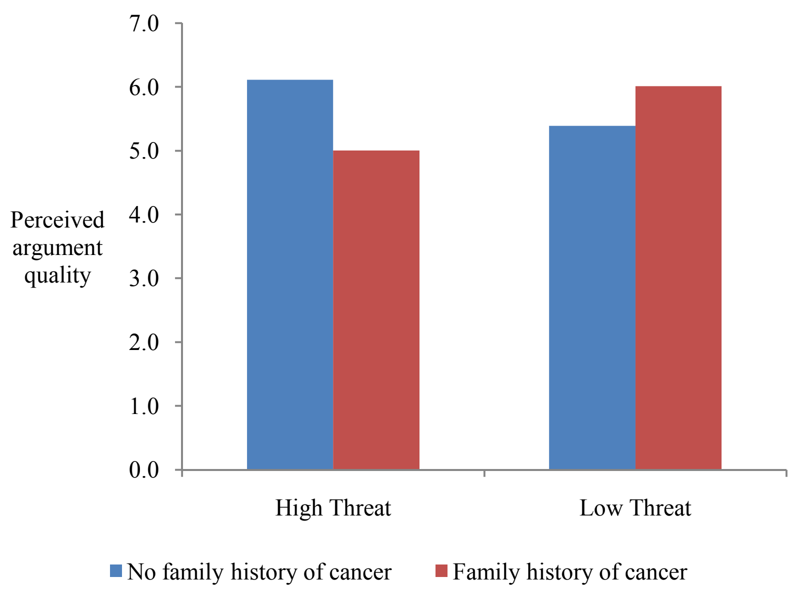
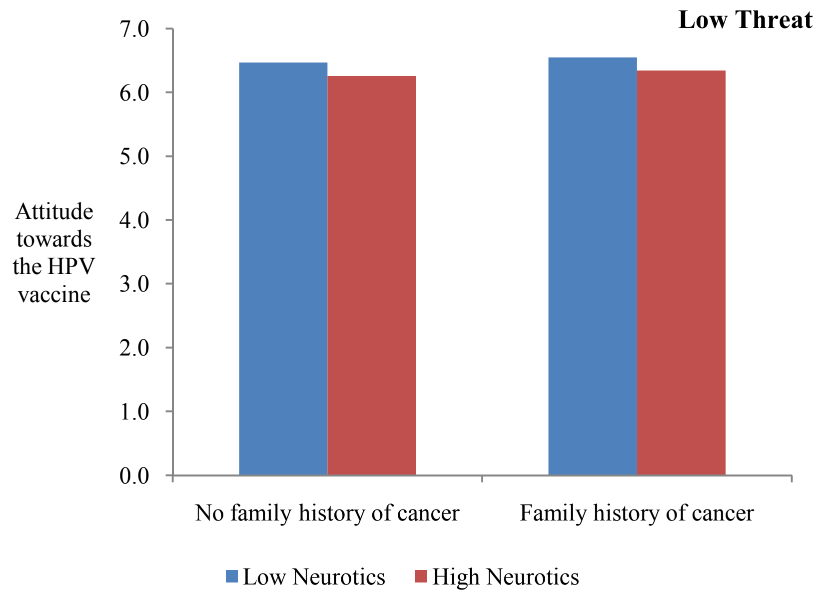


Figure 11. The interactive effect of threat level, family history of cancer, and neuroticism on attitudes towards the HPV vaccine

(a)



(b)

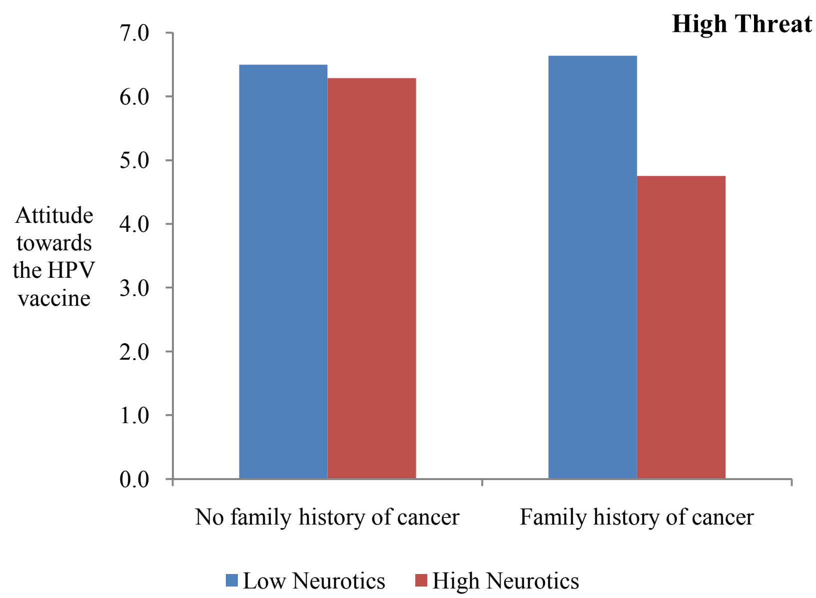


Figure 12. The interactive effect of threat level and number of sexual partners on plans to talk with a doctor about the HPV vaccine

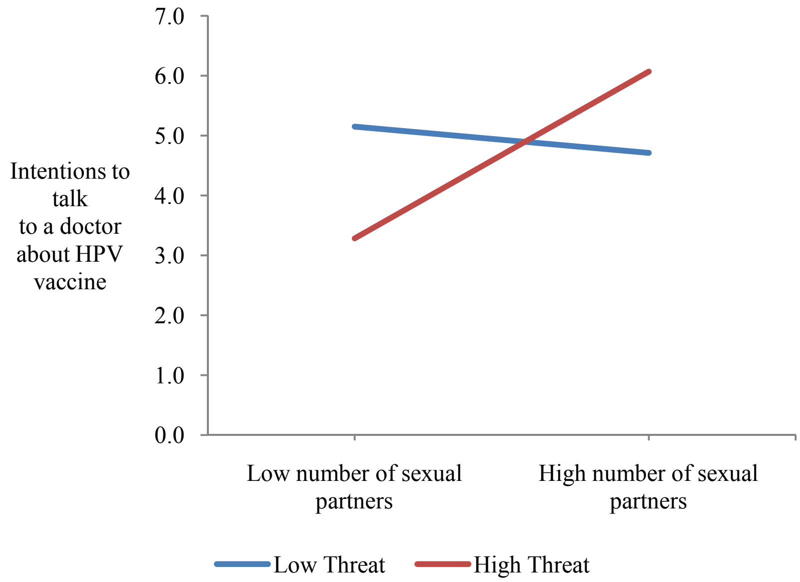
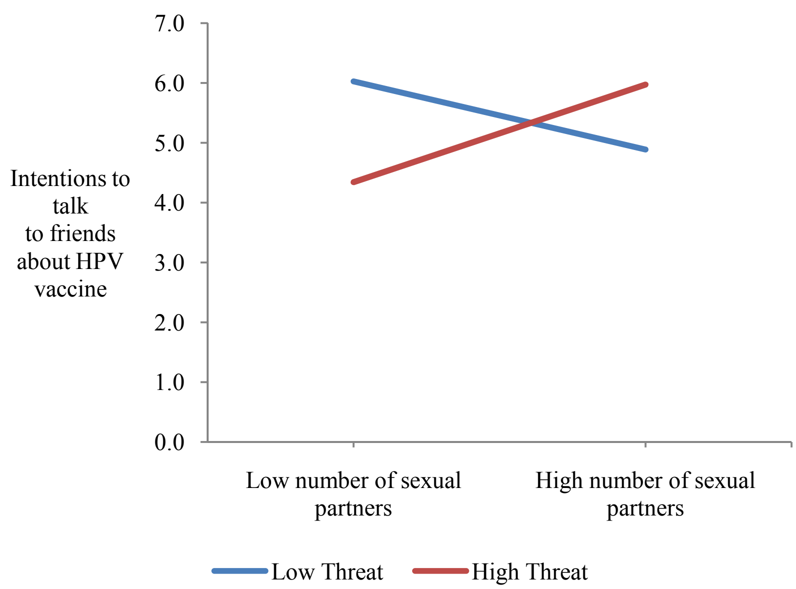


Figure 13. The interactive effect of threat level and number of sexual partners on plans to talk with friends about the HPV vaccine



APPENDIX A

High Threat Communication

You will now hear information that is extremely vital to your health. Genital human papillomavirus also known as HPV is the most common sexually transmitted infection in the United States. HPV causes almost all cases of genital warts and the majority of cervical cancer cases. There is no cure for HPV. If you have ever had sex (or genital contact) with another person, you are at risk for genital HPV. It is estimated that at least 50%, that is, half of *all* women who are sexually active will have a genital HPV infection at some point in their lives. A study conducted here at the Rutgers New Brunswick campus followed over 600 female Rutgers undergraduates over a 3 year period to determine the rate of HPV infection in the college student population. By the end of the assessment period, 60%, over half of the Rutgers undergraduate women in the study had been infected with HPV at some time during the three-year period.

There are more than 30 HPV types that can infect the genital area including the region outside your vagina, the linings inside your vagina, the anus and rectum. HPV infection is the main cause of genital warts. 90% of all cases of genital warts are caused by HPV. Certain HPV types are also carcinogenic meaning that they cause cervical cancer. These cancer causing strains are referred to as high-risk HPV types. High-risk HPV types 16 and 18 cause 70% of all cervical cancers. Cervical cancer is the second most common cancer among women worldwide. Every day, 10 women die from cervical cancer. Over the next few minutes you will hear important information about HPV, genital warts and cervical cancer.

It is estimated that 6.2 million cases of new HPV infections occur each year in the United States and that 20 million people currently have a detectable genital HPV infection. HPV can be transmitted through any kind of sexual contact, not only through sexual intercourse. You can become infected through mere genital contact or rubbing your genital area with an infected partner. You can also become infected by having oral sex. HPV can be asymptomatic; meaning, people who are infected may not have any visible symptoms. In fact, many people who are infected with HPV are not even aware that they are infected. Both men and women can get it and pass it on without even realizing. You may be at risk even if years have passed since you had sex. The more partners you have (and the more partners your partner has had), the higher your risk. Condoms are only partially effective in the prevention of infection because HPV can infect areas that are not covered by a condom—so condoms may not *fully* protect you against HPV.

More than 100 different types of HPV exist. About 30 HPV types are spread through sexual contact and are classified as either low risk or high risk. Certain genital HPV types are classified as "low-risk" because they do not put people at risk for cancer. Low-risk HPV types 6 and 11 cause 90% of all genital warts. Genital warts are growths or bumps that appear in the genital area. Genital warts are *very* contagious. *Two out of three* people who have sexual contact with a partner with genital warts will develop warts, usually within 3 months of contact. You can get them during oral, vaginal, or anal sex with an infected partner and also through *mere* skin-to-skin contact during vaginal, anal, or oral sex with an infected partner. In women, genital warts occur on the outside and inside of the vagina or around the anus. They can also develop in your mouth or throat if you have oral sex with an infected person. Genital warts are soft and moist and vary quite a bit in their appearance. They can be flesh-colored, pink or skin-colored. Certain warts resemble cauliflower-like bumps while others are dome-shaped. Warts can also have a thick horny layer. Warts can itch and bleed and cause pain during urination and defecation. Other symptoms include pain during sexual intercourse and burning discomfort. Because genital warts can multiply and become brittle, they can also cause a number of problems during pregnancy.

Although there are treatment options available for genital warts, even after treatment of the warts, the virus may remain and be transmitted. Your doctor can usually diagnose genital warts by seeing them or by applying vinegar to areas of your body that might be infected. There are treatments for genital warts, though the warts can disappear even without treatment. There is no way to predict whether the warts will grow or disappear. Although treatments can get rid of the warts, *none get rid of the virus*. In fact, for up to two-thirds of patients the warts will reappear within six-to-twelve weeks of treatment. Because the virus is still present in your body, warts often come back after treatment and the infected person can still infect others.

As mentioned earlier, low risk HPV types cause most cases of genital warts. However, certain types of HPV infection can also lead to cervical cancer. Cervical cancer in women is the most serious health problem caused by HPV. The second group of genital HPV types is known as "high-risk" because these types are linked to cervical cancer. High-risk

HPV types 16 and 18 account for approximately 70% of cervical cancers worldwide. You can be infected with HPV for years before it develops into cervical cancer. In fact, a persistent high-risk HPV infection that does not go away increases your risk for developing cervical cancer. Cervical cancer involves the presence of a malignant tumor in your cervix, the structure that connects your uterus to the vagina. Malignant tumors can be life-threatening. They can invade and damage nearby tissues and organs and also spread or metastasize to other parts of the body.

Before cancer appears in the cervix, the cells of the cervix go through some changes during which abnormal cells begin to appear in the cervical tissues. You may experience few symptoms during the early stages of cervical cancer. When the disease progresses and the tumor spreads deeper into the cervix or other organs, you will experience symptoms such as abnormal vaginal bleeding, bleeding that occurs between regular menstrual periods, bleeding after sex, after douching, or a pelvic exam. Your menstrual periods can also last longer and be heavier than before. There may also be vaginal discharge that is bloody with a strange, foul-smelling odor. During sex, you may experience pain and increased vaginal discharge.

Once diagnosed with cervical cancer, survival rates vary based on the stage and the size of the tumor. In the early stages, cancer is found only in the cervix and vagina. In the more advanced stages, cancer spreads to other organs such as your bladder and lungs. Most women in the early stages of cervical cancer have a surgery called a total hysterectomy to remove the cervix and uterus, or go through a radical hysterectomy where your uterus, cervix, and part of your vagina are removed. Radiation therapy is another treatment option where you are exposed to radiation 5 days a week for several weeks or thin tubes containing a radioactive substance are left in your vagina for a few hours or up to 3 days. There are several side-effects of treatment including early onset of menopause, inability to have children, hair loss, nausea, vomiting, and diarrhea.

Most people have not heard of genital HPV because it usually has no symptoms and can sometimes go away on its own. You can also be infected long before you experience any symptoms. It is natural for people who learn they have genital HPV to want to know who gave it to them. But there is no way to know for sure. The virus is very common. A person can have genital HPV for a very long time before it is detected. There is no cure for HPV. Condoms are only partially effective in preventing infection because HPV can infect parts of the genitalia that are not covered by a condom. HPV infection can lead to genital warts and cervical cancer. Genital warts are very contagious. Although they can be treated, the warts reappear for most people even after treatment. Cervical cancer is the most dangerous health problem caused by genital HPV infection and can have life-altering effects on your health. If you have ever had sex (or genital contact) or plan to have sex with another person, you are at risk for genital warts and cervical cancer.

Low Threat Communication

You will now hear some information about a health topic. Genital human papillomavirus also known as HPV is a sexually transmitted infection that can affect men and women of all ages. Genital HPV is not a new disease, but a lot of people don't know about it because genital HPV infection usually has no symptoms and goes away on its own, without causing any health problems. But some types of genital HPV can cause genital warts, and others have been linked to cervical cancer. There is no cure for HPV. The virus is passed on by having genital contact with a person who has genital HPV, including having vaginal or anal sex with an infected partner.

There are more than 30 HPV types that can infect the genital area including the region outside the vagina, linings inside the vagina, the anus and rectum. Genital HPV does not cause most people any health problems but in some cases can lead to genital warts or cervical cancer. HPV infection is the main cause of genital warts. 90% of all cases of genital warts are caused by HPV. Certain HPV types are also carcinogenic meaning that they cause cervical cancer. These cancer causing strains are classified as high-risk HPV types. High-risk HPV types 16 and 18 cause 70% of all cervical cancers. Approximately 1% of the population of the United States has cervical cancer and the most recent report from the Centers for Disease Control and Prevention (CDC) found that rates of cervical cancer are declining in the United States. Over the next few minutes, information about HPV, genital warts and cervical cancer and the most effective methods of prevention will be presented.

HPV can be transmitted through sexual contact, not only through sexual intercourse. The virus can be transmitted through touching or rubbing one's genitals against that of an infected partner. HPV can be transmitted very rarely through oral sex. People are more likely to get genital HPV if they had sex at an early age, had many sex partners or have had sex with someone who has had multiple partners. HPV is also more likely to be diagnosed among women with a weak immune system. HPV can be asymptomatic; meaning, people who are infected may not have any visible symptoms. In fact, many people who are infected with HPV are not even aware that they are infected. Both men and women can get it and pass it on without even realizing because symptoms can appear years after infection. Condoms may lower chances of getting HPV, but they may not fully protect against infection because the virus can infect areas that are not covered by a condom

More than 100 different types of HPV exist. About 30 HPV types are spread through sexual contact and are classified as either low risk or high risk. Most people will have genital HPV at some time in their lives and it usually goes away on its own. A healthy immune system can usually fight off the virus on its own. Certain genital HPV types are classified as "low-risk" because they do not put people at risk for cancer. Low-risk HPV types 6 and 11 cause 90% of all genital warts. Genital warts are growths or bumps in the genital areas of men and women. They can be transmitted during oral, vaginal, or anal sex with an infected partner and also through skin-to-skin contact that may occur during sex with an infected partner. In women, genital warts occur on the outside and inside of the vagina or around the anus. Rarely, they can also develop in the mouth or throat by engaging in oral sex with an infected person. Genital warts are soft and moist and can vary quite a bit in their appearance. They can be flesh-colored, pink or skin-colored. Certain warts resemble cauliflower-like bumps while others are dome-shaped. Warts also have a thick horny layer. Warts can itch and bleed and cause pain during urination and defecation. Other symptoms include pain during sexual intercourse and burning discomfort. Because genital warts can multiply and become brittle they can cause a number of problems during pregnancy.

Although there are treatment options available for genital warts, the virus can remain and be transmitted to others even after treatment. Doctors usually diagnose genital warts by seeing them or by applying vinegar to areas of the body that might be infected. There are treatments for genital warts, though the warts can disappear even without treatment. There is no way to predict whether the warts will grow or disappear. Although treatments can get rid of the warts, *none get rid of the virus*. Because the virus is still present in your body, warts may come back after treatment and the infected person can still infect others.

As mentioned earlier, low risk HPV types cause most cases of genital warts. However, certain types of HPV infection can also lead to cervical cancer. Although HPV infection is very common, only a very small percentage of women with untreated HPV infections develop cervical cancer. Cervical cancer in women is the most serious health problem caused by HPV. The second group of genital HPV types is known as "high-risk" because these types are linked to cervical cancer. High-risk HPV types 16 and 18 account for approximately 70% of cervical cancers worldwide. A person can be infected with HPV for years before it develops into cervical cancer. In fact, a persistent high-risk HPV infection that does not go away increases a person's risk for developing cervical cancer. Cervical cancer involves the presence of a malignant tumor in the cervix, the structure that connects the uterus to the vagina. Malignant tumors can be life-threatening. They can invade and damage nearby tissues and organs and also spread or metastasize to other parts of the body.

Before cancer appears in the cervix, the cells of the cervix go through some changes during which abnormal cells begin to appear in the cervical tissues. There are few symptoms during the early stages of cervical cancer. When the disease progresses and the tumor spreads deeper into the cervix or other organs symptoms such as abnormal vaginal bleeding, bleeding that occurs between regular menstrual periods, bleeding after sex, after douching, or a pelvic exam may be experienced. Menstrual periods may also last longer and be heavier than before. Cervical cancer can also cause vaginal discharge that is bloody with a strange, unpleasant odor. Other symptoms of cervical cancer include increased vaginal discharge, pelvic pain, and pain during sex.

Once diagnosed with cervical cancer, survival rates vary based on the stage and the size of the tumor. In the early stages, cancer is found only in the cervix and vagina. In the more advanced stages, cancer spreads to other organs such as the bladder and lungs. Most women with early cervical cancer have surgery called total hysterectomy to remove the cervix and uterus or go through a r*adical hysterectomy* where the uterus, cervix, and part of the vagina are removed. Radiation therapy is another treatment option where the patient is exposed to radiation 5 days a week for several weeks or thin tubes containing a radioactive substance are left in the vagina for a few hours or up to 3 days. There are several side-effects of treatment including early onset of menopause, inability to have children, hair loss, nausea, vomiting, and diarrhea.

Most people have not heard of genital HPV because it usually has no symptoms and it does not cause health problems for most people. A person can be infected long before experiencing any symptoms. It is natural for people who learn they have genital HPV to want to know who gave it to them. But there is no way to know for sure. The virus is very common. A person can have genital HPV for a very long time before it is detected. There is no cure for HPV. Condoms are not fully effective in preventing infection because HPV can infect parts of the genitalia that are not covered by a condom. HPV infection can sometimes lead to genital warts and cervical cancer. Genital warts are very contagious. Although they can be treated or usually go away on their own, the warts can reappear even after treatment. Cervical cancer is the most dangerous health problem caused by genital HPV infection and can have life-altering effects on a person’s health. 1 to 4% of women in the United States have cervical cancer. Due to increased cervical cancer screening, cervical cancer rates are fortunately declining.

APPENDIX B

Vaccine Information

There is no cure for HPV but there is a way you can prevent getting infected with certain types of HPV. If you've been sexually active, or think you may be sexually active in the future, it's important that you don't fail to consider getting the HPV vaccine. This is the first vaccine ever developed that prevents cervical cancer, precancerous genital lesions, and genital warts. The new HPV vaccine protects against four HPV types, which together cause 70% of cervical cancers and 90% of genital warts. The HPV vaccine was approved by the United States Food and Drug Administration in 2006. The Center for Disease Control and Prevention, the CDC, and the Society for Adolescent Medicine, an organization of doctors, strongly recommend that women between 9 and 26 years of age get vaccinated. Vaccination is recommended regardless of a previous history of HPV infection or abnormal Pap test results.

The safety and effectiveness of the vaccine has been tested in over twenty-thousand women. The vaccine is *100% effective* in preventing genital warts among women who were not infected with HPV at the time of vaccination. The vaccine is *98% effective* in preventing the development of cervical cancer among women who have never been infected with high risk HPV types 16 and 18. So far, studies have followed women for five years and found that women are still protected. Research also suggests that the vaccine protection will last a long time.

The vaccine is less effective in preventing HPV-related disease in young women who have already been exposed to one or more HPV types. That is because the vaccine does not treat existing HPV infections or the diseases they may cause. It can only prevent HPV before a person gets it. Among women who have already had HPV, the vaccine is 44% effective in preventing cervical cancer and 34% effective in preventing genital warts. However, doctors recommend that young women get the vaccine even if they have had a history of HPV infection because the vaccine still offers some protection against cervical cancer and genital warts.

The vaccine is most effective in women who have not yet acquired any of the four HPV types covered by the vaccine. In other words, women who have not been infected with any of those four HPV types will get the full benefit of the vaccine. Women who are sexually active may benefit less from the vaccine because they may have already acquired one or more HPV types. However, it is important to remember that few young women are infected with all four of these HPV types. So, you would still get protection from those types you have not acquired.

This vaccine has been licensed by the FDA and approved by the CDC as safe and effective. It has been studied in thousands of women of ages 9 through 26 around the world and in the majority of cases, there have been no serious side effects. The most common side effect is soreness in the arm where the shot is given. The HPV vaccine is given through a series of three shots over a 6-month period. The second dose is given 2 months after the first dose. The third and final dose is given 6 months after the first dose. The retail price of the vaccine is $125 per dose and it will cost between $360 to $400 for the full series. Although Rutgers student health insurance does not cover the cost of the vaccine, most large insurance plans usually cover the costs of recommended vaccines--some will allow for the vaccine to be given at Rutgers or at your own doctor's office. To find out if the vaccine is covered by your insurance, you should check with your insurance carrier**.**

Because the vaccine does not protect against *all* types of HPV, it will not prevent all cases of cervical cancer or genital warts. About 30% of cervical cancers will *not* be prevented by the vaccine, so it will be important for you to continue getting screened for cervical cancer by getting regular Pap tests. The Pap test is the best way to screen for cervical cancer. Doctor recommend that all women get annual Pap tests once they become sexually active or turn 21, whichever comes first. Regular Pap tests can save a woman's life. Even after you get the HPV vaccine you need to get regular Pap tests. Full time Rutgers students can get a Pap test for free at any of the student health centers on campus.

Once you decide to get the HPV vaccine, your first step should be to contact your primary care doctor or your gynecologist to set-up an appointment to discuss getting the vaccine. If you have insurance, you should probably also call the insurance company to find out how much of vaccine cost they will cover.

There are many risks you may experience if you don't get the genital HPV vaccine. First, if you decide not to get the vaccine you may increase your chances of contracting genital HPV. Second, not getting the vaccine may keep you from feeling the peace of mind that comes with taking charge of your body and your health. Third, by choosing not to get the vaccine you may be more likely to develop cervical cancer. The HPV vaccine is safe and highly effective. It is 100% effective in preventing genital warts and 98% effective in preventing cervical cancer if you have not had HPV before. The vaccine is a simple way for you to protect yourself from cervical cancer. If you’ve been sexually active, or think you may be sexually active in the future, it’s important that you don’t fail to consider getting the HPV vaccine.

APPENDIX C

The following statements are about the Human Papillomavirus (HPV). For each time, please indicate if the statement is True or False by circling your response.

17. A person may be infected and not know it	True	False
18. Those with HPV may need Pap smears more often	True	False
19. HPV is spread by sexual intercourse	True	False
20. Pap smear detects HPV	True	False
21. HPV can be cured with antibiotics	True	False
22. HPV causes abnormal menses	True	False
23. Smoking increases chance of cancer	True	False
24. Condoms do not help protect you from HPV	True	False
25. HPV goes away with right treatment	True	False
26. Certain types of HPV always cause cancer	True	False
27. HPV can cause problems with pregnancy	True	False
28. HPV types 16 and 18 causes 50% of cervical cancer cases	True	False
29. The HPV vaccine prevents against all types of HPV	True	False
30. The HPV vaccine is administered over 6 months	True	False
31. PAP tests are not needed once you get the HPV vaccine	True	False
32. The HPV vaccine prevents against genital warts	True	False

The following questions are of a personal nature but they are relevant to college women. It is important for our study that we have reliable health information for you. Please complete all of the following questions accurately and honestly. Your responses will be kept completely confidential.

1. Do you get annual PAP smear gynecological exams?
   ❒Yes ❒No
   a. Date (month/year) of last PAP test: ___________

2. Have you ever been told by your doctor that you had an abnormal PAP smear?
   ❒Yes ❒No

3. Relationship Status
   a. Single, not dating
   b. Dating
   c. In a serious relationship
   d. Married

4. How would you characterize yourself (please circle one)?
   a. I never had any kind of sexual contact
   b. I have been sexually active/had sexual contact in the past, but not right now
   c. I am currently sexually active

5. Age of first sexual contact with another individual: ______

6. How many men/women have you had sexual contact with in your life? ____

7. How many men/women have you had sexual contact with in the past 6 months? ____

8. Did you use a condom the last time you had sexual intercourse? ❒ Yes ❒ No

9. When you have had sex in the past, would you say that you used a condom? (circle one)
   ❒ Always ❒ Sometimes ❒ Rarely ❒ Never

10. To your knowledge, have you ever been diagnosed with any of the following? (check all that apply)

    ❒ Bacterial vaginosis
    ❒ Chlamydia
    ❒ Gonorrhea
    ❒ Genital Herpes
    ❒ Genital Warts
    ❒ HIV/AIDS
    ❒ Human Papillomavirus (HPV)
    ❒ Syphilis
    ❒ Trichomoniasis

1. Age: _______ years

2. Academic year: ❒ Fresh. ❒ Soph. ❒ Junior ❒ Senior

3. Race: ❒ American Indian/Alaskan Native
   ❒ Asian/Pacific Islander
   ❒ Black/African-American
   ❒ White
   ❒ Hispanic/Latino
   ❒ Other

4. Sexual Orientation: Heterosexual Gay/Lesbian Bisexual

5. Please indicate all the types of health insurance you have (you may circle more than one):
   a. Not insured
   b. Rutgers student health insurance
   c. Private health insurance
   d. Medicaid

6. Of the following income groups, please indicate which group best represents *<u>your family's</u>* <u>total combined income</u> during the last year?

☐ Less than $10,000	☐ $60,000 - $69,999	☐ $300,000 - $399,999
☐ $10,000 - $19,999	☐ $70,000 - $79,999	☐ $400,000 - $499,999
☐ $20,000 - $29,999	☐ $80,000 - $89,999	☐ more than $500,000
☐ $30,000 - $39,999	☐ $90,000 - $99,999	
☐ $40,000 - $49,999	☐ $100,00 - $199,999	
☐ $50,000 - $59,999	☐ $200,00 - $299,999	

Family Health Information

1. Does (or did) your biological <u>father</u> have high blood pressure (hypertension)?

   ❒ No ❒ Yes ❒ Don't know

2. Does (or did) your biological <u>mother</u> have high blood pressure (hypertension)?

   ❒ No ❒ Yes ❒ Don't know

3. Do you have a family history of diabetes?

   ❒ No ❒ Yes ❒ Don't know

4. Do you have a family history of heart disease?

   ❒ No ❒ Yes ❒ Don't know

5. Do you have a family history of cancer?

   ❒ No ❒ Yes ❒ Don't know

   → Which type of cancer?

   ❒ Breast Cancer
   Who in your family has/had breast cancer? _______________

   ❒ Cervical Cancer
   Who in your family has/had cervical cancer? ______________

   ❒ Lung Cancer
   Who in your family has/had lung cancer? ______________

   ❒ Colon Cancer
   Who in your family has/had colon cancer? ______________

   ❒ Skin Cancer
   Who in your family has/had skin cancer? ______________

   ❒ Other

Miller Behavioral Style Scale (MBSS)

1. Vividly imagine that you are **afraid** of the dentist and have to get some dental work done. Which of the following would you do? Check **all** of the statements that might apply to you.

___ I would ask the dentist exactly what work was going to be done.

___ I would take a tranquilizer or have a drink before going.

___ I would try to think about pleasant memories.

___ I would want the dentist to tell me when I would feel pain.

___ I would try to sleep.

___ I would watch all the dentist's movements and listen for the sound of the drill.

___ I would watch the flow of water from my mouth to see if it contained blood.

___ I would do mental puzzles in my mind.

2. Vividly imagine that you are being held hostage by a group of armed terrorists in a public building. Which of the following would you do? Check **all** of the statements that might apply to you.

___ I would sit by myself and have as many daydreams and fantasies as I could.

___ I would stay alert and try to keep myself from falling asleep.

___ I would exchange life stories with the other hostages.

___ If there was a radio present, I would stay near it and listen to the bulletins about what the police were doing.

___ I would watch every movement of my captors and keep an eye on their weapons.

___ I would try to sleep as much as possible.

___ I would think about how nice it's going to be when I get home.

___ I would make sure I knew where every possible exit was.

3. Vividly imagine that, due to a large drop in sales, it is rumored that several people in your department at work will be laid off. Your supervisor has turned in an evaluation of your work for the past year. The decision about lay-offs has been made and will be announced in several days. Check **all** of the statements that might apply to you.

___ I would talk to my fellow workers to see if they knew anything about what the supervisor evaluation of me said.

___ I would review the list of duties for my present job and try to figure out if I had fulfilled them all.

___ I would go to the movies to take my mind off things.

___ I would try to remember any arguments or disagreements I might have had that would have resulted in the supervisor having a lower opinion of me.

___ I would push all thoughts of being laid off out of my mind.

___ I would tell my spouse that I'd rather not discuss my chances of being laid off.

___ I would try to think which employees in my department the supervisor might have thought had done the worst job.

___ I would continue doing my work as if nothing special was happening.

4. Vividly imagine that you are on an airplane, thirty minutes from your destination, when the plane unexpectedly goes into a deep dive and then suddenly levels off. After a short time, the pilot announces that nothing is wrong, although the rest of the ride may be rough. You, however, are not convinced that all is well. Check **all** of the statements that might apply to you.

___ I would carefully read the information provided about safety features in the plane and make sure I knew where the emergency exits were.

___ I would make small talk with the passenger beside me.

___ I would watch the end of the movie, even if I had seen it before.

___ I would call for the flight attendant and ask what exactly the problem was.

___ I would order a drink from the flight attendant or take a tranquilizer.

___ I would listen carefully to the engines for unusual noises and would watch the crew to see if their behavior was out of the ordinary.

___ I would talk to the passenger beside me about what might be wrong.

___ I would settle down and read a book or magazine or write a letter.

Emotion Regulation Questionnaire (ERQ)

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale.

1-----------2-------------3-------------4--------------5-------------6--------------7

strongly disagree | **neutral** | **strongly agree**

	Strongly Disagree			Neutral			Strongly Agree
1. I control my emotions by changing the way I think about the situation I'm in.	1	2	3	4	5	6	7
2. When I want to feel less negative emotion, I change the way I'm thinking about the situation.	1	2	3	4	5	6	7
3. When I want to feel more positive emotion, I change the way I'm thinking about the situation.	1	2	3	4	5	6	7
4. When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.	1	2	3	4	5	6	7
5. When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.	1	2	3	4	5	6	7
6. When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.	1	2	3	4	5	6	7

Big Five Inventory (BFI)

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone *likes to spend time with others?* *Please circle the number next to each statement to indicate the extent to which you agree or disagree with that statement.*

I see Myself as Someone Who…	**Disagree Strongly**	**Disagree a little**	**Neither agree or disagree**	**Agree a little**	**Agree Strongly**
1. Is talkative	1	2	3	4	5
2. Tends to find fault with others	1	2	3	4	5
3. Does a thorough job	1	2	3	4	5
4. Is depressed, blue	1	2	3	4	5
5. Is original, comes up with new ideas	1	2	3	4	5
6. Is reserved	1	2	3	4	5
7. Is helpful and unselfish with others	1	2	3	4	5
8. Can be somewhat careless	1	2	3	4	5
9. Is relaxed, handles stress well	1	2	3	4	5
10. Is curious about many different things	1	2	3	4	5
11. Is full of energy	1	2	3	4	5
12. Starts quarrels with others	1	2	3	4	5
13. Is a reliable worker	1	2	3	4	5
14. Can be tense	1	2	3	4	5
15. Is ingenious, a deep thinker	1	2	3	4	5
16. Generates a lot of enthusiasm	1	2	3	4	5
17. Has a forgiving nature	1	2	3	4	5

18. Tends to be disorganized	1	2	3	4	5
19. Worries a lot	1	2	3	4	5
20. Has an active imagination	1	2	3	4	5
21. Tends to be quiet	1	2	3	4	5
22. Is generally trusting	1	2	3	4	5
23. Tends to be lazy	1	2	3	4	5
24. Is emotionally stable, not easily upset	1	2	3	4	5
25. Is inventive	1	2	3	4	5
26. Has an assertive personality	1	2	3	4	5
27. Can be cold and aloof	1	2	3	4	5
28. Perseveres until task is finished	1	2	3	4	5
29. Can be moody	1	2	3	4	5
30. Values artistic, aesthetic experiences	1	2	3	4	5
31. Is sometimes shy, inhibited	1	2	3	4	5
32. Is considerate and kind to almost everyone	1	2	3	4	5
33. Does things efficiently	1	2	3	4	5
34. Remains calm in tense situations	1	2	3	4	5
35. Prefers work that is routine	1	2	3	4	5
36. Is outgoing, sociable	1	2	3	4	5
37. Is sometimes rude to others	1	2	3	4	5
38. Makes plans and follows through with them	1	2	3	4	5

39. Gets nervous easily	1	2	3	4	5
40. Likes to reflect, play with ideas	1	2	3	4	5
41. Has few artistic interests	1	2	3	4	5
42. Likes to cooperate with others	1	2	3	4	5
43. Is easily distracted	1	2	3	4	5
44. Is sophisticated in art, music or literature	1	2	3	4	5

Mood Measure

*This scale consists of a number of words that describe different feelings and emotions. Indicate to what extent you feel this way **right now**, that is, **at the present moment**.*

	Not at all	A little	Somewhat	Quite a bit	Extremely
1. relaxed	1	2	3	4	5
2. nervous	1	2	3	4	5
3. tense	1	2	3	4	5
4. jittery	1	2	3	4	5
5. restful	1	2	3	4	5
6. anxious	1	2	3	4	5
7. calm	1	2	3	4	5
8. scared	1	2	3	4	5
9. worried	1	2	3	4	5
10. frightened	1	2	3	4	5
11. angry	1	2	3	4	5
12. upset	1	2	3	4	5
13. distressed	1	2	3	4	5
14. ashamed	1	2	3	4	5
15. disgusted	1	2	3	4	5
16. nauseous	1	2	3	4	5

Risk Behavior Diagnostic Scale (RBD)

	Strongly Disagree				Strongly Agree
1. I believe that HPV is severe.	1	2	3	4	5
2. I believe that HPV has serious negative consequences	1	2	3	4	5
3. I believe that HPV is extremely harmful	1	2	3	4	5
4. It is likely that I will get HPV	1	2	3	4	5
5. I am at risk for getting HPV	1	2	3	4	5
6. It is possible that I will get HPV	1	2	3	4	5
7. The vaccine is effective in preventing HPV	1	2	3	4	5
8. The vaccine is effective in preventing genital warts	1	2	3	4	5
9. The vaccine is effective in preventing cervical cancer	1	2	3	4	5
10. The vaccine works in preventing HPV	1	2	3	4	5
11. The vaccine works in preventing genital warts	1	2	3	4	5
12. The vaccine works in preventing cervical cancer	1	2	3	4	5
13. If I get the vaccine, I am less likely to get HPV	1	2	3	4	5
14. If I get the vaccine, I am less likely to get genital warts	1	2	3	4	5
15. If I get the vaccine, I am less likely to get cervical cancer	1	2	3	4	5
16. I am able to get the vaccine to prevent getting HPV	1	2	3	4	5
17. I have the money to get the vaccine to prevent HPV	1	2	3	4	5
18. I have the time to get the vaccine to prevent HPV	1	2	3	4	5
19. I can easily get the vaccine to prevent HPV	1	2	3	4	5

<u>Please tell us what you plan to do in the future.</u>

1. I intend to get the HPV vaccine: ❒ Yes ❒ No ❒Not sure

   1a. Why or why not? _______________________________________

2. I plan on talking with my doctor about the HPV vaccine within the next month

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

3. I intend to always use condom when I have sex.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

4. I intend to talk to my friends about the HPV vaccine to prevent cervical cancer

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Message Cognitions

Please think about the message you heard in answering the following questions.

1. When I was listening to the message about HPV, my instinct was to (circle one):

Want to protect myself from genital warts and cervical cancer	1	2	3	4	5	6	7	Not want to protect myself from genital warts and cervical cancer

2. When I was listening to the message about HPV, my instinct was to (circle one):

Want to think about genital warts and cervical cancer	1	2	3	4	5	6	7	Not want to think about genital warts and cervical cancer

3. The message was manipulative (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

4. This message was misleading (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

5. This message was exploitative (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

6. This message was exaggerated (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

7. This message was distorted (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

8. This message was overblown (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

9. This message was overstated (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

10. This message was an accurate description of HPV, genital warts and cervical cancer. (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

11. This message was an objective description of HPV, genital warts and cervical cancer (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

12. I clearly understood this message (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

13. I learned a lot about HPV, genital warts and cervical cancer from this message (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

14. The quality of arguments in this message were good (circle one):

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

15. The descriptions of HPV, warts, and cervical cancer were: (circle one)

Not Graphic	1	2	3	4	5	6	7	Very Graphic

16. The descriptions of HPV, warts, and cervical cancer were: (circle one)

Not Vivid	1	2	3	4	5	6	7	Very Vivid

17. The descriptions of HPV, warts, and cervical cancer were: (circle one)

Not Detailed	1	2	3	4	5	6	7	Very Detailed

18. While listening to the message, the images of HPV, warts, and cervical cancer in my mind were: (circle one)

Not Clear	1	2	3	4	5	6	7	Very Clear

19. While listening to the message, I could picture what genital warts would *look like on my body*:

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

20. While listening to the message, I could picture what genital warts would *feel like* to touch.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

21. While listening to the message, I could imagine *feeling* the genital pain and discomfort caused by warts.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

22. While listening to the message, I could imagine I could *smell* the bloody vaginal discharge caused by cervical cancer

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

23. While listening to the message, I could imagine what it would *feel* like to have my uterus, cervix and vagina removed.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Attitudes towards the Vaccine

Please circle the number that you think best reflects your attitude.

1. The HPV vaccine is:

Bad	1	2	3	4	5	6	7	Good

2. The HPV vaccine is:

Harmful	1	2	3	4	5	6	7	Beneficial

3. The HPV vaccine is:

Undesirable	1	2	3	4	5	6	7	Desirable

4. The HPV vaccine is:

Not Effective	1	2	3	4	5	6	7	Effective

5. The HPV vaccine is:

Not Worth It	1	2	3	4	5	6	7	Worth It

6. The HPV vaccine

Not Important	1	2	3	4	5	6	7	Important

The following 4 items are about low-risk HPV types 6 and 11 that cause genital warts

1. Compared to most women, what do you think the chances are that you will be infected with low-risk HPV type 6 or 11 someday?

much lower than average				*much higher than average*
1	2	3	4	5

2. What do you think the chances are that the average woman will be infected with low-risk HPV type 6 or 11 someday?

0	1	2	3	4	5	6	7	8	9	10
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

3. What do you think the chances are that you will have low-risk HPV type 6 or 11 someday?

0	1	2	3	4	5	6	7	8	9	10
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

4. On a scale of 0 to 100, what do you think your chances of getting low-risk HPV type 6 or 11 are, where 0 is no chance of getting infected, and 100 means you will definitely get it?

0	1	2	3	4	5	6	7	8	9	10
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

The following 4 items are about high-risk HPV types 16 and 18 that cause cervical cancer

5. Compared to most women, what do you think the chances are that you will be infected with high-risk HPV type 16 or 18 someday?

much lower than average				*much higher than average*
1	2	3	4	5

6. What do you think the chances are that the average woman will be infected with high-risk HPV type 16 or 18 someday?

0	1	2	3	4	5	6	7	8	9	10
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

7. What do you think the chances are that you will have high-risk HPV type 16 or 18 someday?

0	1	2	3	4	5	6	7	8	9	10
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

8. On a scale of 0 to 100, what do you think your chances of getting high-risk HPV types 16 or 18 are, where 0 is no chance of getting infected, and 100 means you will definitely get it?

0	1	2	3	4	5	6	7	8	9	10
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

APPENDIX D

Follow-Up Interview

I would like to ask you a few questions based on the laboratory session you attended a few weeks ago.

1. Have you received the HPV vaccine? ❒ Yes ❒ No

    a. If YES: Where did you obtain the vaccine? ____________

    b. If NO: Is there a reason you did not try to get the vaccine? ______________

2. Have you talked to a doctor or a health professional about getting the HPV vaccine? ❒ Yes ❒ No

3. Since the experimental session 6 weeks ago, how much would you say you have thought about HPV, genital warts, and cervical cancer?

Thought a lot about HPV, genital warts and cervical cancer	1	2	3	4	5	6	7	Not thought about HPV, genital warts and cervical cancer at all

4. Since the experimental session 6 weeks ago, have you sought out or tried to get any additional information about HPV, genital warts, and cervical cancer?

    ❒ Yes ❒ No

5. The list below indicates some sources people use to get additional information about health topics. Please indicate the extent to which you have each of these sources to find out more about HPV.

	Not at all	Once	A few times	Many Times
Internet Which sites? ______________________	1	2	3	4
Magazines Which magazines?_________________	1	2	3	4
Doctor or Nurse	1	2	3	4
Friends	1	2	3	4
Family	1	2	3	4
Any other sources? ❒ Yes ❒ No If yes, please indicate where or from	1	2	3	4

whom you sought more information:
____

I would like to ask a few questions about what you may have learned about HPV and the vaccine. I will read out the question and possible answers. Please identify the answer you select.

1. HPV infection can be prevented by using condoms	❒ True	❒ False
2. High-risk strains of HPV cause 70% of all cervical cancer cases	❒ True	❒ False
3. In the United States, HPV is most common among 15-24 year olds	❒ True	❒ False
4. There is no real treatment for HPV	❒ True	❒ False
5. Warts caused by HPV can also appear around the mouth or the anus	❒ True	❒ False
6. The HPV vaccine is most effective in preventing cervical cancer only in woman who have had no previous history of HPV infection	❒ True	❒ False
7. The vaccine prevents against all types of HPV	❒ True	❒ False
8. The vaccine was found to be 100% effective in preventing genital warts among all women	❒ True	❒ False
9. Annual pap tests are not needed once you get the vaccine	❒ True	❒ False
10. When or how frequently is the vaccine administered?	________________	
11. What was the cost of the vaccine?	________________	
12. Genital warts are only contagious when they are visible	❒ True	❒ False
13. HPV symptoms can appear several years after infection	❒ True	❒ False
14. Once you have had HPV, you cannot get the infection again	❒ True	❒ False
15. Abnormal periods are one of the symptoms of the later stages of cervical cancer	❒ True	❒ False
16. The vaccine is recommended only for women who have never had a history of HPV infection or abnormal Pap test results	❒ True	❒ False

Other than the information presented in the message you heard, have you heard or read anything about the HPV vaccine or its side-effects?
____

Curriculum Vitae

Aarathi Meenakshi Venkatesan

Education

PhD., Psychology, Rutgers—The State University of New Jersey	May 2010
M.S., Psychology, Rutgers—The State University of New Jersey	May 2006
B.A., Psychology, University of California, Los Angeles	June 2001

Publications

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