News about Genetics and Smoking: Priming, Family Smoking History, and News Story Believability on Inferences of Genetic Susceptibility to Tobacco Addiction

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Print news stories about genetics convey information to the public. This study assesses the effects of priming a belief in genetic susceptibility to smoking addiction on smokers' inferences about their own susceptibility to smoking addiction, their efficacy to quit smoking, and their intention to get a genetic test for addiction susceptibility. Respondents were 450 young adult smokers surveyed on the telephone in a randomized experiment embedded in a questionnaire about cigarette smoking practices. In the priming condition, respondents heard a news story about genes for smoking addiction. In the unprimed condition, respondents heard a news story concerning the gender of the offspring of smokers. Priming with the genetics news story did not affect respondents' inferences about personal genetic susceptibility to smoking addiction. However, those finding the news story believable and having a strong family history of smoking were more likely to infer a greater personal genetic susceptibility.

Keywords: *smoking; priming; genetic testing; family smoking*

Molecular genetics research provides unprecedented opportunities for individuals to learn about their genetic predisposition to potentially preventable diseases and to modify their behaviors to reduce risk (Marteau & Lerman, 2001). Genetic discoveries are not limited to disease susceptibility but may also reveal ways in which our behavior patterns are influenced by heredity

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(Plomin & Crabbe, 2000). One potentially important area of emerging science concerns the role of genetic factors in tobacco use and addiction (Hall, Madden, & Lynskey, 2002; Lerman & Berrettini, 2003; Munafo, Johnstone, Murphy, & Walton, 2001). Although not without controversy, new knowledge about genetics and tobacco dependence may ultimately lead to reductions in disease risk by motivating individuals to quit smoking and by enhancing the effectiveness of targeted treatment (Lerman & Niaura, 2002).

This explosion of research in molecular and behavioral genetics research has led to another explosion—news media coverage of genetic information. By *news media coverage* we do not mean organized campaigns designed to change behavior but rather public news information about new scientific evidence relevant to a particular behavior. Our own preliminary analyses indicate that in the period 1997 to 2003, about 8,000 stories per year appear about genetic influences on human behavior and disease across sources, including *The New York Times*, the *AP Wire Services*, broadcast news, and the top 20 newspapers in the United States. Although much has been written about the way that the news media cover genetics (Condit, 1999; Condit et al., 2001; Condit, Ofulue, & Sheedy, 1998; Craig, 2000; Tambor, Bernhardt, Rodgers, Holtzman, & Geller, 2002), it is not yet clear how this information or its representation will affect attitudes and decisions about behavior change among individuals at increased risk.[2]

Researchers have lamented this lack of knowledge of how the presentation of health information to the public affects the public's attitudes in a variety of arenas in addition to genetics. *The Lancet Oncology* editorialized that new research findings about hormone replacement therapy created panic in the public when it could have helped women, in consultation with their physicians, make better, well-tailored decisions about this therapy (*The Lancet Oncology*, 2004). Researchers have been divided about the impact that media coverage of genetics might have with some arguing that the public will be lead to conclude that traits, behaviors, and diseases are biologically determined (Nelkin & Lindee, 1995) and others arguing that media coverage has not shifted appreciably over time in its attributions about biological and environmental causes (Condit et al., 1998). A better understanding of the impact of genetic risk information on attitudes and behavior change is needed (Saab et al., 2004).

With regard to smoking behavior and genetic susceptibility to addiction, news media coverage could have a variety of consequences on public perceptions and behaviors. Increased awareness of genetic risk for tobacco dependence may enhance motivation to quit smoking or to seek treatment. Alternatively, the perception that one's risk is genetic and immutable might reduce personal efficacy, generate a sense of fatalism, and reduce intentions to

change smoking behaviors. In a study on the risk for heart disease, when participants thought their risk was determined by a genetic test, the condition was seen as less preventable (French, Marteau, Senior, & Weinman, 2000). In a related study, smokers informed of a genetic predisposition to lung cancer were more fearful but no more likely to quit smoking (Lerman et al. 1997). In an analogue study (Wright, Weinman, & Marteau, 2003), smokers who were informed of a hypothetical genetic predisposition to tobacco dependence were significantly more likely to request a cessation method deemed effective based on their genetic risk. However, they were also less likely to report that they would rely on their own will power, suggesting that genetic information may have undermined their sense of personal efficacy.

The potential for news media coverage to influence health beliefs and behavior change has been supported in several studies (Fan & Halloway, 1994; Yanovitsky & Stryker, 2001). One of the basic ways that media coverage of an issue can influence audiences is through priming. Priming is the process of activating specific nodes in an audience's mental storehouse of information through cues employed within the media's message. Although priming has not been seriously investigated as the basis for the news media's role in reducing risky behavior nor in the likelihood of obtaining a genetic test, it has been studied in a variety of other areas. Iyengar and Kinder (1987) exposed some audiences to news about specific issues (economy) and others to different issues (foreign affairs). Subsequent judgments depended more on the issues primed in news, even though controls and those exposed to news had the same mean scores on the issues primed. However, the associations between the primed issues and the judgments were stronger than in the control. The information in the news accounts may have made the particular issues more salient and more likely the basis for judgment, even though opinions on the issue did not change.

Advertisers are concerned with priming effects as well. Yi (1990a) studied magazine ads for a product (larger automobiles) that could be interpreted in more than one way (*safe* vs. *fuel inefficient*). Some read a prior story about the safety of air travel and others read a prior story about a CEO in the oil industry. Those reading the air travel safety story tended to have more favorable purchase intentions and attitudes toward the brand and toward the ad than those reading about the oil industry executive. The results were attributed to more *safety* thoughts about the ad in the air travel condition and more *fuel economy* thoughts in the oil condition. The article read before seeing the ad primed certain thoughts leading the interpretation in one of two specific directions. Yi (1990b) also found semantic priming effects with ambiguous advertisements about computers. Similar findings have been obtained in priming racial stereotypes (Valentino, 1999; Valentino, Traugott, &

Hutchings, 2002), social norms regarding condom use (Ybarra & Trafimow, 1998), foreign policy judgments (Gilovich, 1981), and character judgments of political candidates (Domke, 2001; Domke, Shah, & Wackman, 1998).

In sum, although priming cues have not been widely studied in health risk and prevention contexts, the manipulation of specific cues in media messages about health issues should operate similarly. Specifically, activating the audience's thoughts about the genetic bases for addiction and about the role of family history in smoking habits should increase the salience of these thoughts for the respondents, thereby making them more accessible. This elevated accessibility should increase the association between belief in a genetic predisposition toward smoking addiction and personal efficacy and an intention to obtain a genetic test. The priming of audience cognitions does not necessarily change attitudes, opinions, intentions, or behaviors but rather can make the primed objects more accessible from memory, and to the extent that the primed cognition has a mental association with other related cognitions, those too should be activated and made more accessible.

We hypothesized that news information about genetic susceptibility to smoking addiction would affect efficacy to quit smoking and the intention to obtain a genetic test for smoking addiction through a cognitive mediator. That mediator is the inference (measured as a likelihood) that the recipient of the genetic information is at risk for a genetic addiction to smoking. Our expectation was that a person's own smoking history and that of their immediate family members would interact with the news information about genetic susceptibility such that those with a family history of smoking would be more likely to infer they were susceptible to a genetic basis for their smoking behavior.

Although the meaning of the word *genetic* shows considerable variability in the public at large, some of which is scientifically incorrect, most respondents in one study were capable of illustrating a genetic characteristic that ran in their own families (Lanie et al., 2004). This suggests that people have a sense of the role of family history in providing a genetic basis for various characteristics. The cognitive inference of genetic susceptibility should arise in those with a family history but not necessarily in those with little or no family history of smoking. This is precisely what priming does: It activates certain cognitions (e.g., smoking addiction) and connects these to other related cognitions (genetic basis for addiction), especially in those for whom the connection is stronger a priori (family history) than those for whom it is weaker (little or no history). The hypothesized relationships among variables are described schematically in Figure 1.

Two outcome measures are tested in addition to the mediating cognitive variable (that is, the inference of personal genetic susceptibility to smoking):

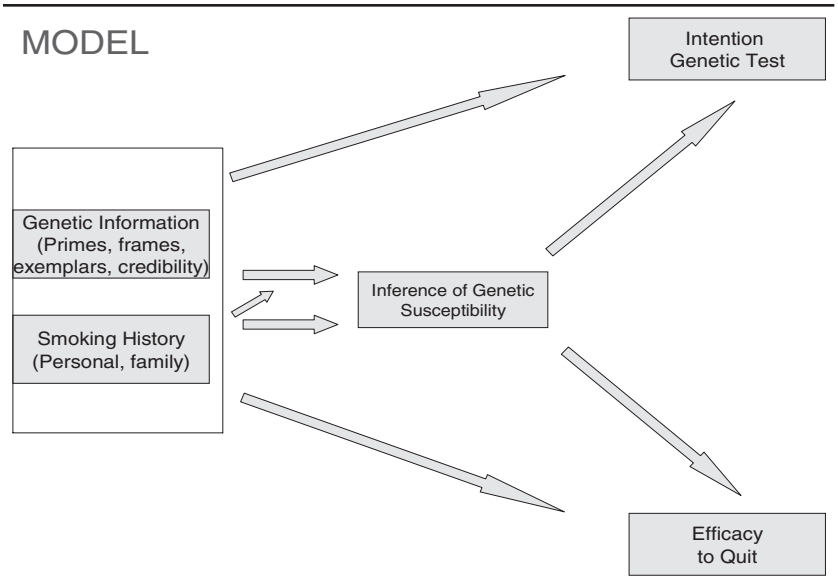

Figure 1. Schematic Model of the Direct and Indirect Relationships Among Genetic Information, Smoking History, Inference of Genetic Susceptibility, Efficacy to Quit, and Intention to get a Genetic Test

intention to get a genetic test and efficacy to quit smoking. Self-efficacy and perceived behavioral control have been shown to be important predictors of future behavior (Ajzen, 1985). Perceived behavioral control and past smoking behavior are good predictors of actual smoking behavior (Godin, Valois, Lepage, & Desharnais, 1992; O'Callaghan, Callan, & Baglioni, 1999; Sutton & Eiser, 1984). Self-efficacy has been shown to be an important predictor of the intention to quit smoking, even after the effects of attitude and subjective norm are removed (de Vries, Dijkstra, & Kuhlman, 1988). Studies of young White, Puerto Rican, and African American women also show strong effects of efficacy on intention to smoke in the next month (Hanson, 1997).

The intention to obtain a genetic test of smoking addiction susceptibility was also included as an indicator of the perceived seriousness of the impact of the information primed by the abbreviated news account. Although we did not expect the limited information in the news stories to have strong effects on the intention to obtain a genetic test, differences between the primed and unprimed conditions could result for those with a strong family history of smoking.

The figure also hypothesizes that smoking history and genetic risk information might have direct effects on efficacy to quit smoking and the intention

to obtain a genetic test. In addition to these potential direct effects is the mediated effect through inference of susceptibility to smoking addiction. To test these direct and indirect effects, the statistical tests employed first a test for direct effects and then added the indirect effects through the inference of genetic susceptibility. In this way, we will be able to determine if the total effect from genetic information and smoking history to efficacy and to intention to obtain a genetic test is both direct and indirect (that is, mediated) or only one or the other.

To begin to fill the gap in research on the impact of news stories about genetics, we conducted a survey of 450 young adult smokers[3] in which they were exposed to information about one of two news stories: a scientific study linking genes to tobacco addiction (genetic story condition) or a scientific study about the effects of smoking on sex of offspring (nongenetic story condition). We hypothesized that respondents exposed to genetic story condition would be more likely than other respondents to infer that they had inherited genes for liability to tobacco addiction and would have stronger intentions to obtain a hypothetical genetic test for tobacco dependence as well as decreased self-efficacy to quit. We also predicted that the effects of the news story condition (genetic vs. nongenetic) on these outcomes would be moderated by smoking history and story believability. Specifically, we expected the greatest impact of news story condition to be among participants who found the story to be believed and those who have a stronger personal and family history of smoking. Finally, we hypothesized that the effects on efficacy to quit smoking and on intention to obtain a genetic test would be mediated by the inference of genetic susceptibility to smoking addiction.

Method

Participants

A nationally representative sample of young adult smokers was obtained via a random digit dialing survey conducted in May and June 2002 by Schulman, Ronca, and Bucuvalas, Inc., on behalf of the University of Pennsylvania. The sample included 450 young adults aged 18 to 25 who had smoked at least one whole cigarette in the past 6 months.[4] The sample was 52.2% male, 9.3% African American, 76% White, 21% married or living as married, and 35% Protestant, 26% Catholic. The average education was about 13 years of schooling (i.e., some college); the average age was 21.4 years (SD = 2.31). The overall cooperation rate for the survey was 77%.[5]

Procedures

Subjects were randomly assigned to a genetic story or nongenetic story condition. The assignment to condition was done so that each condition contains a random half of young adults who reported having at least one first-degree relative (mother, father, sister, or brother) who smoked on a daily basis for at least 1 month and a random half of those who did not have any relatives with a smoking history. Prior to the manipulation, we obtained measures of personal and family history of smoking. Following the manipulation, we assessed believability of the claims in the genetic story, inferred genetic risk, self-efficacy to quit smoking, and likelihood of getting a genetic test for tobacco addiction.

To induce respondents to think about the possibility that they have inherited genes for smoking addiction and to tie that genetic predisposition to a history of smoking in their family, respondents in the genetic story condition heard the following:

> The news media have recently reported on studies done by the National Cancer Institute suggesting that some people are more at risk to become addicted smokers than others because they have inherited certain genes. People who have a family history of smoking are more likely to have inherited these genes, the stories have said.

To ensure reception of the information, respondents were asked the question "Have you read any of the stories in the newspaper about inheriting genes related to smoking addiction?" To emphasize the link between genetics, family history, and addiction to smoking, the question was repeated three additional times about different media outlets: television, the Internet, and radio.

Respondents assigned to the nongenetic story condition (i.e., the control condition) received the following scenario.

> The news media have recently reported on studies done at the National Cancer Institute suggesting that smokers have more girl than boy babies. Couples are more likely to have girl babies if either partner smokes heavily while trying to conceive, the stories say.

Questions parallel to those for the genetic story followed the smoking story. For example, one question read, "Have you read any of the stories in the newspaper about smoking and having girl babies?" Both stories did in fact appear in print within the previous year.

Measures

Outcome variables. Inferred genetic addiction was assessed by the following item: "Based on everything you know and have heard about smoking and addiction, how likely is it, do you think, that you have inherited genes that will increase the chances of your becoming addicted to smoking cigarettes?" Answers were coded on a 5-point scale, with 1 as *impossible*, 2 as *possible but very unlikely*, and 5 as *very likely* ($M = 2.78$, $SD = 1.49$).

Intention to get a genetic test was measured by the following item.

> Developments in genetic testing have come very quickly. Some tests try to find out if people have inherited genes that increase their chances of becoming addicted to smoking. How likely is it that you would get this test if the test was totally confidential, accurate, painless, covered by health insurance, and convenient to schedule?

As in previous research (Struewing, Lerman, Kase, Giambarresi, & Tucker, 1995), this item was coded on a 4-point scale, from 1 as *definitely not* to 4 as *definitely get the test* ($M = 2.73$, $SD = 0.99$).

Self-efficacy to quit smoking was obtained via a situational measure employed by Velicer, DiClemente, Rossi, and Prochaska (1990). The format for the questions was "How sure are you that you can quit smoking cigarettes completely and permanently in the next 3 months if you really wanted to?" *Not at all sure* = 1 and *completely sure* = 4. The other items asked about contexts where the person could avoid smoking after quitting when talking and relaxing, at a party with friends, etc. The mean on this eight-item scale was 2.65 ($SD = .82$). The measure has excellent internal reliability (alpha = 0.91) and good distributional properties.

Predictors and covariates. The credibility of the claims in the genetic story was assessed on a 4-point believability scale, with 1 as *not at all believable* and 4 as *completely believable* ($M = 2.26$, $SD = 0.86$).[6] Research on persuasive messages shows that effective ones should be believable, novel, and important (Morley & Walker, 1987). The judgment of the genetic story's believability occurred later in the questionnaire, after questions about efficacy, smoking knowledge, and the two outcome measures. The believability of the claims of both stories was assessed for all participants. However, when a story's claim believability is discussed below, we are referring only to believability of the story about a genetic basis for smoking addiction.

Family history of smoking was computed as the ratio between the total number of first-degree relatives (mother, father, sister, brother) who smoked

on a daily basis for 1 month or more, as reported by respondents, and the respondent's family size. The maximum number of first-degree relatives that could be reported was four. This measure taps smoking among first-degree relatives as a ratio to the number of such relatives. The measure varies between 0 and 1 ($M = 0.51$, $SD = 0.33$). In analyses reported below, this scale was split into three approximately equal categories to simplify analyses and interpretations.

Analytic Procedure

The general linear model (GLM) was used to test hypotheses. This approach was employed because inspection of the means on certain outcomes measures indicated the possibility of curvilinear effects (linear plus quadratic) differing by experimental condition and blocking variables. Testing these nonlinear interactions via regression is possible (and was done for purposes of verification) but produces complex models with substantial multicollinearity that is difficult to present and interpret (Kleinbaum, Kupper, Muller, & Nizam, 1998). The results from GLM will be F tests for a given predictor (or interaction among predictors) along with graphical displays where the effect is complex. The model of Figure 1 is tested in two steps: The first assesses direct effects of the message and its interaction with family history on the outcomes of efficacy to quit and intention to get a genetic test, and the second step adds inference of genetic susceptibility to smoking addiction as a mediator. If the cognitive inference is a mediating variable, then any effects of the message on intention or on efficacy should be reduced once the inference of genetic susceptibility to smoking enters the prediction equation.

Results

Inferred Genetic Addiction

Results from the GLM predicting the inference of genetic susceptibility from priming, family history of smoking, and believability of the story are presented in Table 1. Contrary to our hypothesis, the interaction effect between priming a genetic susceptibility to smoking addiction and the person's own family history on inference of genetic susceptibility was not significant. In fact, the direction of the priming effect is opposite to what was expected with the control group's mean ($M = 2.89$) greater than that of the priming group ($M = 2.65$; t [$df = 434$] $= 1.73$, $p = .085$).

However, there are four significant effects in which the believability of the story's claim plays a significant role. There is a main effect for family history

Table 1
General Linear Model F *Tests for Perceived Likelihood of Having Inherited Addiction Genes*

Variable	*F*	*df*1	*df*2	*p*
Intercept	879.50	1	414	.000
Genetic prime	0.14	1	414	.710
Family history	4.09	2	414	.020
Claim credibility	42.50	2	414	.000
Prime × Family History	0.05	2	414	.950
Prime × Claim Credibility	2.74	2	414	.070
Family History × Claim Credibility	2.81	4	414	.020
Prime × Family History × Claim Credibility	0.55	4	414	.700
Total (n = 432)	7.16	17	414	.000
R^2	.23			

($p < .02$) and for claim credibility ($p < .001$), two interaction effects for family history by claim credibility ($p < .02$), and a borderline effect for priming by claim credibility ($p < .07$). The stronger the family history of smoking, the more likely the inference of inheriting genes for smoking addiction (adjusted means increase from 2.38, to 2.73, to 3.03).[7] The strong effect of claim believability indicates that as the story's claim is judged believable, the inference of genetic susceptibility to smoking addiction is also seen as more likely.

Both of these main effects are embedded in two-way interactions plotted in Figures 2 and 3.

The main effect for claim believability on the inference of genetic susceptibility is slightly stronger for those getting the genetic story prime than for those getting the control story. For those judging the genetic story to be of low to moderate believability, the slopes are the same. At high believability, those hearing the gender story make a less strong inference of genetic susceptibility to smoking addiction than those getting the genetic prime story. The genetic story may have primed the inference of susceptibility to smoking addiction only for those judging the claim to be of the highest believability.

Family history also moderates the relationship between claim believability and inference. Those with the strongest family history of smoking also have the strongest association between claim credibility and inference. Figure 3 shows a clear fan effect, such that at lowest believability, family history does not predict inference of addiction susceptibility. At the highest believability, family history is linearly associated with the inference of smoking addiction.

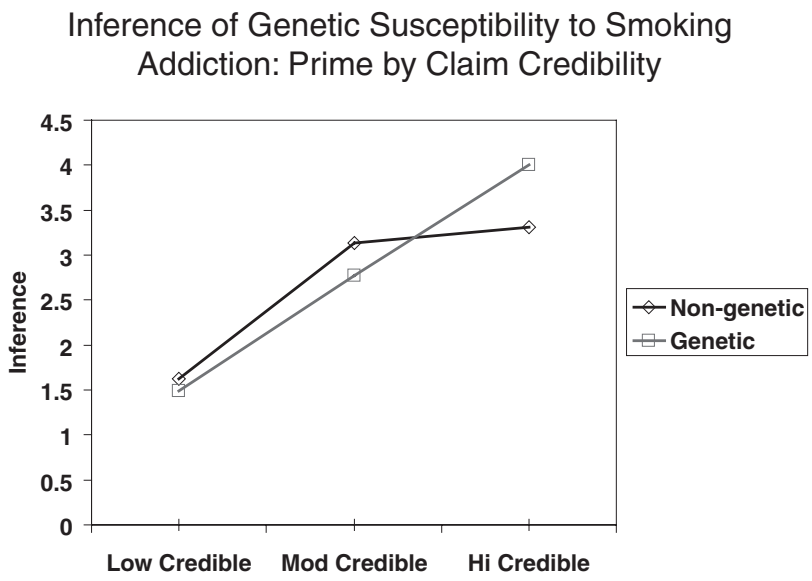

Figure 2. **Impact of Genetic Information Prime and Story Credibility on Inference of Genetic Susceptibility to Smoking Addiction**

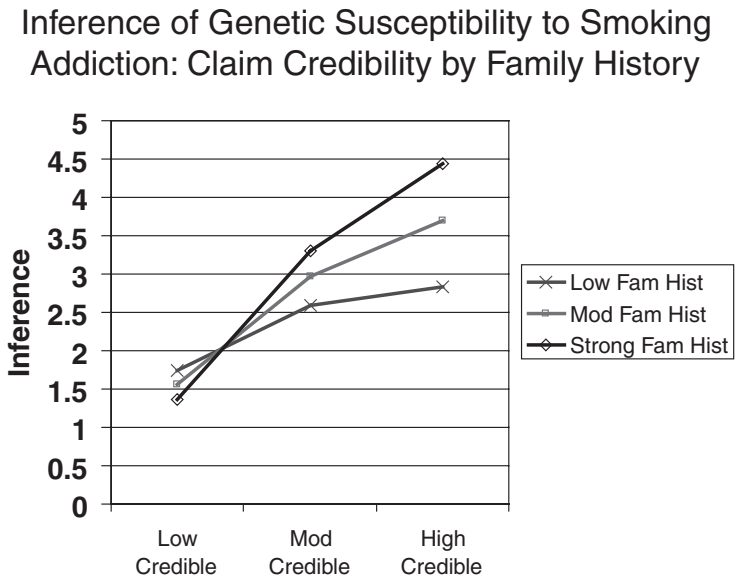

Figure 3. **The Two-Way Interaction of Claim Credibility and Family History on the Inference of Genetic Susceptibility to Smoking Addiction**

Table 2
General Linear Model F *Tests for Likelihood of Getting a Genetic Test With and Without Inference of Genetic Susceptibility*

	Model 1				Model 2			
Variable	*F*	*df*1	*df*2	*p*	*F*	*df*1	*df*2	*p*
Intercept	1670.30	1	424	.000	376.600	1	412	.000
Prime genetic	0.18	1	424	.670	0.007	1	412	.930
Family history	0.48	2	424	.620	0.180	2	412	.840
Claim credibility	7.89	2	424	.000	1.230	2	412	.290
Prime × Family History	0.59	2	424	.550	0.270	2	412	.760
Prime × Claim Credibility	3.55	2	424	.030	2.780	2	412	.060
Family History × Claim Credibility	0.53	4	424	.720	0.150	4	412	.960
Prime × Family History × Claim Credibility	1.23	4	424	.300	0.910	4	412	.460
Infer genetic addiction					25.800	1	412	.000
Total (n = 431)	1.82	17	424	.030	3.160	18	412	.000
R^2	0.07				0.12			

Likelihood of Getting a Genetic Test

A similar set of analyses was conducted for the likelihood of getting a genetic test. Two GLMs were run, first with all main and interaction effects for genetic prime, family history, and claim credibility but without the inference of genetic susceptibility to addiction as the mediator. The second GLM included the inference as a mediator. The results are presented in Table 2.

In Model 1, the intention to obtain a genetic test for smoking addiction is predicted by claim credibility and by the interaction of genetic prime with claim credibility. As the claim is seen as more credible, the intention to obtain a genetic test for smoking addiction increases from 2.35 to 2.80 to 3.08 ($p <$ .001). This main effect is actually steeper for those getting the genetic prime than for those in the control condition, as is graphed in Figure 4 ($p <$ .03). The relationship between story believability and the intention to obtain a genetic test is strengthened in the genetic prime case in comparison to the control.

However, these effects are mediated by inference of genetic susceptibility. In the second model of Table 2, inference of genetic susceptibility is added. It has a significant linear effect on intention to get a genetic test (B = .18, $p <$ .001). The two significant effects involving claim believability are rendered nonsignificant, although the interaction between claim credibility and priming is borderline (p = .06).

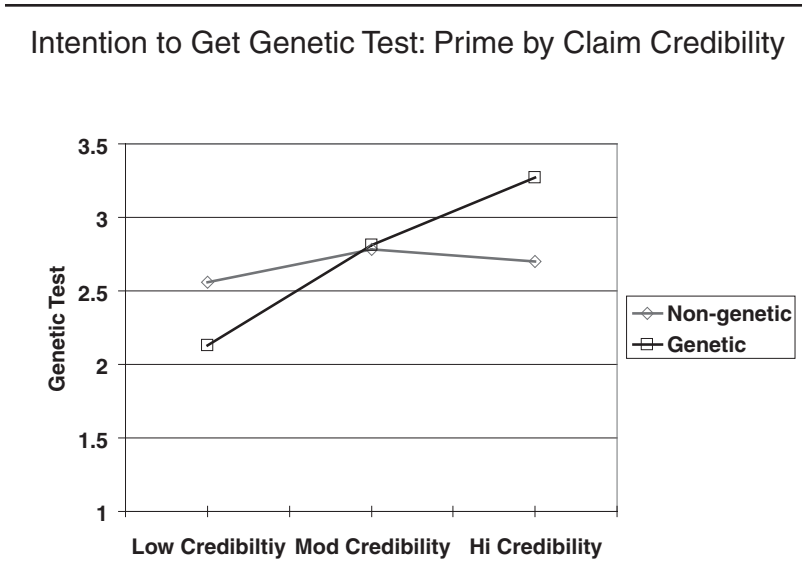

Figure 4. The Effect of Genetic Information Prime and Claim Credibility on the Likelihood of Getting a Genetic Test for Smoking Addiction

The analyses presented in Table 2 suggest that any effects of believable stories about the role of genetics and family history of addiction on intention to get a genetic test are mediated through an inference audiences make about their personal likelihood of having inherited such genes. All other effects are reduced to nonsignificance with only a borderline effect of prime by claim credibility remaining.

Efficacy to Quit Smoking

Table 3 presents two models predicting efficacy to quit smoking. The first uses all the main and interaction effects for genetic prime, family history, and claim credibility without the inference of genetic addiction. The second includes all the predictors from Model 1 plus the inference of genetic addiction.

The only significant effect in Model 1 is family history. As family history of smoking becomes stronger, the efficacy to quit smoking decreases from 2.85 to 2.81 to 2.51 ($p < .03$). Although the genetic prime story had no elements relating directly to self-efficacy, it could have indirect effects on efficacy by inviting a genetic inference of genetic susceptibility to smoking addiction that in turn could undermine efficacy. Model 2 tests this possibility.

Table 3
General Linear Model F *Tests for Efficacy to Quit Smoking With and Without Inference of Genetic Addiction*

	Model 1				Model 2			
Variable	*F*	*df*1	*df*2	*p*	*F*	*df*1	*df*2	*p*
Intercept	2,450.00	1	425	.000	1,003.400	1	413	.000
Prime genetic	1.14	1	425	.290	1.070	1	413	.300
Family history	3.67	2	425	.030	2.600	2	413	.080
Claim credibility	1.26	2	425	.29	3.210	2	413	.040
Prime × Family History	1.52	2	425	.220	1.420	2	413	.240
Prime × Claim Credibility	2.01	2	425	.140	1.170	2	413	.310
Family History × Claim Credibility	1.32	4	425	.260	1.460	4	413	.220
Prime × Family History × Claim Credibility	0.64	4	425	.640	0.630	4	413	.640
Infer genetic addiction					19.660	1	413	.000
Total (n = 432)	1.19	17	425	.260	2.21	18	413	.003
R^2	.05				.088			

Model 2 increases the variance explained from 5% to 8.8%. Family history is no longer significant but remains borderline (p = .08). The inference of genetic addiction is a significant, negative predictor of self-efficacy (B = –.13, p < .001). Whatever effects of story there are on efficacy are mediated through the cognitive inference persons make about their own susceptibility to genetic addiction for smoking.

Discussion

Our data focus on the perception of a particular aspect of perceived risk—the possibility of inheriting genes for smoking addiction—and actions that could be taken to move from perception to reality (i.e., getting a genetic test) as well as perceptions important to both the intention and actuality of quitting (i.e., self-efficacy). There are three broad results from the study: (a) The priming manipulation did not function as expected, (b) believability of the claim was an important factor mediating and moderating the impact of the genetic news prime on cognitive inferences about genetic susceptibility to addiction, and (c) the cognitive inference of susceptibility mediated the effects of the news prime on efficacy to quit smoking and on intention to get a genetic test.

Priming

One of the primary mechanisms for influence through the news media is priming of specific thoughts and their mental neighbors, making them more salient and accessible (Price & Tewksbury, 1997; Valentino, Hutchings, & White, 2002). Our attempt to prime some of our respondents to associate family history of smoking with a susceptibility to genetic addiction for smoking did not work. In fact, those primed were marginally less likely to infer they were likely to have a genetic addiction to smoking than those not primed. This marginal effect is significant when family history of smoking and parental health are controlled ($B = -.28$, $p < .05$).

One possibility is that those in the prime condition (all of whom are smokers) engaged in a kind of defensive processing of the primed message—perhaps because they felt vulnerable and perceived themselves to be less in control of their behavior in light of this claim (Liberman & Chaiken, 1992; Sagarin, Cialdini, Rice, & Serna, 2002). Defensive processing is one kind of resistance to messages that challenge existing behavior patterns. There are many others (Knowles & Linn, 2004; Wegnerer, Petty, Smoak, & Fabrigar, 2004), including selective avoidance, defensive inattention, counterarguing, reactance, attitude strength, and others.

Those in the prime condition, on hearing about the possible genetic link to smoking addiction, might resist this claim, processing it defensively. They might counterargue, leading to a perception that they are less under the control of genetic factors than typical others and, therefore, more efficacious to control their smoking behavior if they so choose. Although we do not have any direct evidence that those in the prime condition experience greater anxiety, withdrawal, vulnerability, reactance or inattention, some other data from our study are supportive.

In the survey, immediately after the experimental manipulations were delivered and all pertinent outcome questions were asked, another set of questions queried respondents about their perceptions about lung cancer deaths. The question asked for an estimate of the number of people out of 100 lifetime smokers who will die of lung cancer.[8] The overall correlation between a smoking behavior index (based on smoking history and perceived addiction)[9] and estimates of lung cancer deaths is –.13 ($p < .01$). When people are primed to think about a genetic basis for smoking addiction, this overall negative relationship is even more negative. Regression results indicate a significant interaction effect between priming and the smoking index ($p < .03$), such that those being primed actually have lower estimates of the number of lung cancer deaths when they have a stronger history of smoking than those not primed. Neither main effect is significant. These results are graphed in Figure 5.

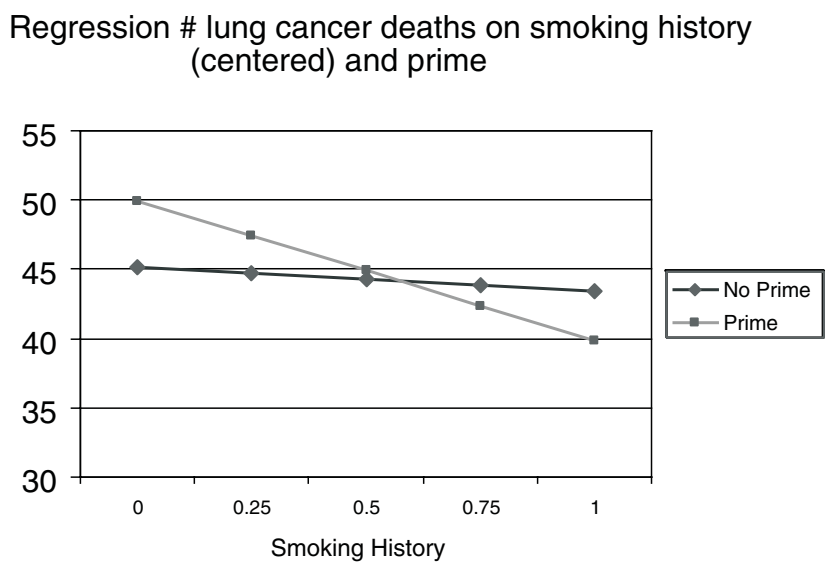

Figure 5. Estimated Marginal Means for the Number of Lung Cancer Deaths Predicted by the Interaction of Personal Smoking History and Priming of Genetic Susceptibility to Smoking Addiction

Heavier smokers have a more optimistic view of the susceptibility of smokers to death from lung cancer, judging fewer deaths to result, the stronger their own smoking habits. In our data, priming genetic susceptibility not only fails to foster the inference of one's own susceptibility to a genetic addiction to smoking (perhaps through some form of defensive processing such as counterarguing) but shows a tendency to the opposite inference and, consistent with this observation, greater optimism about lung cancer deaths from smoking than if the priming had not occurred.

The reason for these effects cannot be found in differences in judged believability of the claim made in the priming versus control conditions. Recall that all respondents evaluated the believability of the claim that "some people are more at risk to become habitual smokers than others because they have inherited certain genes from their family." No differences in credibility of the claim were obtained between prime and control conditions ($t[441] = 1.4, p > .15$), even though in the prime condition, the priming of the association between family history and genetic addiction occurred four times, and the credibility of the National Cancer Institute and the news media supported the claim.

In hindsight, the results of the priming manipulation perhaps should have been anticipated. Previous research on risk perception suggests that

optimism biases are common in many behaviors (Klein & Helweg-Larson, 2002). For example, young adult smokers in one study believed that they had better than average health in comparison to other smokers (and, in some cases, to nonsmokers) and that quitting would have little immediate benefit for their health (Prokhorov et al., 2003). Weinstein (1998) offered data showing that the inaccuracies in smoker's perceptions about health implications tended to minimize perceived risk. The paradoxical conclusion is that these optimistic biases, in turn, are associated with an elevated sense of control of future events (Klein & Helweg-Larson, 2002), possibly enhancing efficacy and the confidence to act to reduce risk.

Our results on priming are consistent with these biases. In future studies, where the credibility of the story might be more fully elaborated, information about genetic susceptibilities might be more difficult to reject cognitively with the result that optimism biases may be less likely to operate. The operation of the optimism bias in this case may seem beneficial in that efficacy could be enhanced, a known necessary condition for the intention to quit smoking. However, our discussion of the effects of priming so far has ignored individual differences in how credible people thought the genetic story to be.

Interpreting the message: Claim believability. Defensive avoidance and optimism biases center on the general, unmediated effect of the priming manipulation on basic cognitive reactions—namely, the inference of one's own genetic susceptibility to smoking addiction. However, message factors are likely to work through various kinds of interpretive processes, an assumption that Albarracin (2002) has made central to her persuasion paradigm extending the elaboration likelihood model (Petty & Cacioppo, 1986). Interpretive approaches have been central to understanding how people respond to health risk through processes of threat representation, strategies for coping with the threat, and appraisal of the effectiveness of coping (Leventhal & Diefenbach, 1991; Leventhal et al., 1997).

Albarracin's (2002) model is less concerned with interpretation of threat and risk associated with health and more focused on the general mechanisms through which the interpretation of messages might account for their effects. In our data, claim believability and family history of smoking act as mediators of the effects of the priming manipulation producing consequences for efficacy and intention to get a genetic test that are different from the unmediated main effects of priming alone.

The following conclusions about claim believability found support: (a) When a news story's claim is considered believable, smokers with a family smoking history will be more likely to infer that they could have inherited genes for addiction; (b) priming the association between family history and

genetic addiction to smoking in news stories does not increase the likelihood of the inference of personal genetic susceptibility, unless the story's claim is judged to be believable; (c) when priming, family history and claim believability are considered simultaneously as predictors of the inference of genetic susceptibility (Table 1)—the (unexpected) direct effect of priming alone becomes nonsignificant with its effects absorbed by the two-way interactions of claim credibility with priming and with family history.

In Albarracin's (2002) framework, family history and judged credibility of the claim represent aspects of interpretive filters mediating the effects of the message in the prime condition. How the claim is interpreted (that is, believed) makes a substantial difference in whether people attribute to themselves the inference that they could have a genetic basis for their smoking behavior. Those who interpret the claim as believable and who either are primed by the news account or have a family history of smoking are more likely to infer their genetic susceptibility. In turn, this inference is linked strongly to efficacy to quit smoking but in a negative direction. That is, those who infer a genetic susceptibility also attribute to themselves a lower efficacy to quit smoking that, based on past evidence, would be linked to a lower intention to try to quit smoking (de Vries et al., 1988; Velicer et al., 1990).

Claim believability plays a significant role in accounting for variance in a person's inference of genetic susceptibility to addiction. Because credibility was not manipulated in this study, we cannot know if increasing the usual cues of credible information (e.g., source bias, status, expertise and trustworthiness, evidence for the claim, etc.) will increase the impact of public information on inference-making about genetic susceptibility. However, some indirect evidence about claim believability suggests that it is not simply an individual difference factor reflecting characteristics such as skepticism bred of education. For example, the correlation between claim credibility and years of education was .015 ($p = .76$), indicating that education was unrelated to judged claim credibility.

Story (and claim) credibility are likely to remain extremely important in future research on effects of news media stories because public opinion data suggest considerable variability in how much influence genes are perceived to have in accounting for differences in personality, disease, behavior, and physical characteristics (Singer, Cornea, & Lamias, 1998). For example, in a 1997 poll cited by Singer et al. (1998), alcoholism was seen to be the result of genetic or hereditary factors mostly or completely (33%), somewhat (44%), and not at all (20%). Focus group members concluded that lung cancers were because of genetic factors about 31% and personal factors about 32%, with environmental and social factors accounting for the remainder (Parrott, Silk, & Condit, 2003). Given variation in the importance of genetic factors in public

perceptions of influence, establishing the credibility of claims about genetic influence will be crucial in future research as will obtaining information about the perceived magnitude of genetic influences, even given their believability. Some aspects of story credibility likely to be important include argument strength (Petty & Cacioppo, 1986) and the use of vivid examples (Zillman & Brosius, 2000), certainty about the claims' validity, and other factors (Devos-Comby & Salovey, 2002). Future research will need to examine some of the attributes that make health stories, particularly those about genetics, credible beyond simply the source's status.

Mediating role of inference of genetic susceptibility. As described in Figure 1, a person's inference of a genetic susceptibility to smoking addiction mediates the effects of message priming on efficacy and on the intention to get a test. Specifically, (a) the effects of a believable news story on intention to get a genetic test for smoking addiction depends on making the inference that one could have inherited genes for addiction, and (b) self-efficacy to quit smoking depends on the inference of genetic susceptibility to smoking addiction.

Respondents' inferences that they might have inherited genes for addiction played a significant role in their intentions to obtain a genetic test. It was the strongest predictor in the model for intention to get a test ($B = .18$, $p < .001$; Table 2). This suggests that understanding the basis for the inference that one has inherited genes for addiction is important in understanding the desire to obtain a genetic test for smoking. People can overestimate or underestimate their likelihood of having a genetic addiction for smoking or be completely in error about their susceptibility. Yet given the association between the cognitive inference and intention to get a test, understanding the impact of message characteristics on the inference has increased importance. Previous research in cancer genetics and testing has shown that despite strong intentions to obtain a genetic test among high-risk individuals (Streuwing et al., 1995), rates of actual uptake of genetic testing were much lower than anticipated (Lerman, Schulman, Narod, & Lynch, 1996; Lerman et al., 1999). However, in the context of a genetic test for a modifiable behavior, such as smoking, other factors such as self-efficacy may play a key role in actual test use (Codori et al., 1999).

Those inferring they were susceptible to a genetic addiction to smoking felt less efficacious to quit over and above their family history of smoking and their belief in the credibility of claim of a genetic basis for smoking addiction. However, self-efficacy in quitting was not affected by the genetic story prime. Because self-efficacy is an important factor in the intention to quit (a necessary condition to actual quit attempts; de Vries et al. 1988; Velicer et al.,

1990), a better understanding of the effects of credible news stories and priming effects on self-efficacy is warranted.

Conclusion. A few other limitations of the present study should be noted. Although the cooperation rate for the survey was good (77%), it is possible that respondents and nonrespondents differ on smoking history or other important characteristics that could bias study outcomes. In addition, the sample was composed of young adults, and the results may not generalize to older populations who are often more ready to give serious consideration to giving up smoking (Woods et al., 2002). Finally, this study used brief oral descriptions of news stories rather than the actual news stories; assessing the impact of the latter is an important topic for future research. Despite these potential limitations, our results indicate that family smoking history and information from credible news stories have important effects on beliefs about risk of inheriting genes for smoking susceptibility and on intentions to obtain a genetic test. These results are just the first steps in understanding the naïve inferences people make and how these inferences play into judgments about efficacy to quit and intention to obtain a genetic test.

Notes

1. Corresponding and reprint address: Joseph N. Cappella, 3620 Walnut St., Annenberg School for Communication, University of Pennsylvania, Philadelphia, PA 19104-6220; jcappella@asc.upenn.edu; 215-898-7059. This research was supported by the Annenberg Public Policy Center and grants from the National Cancer Institute P50 CA095856 (Joseph N. Cappella, Caryn Lerman) and National Institute on Drug Abuse P50 CA84718 (Caryn Lerman).

2. Content analyses have not given as much attention to broadcast media as to print media. However, researchers have considered the description and impact of how genetic influences are framed.

3. The sample focused on young, adult smokers because some research suggests that this is an important transitional period from the testing time of adolescence to the habits of adulthood. For some, the period is marked by progression to habitual smoking and increases in smoking rates (Baranowski et al., 1997; Lantz, 2002).

4. This criterion does produce a high percentage of current smokers: 83% have smoked at least 100 cigarettes in their lifetime; 53% smoked everyday in the past 30 days, and only 8% did not smoke at all in the same period; 68% labeled themselves as smokers. With the national rate of smokers at about 22% using a more stringent criterion than "one whole cigarette in the past 6 months" would have made a random digit dialing sample of this size prohibitively expensive.

5. This rate is Cooperation Rate 1 as defined by the American Association for Public Opinion Research (2004).

6. In testing, this four-level scale was reduced to three by collapsing the two middle categories (*slightly* and *very*). This aids interpretation of the analysis of variance

models. Testing with the four-level scale was also carried out using regression and linear and quadratic effects and interactions with similar results.

7. Main effects are interpreted in the context of significant interaction effects when the interaction effects are not crossed but instead indicate variation in slopes all of the same direction. In this situation, the main effects are not distortions of the underlying effects for subgroups.

8. Actually, the question was asked in four different contexts, each prefacing the same question about the number of lung cancer deaths with a statement alerting the respondent that other questions about other diseases would follow. One of the four versions was significantly different from the other three, $F(3, 428) = 3.00, p < .03$. In results reported in the text, question format is controlled.

9. Smoking behaviors were assessed by five items that measured whether respondents smoked at least 100 cigarettes in their life, whether they ever smoked a cigarette every day for at least a month, whether in the past 30 days they smoked at least one cigarette daily, whether they consider themselves smokers and addicted to smoking. All items were coded 1 for an affirmative answer and 0 for a negative one. The items were averaged into an index (Cronbach's alpha = .87).

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