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Entertainment-Education in a Media-Saturated Environment: Examining the Impact of Single and Multiple Exposures to Breast Cancer Storylines on Two Popular Medical Dramas

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In the United States, entertainment-education (E-E) initiatives in primetime television that provide public health information are at risk for diminished impact due to the media-saturated environment in which they must compete. One strategy to overcome this limitation is to use multiple primetime TV shows to reinforce similar health messages in multiple storylines. The current study explores such an approach by evaluating the impact of two separate breast cancer genetics storylines featured on two different TV programs as the result of outreach to writers and producers. These storylines aired within approximately 3 weeks of each other on the popular medical dramas, ER *(NBC) and* Grey's Anatomy *(ABC), and included information about the BRCA1 breast cancer gene mutation and the risks it poses to women who test positive for it. The evaluation used data collected from a panel sample of 599 female survey respondents at three points in time. Results show that while the individual storylines had a modest impact on viewers' knowledge, attitudes, and behaviors related to breast cancer, combined exposure seemed to be most effective at changing outcomes. Implications of our findings for future E-E interventions and evaluations are discussed.*

Entertainment-education (E-E) is a communication strategy that has been popular among international health promotion program planners since the 1950s. E-E strategies have been integrated into dramatic serial TV programs, and other forms of entertainment, in countries as diverse as Mexico, Turkey, India, South Africa, and Columbia on health issues such as domestic violence, HIV/AIDS prevention, reproductive health, and family planning. Due in part to this international success, public health practitioners in the United States also have sought to add E-E to their repertoire of public health promotion tools. In the United States, E-E has the potential to cost-effectively reach millions of people with health messages. Researchers have noted some unique challenges that confront the execution of domestic E-E programs, however, one of which is the large number of varied media outlets competing for the attention of audience members (Sherry, 2002; Singhal & Rogers, 2002). The large number of media outlets in the United States implies that audience share is likely to be far smaller for any one program than in many developing markets where there are fewer alternatives for viewers. Therefore, the media-saturated environment potentially could dilute the effectiveness of an E-E intervention (Sherry, 2002).

As Sherry (2002) discusses, however, media theory can help structure E-E programs so that they work within the limitations of a media-saturated environment. Among the theories that Sherry examines is Gerbner, Gross, Morgan, and Signorielli's (1986) cultivation theory. While the original theorists emphasized that it is the long-term exposure to the total pattern of TV programming that is important for its impact on viewers, Sherry uses cultivation theory to illustrate how a media-saturated environment enables the repetition of messages, especially at a thematic level, which may contribute to audience effects. Further, health communication scholars recognize that repetition of messages across channels and media can increase message impact (Piotrow, Kincaid, Rimon, & Rinehart, 1997). In fact, as part of their outreach strategy, campaign planners typically use a variety of credible sources to communicate their messages to the population of interest.

While repetition of key messages is important, in the United States there are only a small number of E-E interventions that have exercised a coordinated campaign across a variety of media outlets. One such example was the Harvard Alcohol Project's (HAP) campaign directed at reducing drunk driving by encouraging the adoption of designated drivers. Launched in late 1988, the campaign had substantial Hollywood support with campaign messages inserted into more than 160 entertainment TV programs. Results from initial pre-test and post-test surveys showed a 10 percentage point increase in respondents who reported that they used a designated driver all or most of the time (Winsten & DeJong, 2001).

Unlike the HAP campaign, most analyses of E-E interventions focus on the impact of health-related depictions from one TV program. For example, studies have shown an association between exposure to health information on the medical drama *ER* and changes in viewers' knowledge and behaviors on a diverse range of health issues such as emergency contraception; the human papilloma virus (HPV); teen obesity and nutrition; and syphilis, just to name a few (Brodie et al., 2001; Valente et al., 2007; Whittier, Kennedy, St. Lawrence, Seeley, & Beck, 2005). The positive impact of health storylines is not limited to viewers of medical dramas and also has been found in genres including nonmedical primetime dramas (Movius, Cody, Huang, Berkowitz, & Morgan, 2007; Sharf, Freimuth, Greenspon, & Plotnick, 1996); daytime soap operas (Kennedy, O'Leary, Beck, Pollard, & Simpson, 2004); telenovelas (Wilkin et al., 2007); and even situation comedies (Kennedy, Beck, & Freimuth,

2007; Collins, Elliott, Berry, Kanouse, & Hunter, 2003). Research on these health depictions has shown that major and minor storylines, depicted across one or several episodes, and even short vignettes in a single episode, can have effects on viewers.

The behavior change theory most often used to understand the impact of E-E programs is Bandura's social cognitive theory (1977, 1986, 2002). Social cognitive theory suggests that observational learning can lead to the acquisition of new knowledge, attitudes, and behaviors. Research suggests that self-efficacy, motivation, and identification are important factors in the process of social modeling (Brown & Fraser, 2004; Papa et al., 2000; Sood, 2002). Therefore, as past studies illustrate, narratives may not influence all audience members equally (Murphy, Hether, Huang, & Beck, 2006; Sharf & Freimuth, 1993; Sharf et al., 1996). Rather, individual attributes and demographic characteristics, such as gender and race, can be expected to influence how viewers respond to a particular storyline (Valente, 2002).

Since health content is integrated into TV programs at the discretion of producers and writers, evaluation of health storylines often is difficult due to limited information about the specific storyline, the actual health content, and even the final airdate(s) (Valente et al., 2007). These difficulties expand when dealing with multiple programs. As a consequence, there are no published studies that examine the impact of multiple storylines about the same health topic airing on different TV programs during the same time period.

The current study examines the impact of two breast cancer storylines that aired during a 3-week period in the fall of 2005 on two popular primetime television programs, *ER* (NBC; Sherman Barrois & Albert, 2005; Zabel & Chulack, 2005) and *Grey's Anatomy* (ABC; Schmir & Linka Glatter, 2005). Both stories focused on the breast cancer risk that confronts women who test positive for the breast cancer gene mutation (BRCA1). Further, both stories featured a protagonist who chose to undergo preventative surgery to reduce her risk of developing cancer. The present study uses a panel sample of female survey respondents to analyze the impact of each storyline individually and jointly.

Breast Cancer Risk and the BRCA Gene Mutation

Breast cancer affects more than 192,000 American women each year, and approximately 5% to 10% of these cases are hereditary (NCI, 2007a, para 1.). According to the National Cancer Institute (NCI; 2007a, para. 1) certain gene mutations make some women more susceptible to developing breast and other types of cancers. Women with inherited gene mutations BRCA1 or BRCA2 have up to an 85% risk of getting breast cancer, compared with 13% of women in the general population. If a woman tests positive for either type of breast cancer gene mutation, prophylactic surgery is one strategy to manage the risk of developing cancer. This surgery may involve the removal of healthy breasts (bilateral mastectomy), fallopian tubes and ovaries (salpingo-oophorectomy), or both.

While the prevalence of these surgeries is largely unknown, some studies report that between 19% and 50% of mutation-positive women have chosen to undergo prophylactic mastectomy to manage their cancer risks (Lynch, Lynch, & Rubinstein, 2001; Meijers-Heijboer et al., 2001). Other research has shown that prophylactic mastectomy resulted in an approximately 90% reduction in breast cancer risk for women with a family history of breast cancer (Hartmann et al., 1999), and an even higher risk reduction in women with BRCA 1 or BRCA2 gene mutations (Hartmann

et al., 2001; Meijers-Heijboer et al., 2001). Similarly, studies have shown that salpingo-oophorectomy reduces breast and other BRCA-related gynecologic cancer risks in carriers of BRCA mutations (Kauff et al., 2002; Rebbeck et al., 2002). Researchers have noted that these often are difficult surgeries for physicians to recommend, however, because both patients and physicians may be reluctant to remove healthy tissue to prevent a disease that may not occur (Newman, 2001). Therefore, the NCI (2007b, para. 15) has emphasized the importance of cancer risk assessment and counseling, in addition to careful consideration of other preventative options, before women make the decision to undergo prophylactic surgery.

While BRCA genetic tests are available, the complexity of test interpretation and the limited data on clinical validity and utility has resulted in these tests typically being recommended only to women who have a family history of cancer (Jacobellis et al., 2004). From a public health perspective the value of these storylines lies not only in raising awareness of genetic testing, but also in raising awareness of the genetic risks of breast and ovarian cancer and the importance of knowing one's family medical history. As with other cancers, early detection is crucial in reducing the number of women who die from breast cancer (NCI, 2007b, para. 4).

The Intervention

This study reports on the impact of two storylines featured on two primetime medical shows, *ER* and *Grey's Anatomy*, in the fall of 2005. These two storyline ideas were first conceived in early 2005 during a panel presentation for television writers on the topics of new genetics, organized by Hollywood, Health & Society (HH&S), a program of the Annenberg Norman Lear Center at the University of Southern California. Subsequently, writers of both shows independently made all creative decisions related to the storylines, their health content, and airdates.

The *ER* storyline aired across two episodes on October 6 and October 20, 2005, and the *Grey's Anatomy* storyline aired in one episode on November 13, 2005. The *ER* storyline focused on a character named Stephanie Lowenstein who had a family history of breast cancer and previously had tested positive for the BRCA1 gene mutation. In the first episode of the storyline, the increased risk of developing breast and ovarian cancer after testing positive for the BRCA1 gene mutation was explained. As the storyline developed, Dr. Lockhart recommended that Stephanie seek another opinion from an oncologist regarding her options. Further, Dr. Lockhart suggested that a prophylactic mastectomy and oophorectomy might be a good way for Stephanie to manage her risk of cancer. Stephanie ultimately decided to undergo a double mastectomy, but not the oophorectomy (Zabel & Chulack, 2005).

In a second episode, Stephanie discovered that during the surgery the doctors found an enlarged lymph node, indicating that she may have cancer after all. While Stephanie's cancer diagnosis remained unresolved, the storyline shifted to address Dr. Lockhart's breast cancer risk. In a conversation with Stephanie, Dr. Lockhart disclosed that she, too, had a family history of breast cancer, yet she had never had a mammogram. The episode concluded with Dr. Lockhart getting a mammogram, thus emphasizing the importance of early detection and screening (Sherman Barrois & Albert, 2005).

The *Grey's Anatomy* storyline also depicted the difficult decision of choosing to undergo preventative surgery as a consequence of a positive BRCA1 test. In this storyline, a character named Savvy, who tested positive for BRCA1 and had a family

history of breast and ovarian cancer, wanted to have her ovaries, uterus, and breasts removed as a strategy to manage her cancer risk. The story presented the complexities of prophylactic surgery, especially concerning the removal of body parts that are intricately connected to a female's sexual and gender identity. The storyline also communicated the importance of second opinions in a patient's health care, as well as the implications of having a family history of breast cancer and testing positive for the BRCA1 gene mutation (Schmir & Linka Glatter, 2005).

While the two storylines had similarities in their health content, they also differed in several important ways. For example, in the *Grey's Anatomy* storyline, Savvy's husband, Weiss, and several doctors were initially unsupportive of the preventative surgery, and it was Savvy who championed it. By contrast, on *ER* the recommendation for the preventative surgery came from Dr. Lockhart, who encouraged the patient to pursue this course of action.

Together, these two storylines provide a unique opportunity to examine not only the impact of each storyline individually, but also to measure the combined impact of exposure to both storylines. This study uses a survey of primetime TV viewers to test the following hypotheses:

> H1: Exposure to each BRCA1 gene mutation storyline will be associated with the following:
> H1a: greater knowledge about the BRCA1 gene mutation;
> H1b: greater knowledge of family history as a breast cancer risk;
> H1c: more positive attitudes regarding (i) the importance of early breast cancer detection, (ii) preventative surgery, and (iii) the importance of getting a second opinion
> H1d: greater behavioral intentions to undergo breast cancer screening; and
> H1e: greater self-reported behavior change.
> H2: Exposure to *both* BRCA1 storylines will be associated with greater change on more outcome measures (knowledge, attitudes, behavioral intentions, and behaviors) than exposure to either show individually.

Methods

A private research company, Frank N. Magid Associates, sent solicitation emails and administered the survey to registered primetime TV viewers in their database at three points in time. Respondents were recruited randomly from the Magid email panel of survey-takers and they joined the primetime panel on a voluntary basis. This non-nationally representative panel participates in five to seven surveys each year. The study applied for and received a designation of exemption from the University of Southern California (USC) Institutional Review Board.

Baseline data were collected prior to the airing of the first *ER* episode in early October. Of the 20,497 email solicitations sent, 1,912 surveys were returned (9.3%), of which 1,783 were completed (8.7%). A second wave of data was collected after the airing of the second episode of the *ER* storyline (October 20, 2005), but prior to the airing of the *Grey's Anatomy* storyline. Of the 22,996 email solicitations sent, 2,044 surveys were returned (8.9%), and 1,869 were completed (8.1%). Finally, a third wave of data was collected after the airing of the *Grey's Anatomy* BRCA storyline on November 13, 2005. In this wave, there were 25,496 solicitations sent,

with 2,026 respondents (7.9%) and 1,809 completed (7.1%). No email reminders were sent. While the response rates are low, it is difficult to calculate an accurate response rate because it is unknown whether all recipients actually received the email solicitations. The research firm estimates that approximately 20% of email addresses were no longer valid. In addition, with the increased use of spam filters over the past few years, online surveys such as these have seen lowered response rates across the board.

There were 819 respondents who completed all three waves of the survey, and the final sample was restricted to 599 female respondents. The decision to limit the sample to females only was based on our theoretical framework, social cognitive theory, which posits that the behaviors and attitudes modeled in the storylines were most relevant to women who were more likely to identify with the characters and their situations.

Sample Characteristics

The analytic sample was primarily Caucasian (92%) with some college/trade school education (40%), and the majority had household incomes between $25,000 and $49,999 (40%). Seven percent of respondents reported having been personally diagnosed with cancer, and 66% reported having a close friend or family member with cancer. Respondents watched a mean of 23 hours of television per week. Table 1 reports the complete demographic description of the sample.

A logistic regression comparing respondents lost to follow-up with those retained showed two significant predictors of attrition. As shown in Table 2, panel respondents who completed all three waves of the survey tended to be older (AOR = 1.02, $p < .001$) and were more likely to be from a minority group (AOR = 3.26, $p < .001$).

Outcome Measures

The outcome variables measured in the survey included respondents' knowledge of the BRCA gene and breast cancer risks; attitudes about breast cancer; behavioral intentions with respect to breast cancer screening; and self-reported behaviors initiated as a result of seeing the specific episodes of *ER* and *Grey's Anatomy* under investigation. It is important to note that when the survey instrument was created, the exact health content of the storylines was unknown to the researchers (specific details related to the storylines were tightly guarded by the shows' writers and producers). Therefore, where relevant, the analysis is limited to items that were addressed in the episodes.

Knowledge. Knowledge of the BRCA gene and breast cancer risk was measured through a series of dichotomous questions. General knowledge of the BRCA gene was assessed by asking respondents, "Have you ever heard of the BRCA gene (*pronounced 'braca' or 'B-R-C-A'*)?" Knowledge of the risks of the BRCA gene mutation was measured by asking respondents whether they agreed or disagreed with the following two statements: (1) "Having the BRCA gene mutation increases one's risk of getting breast cancer"; and (2) "Having the BRCA gene mutation increases one's risk of getting ovarian cancer." Knowledge of family history as a breast cancer risk was measured by asking respondents to select from among seven response options whether family history/genetics is a breast cancer risk.

Attitudes. Attitudes about breast cancer were measured with the following question: "On a scale from 1 to 4, how much do you agree with each statement when thinking about breast cancer?" Respondents rated three items on a 4-point

Table 1. Characteristics of the panel sample

	N = 599
Mean age	43 years
Ethnicity	
White/Caucasian	92%
African American/Black	4%
Hispanic/Latino	2%
Asian American/Pacific Islander	1%
Other	1%
Education	
Some high school or less	2%
Completed high school	23%
Some college/trade school	40%
College graduate	29%
Graduate school	6%
Household income	
Less than $25,000	14%
$25,000–$49,999	40%
$50,000–$74,999	25%
$75,000 or more	21%
Marital status	
Single	15%
Married	69%
Divorced/separated	13%
Other	3%
Controls	
Has been diagnosed with cancer	7%
Has close family member or friend with cancer	66%
Mean weekly hours of TV viewing	23 hours
Exposure to other breast cancer information (1 to 5)—Wave 2	1.57
Exposure to other breast cancer information (1 to 5)—Wave 3	1.19
ER exposure	
No episodes	72%
1 episode	9%
2 episodes	19%
Grey's Anatomy exposure	18%
Combined exposure	
No episodes	61%
1 episode	17%
2 episodes	15%
3 episodes	7%

Likert-type scale, where (1) = "strongly disagree" and (4) = "strongly agree." The three attitude items follow: (1) It is important to detect breast cancer early; (2) Having a mastectomy (*surgery to remove the breast*) is a good option for preventing breast cancer; and (3) If someone is diagnosed with cancer, he or she should get a second opinion.

Table 2. Adjusted odds ratios indicating the association between respondents lost to follow-up and control variables

	Attrition
Age	1.02***
Education	1.07
Income	.94
Minorities	3.26***
Hours of TV viewing	1.00
Respondent had cancer	.94
Family/friend had cancer	.89
Other breast cancer exposure	.95
Adjusted R^2	.04

***$p < .001$.

Behavioral Intentions. Intentions were measured by assessing respondents' self-reported breast cancer screening intentions. Respondents were asked, "How likely are you to do the following within the next 2 years?" Using a 4-point Likert-type scale that ranged from "very unlikely" to "very likely," respondents rated the following items: (1) Get a mammogram; (2) Get a breast exam at my doctor's office; (3) Recommend a breast cancer screening (*mammogram or breast exam at doctor's office*) to a woman I know; and (4) Get tested for the BRCA gene mutation.

Behaviors. Self-reported behavior changes were measured by asking respondents, "In the past month, did you *do* any of the following as a result of seeing an episode of *ER*/*Grey's Anatomy?*" While the instrument measured responses to 10 items with a dichotomous response option (yes/no), only the three items that are most relevant to the current storylines will be reported. These include the following: (1) Schedule a breast cancer screening, (2) Schedule a test for the BRCA gene mutation, and (3) Talk to someone about breast cancer. In addition to examining these variables individually, two behavior indices also were created: one for changes attributed to viewing *ER* and one for changes attributed to viewing *Grey's Anatomy*. These indices were created by summing all of the positive responses to the three individual behavior questions asked of each show, creating a range from zero to three.

Exposure. The survey instrument asked respondents whether they had seen any of five *ER* and *Grey's Anatomy* episodes that had aired during the previous 5 weeks. From this data, three exposure variables were created and used in the analyses: (1) exposure to the *ER* storyline was measured by an index variable with three values that compared nonviewers with viewers who had seen either one or both of the *ER* episodes; (2) exposure to the *Grey's Anatomy* storyline compared nonviewers with viewers; and (3) combined exposure was measured with an index that ranged from zero to three that compared nonviewers of both episodes with viewers who had seen one, two, or all three of the BRCA storyline episodes that aired across both shows. Table 1 reports the distribution of the exposure variables.

The analysis plan consisted of three phases that involved examining the impact of each storyline separately, followed by examining the combined impact of viewing both the *ER* and *Grey's Anatomy* storylines. Lagged regression analysis was used to

control for baseline responses (Valente, 2002); in addition, other control variables included age, education, income, ethnicity, hours of weekly TV viewing, personal diagnosis of cancer, friend or family member with cancer, and exposure to other breast cancer information. Because there were so few minority respondents, ethnicity was recoded into a dichotomous variable that compared Caucasians with all other minority populations. Exposure to breast cancer information was controlled for by an index that measured exposure to breast cancer information from other media sources (e.g., newspapers/magazines, radio, Internet, billboards, and other).

Results

Knowledge. Table 3 reports the adjusted odds ratios (AORs) indicating the association between watching the BRCA storyline(s) and knowledge of the BRCA gene. The analysis of *ER* exposure indicated that with each *ER* episode viewed, respondents were 50% more likely to have heard of the BRCA gene (AOR = 1.50, $p < .001$). Respondents who watched the *Grey's Anatomy* storyline were twice as likely to have heard of the BRCA gene than nonviewers (AOR = 2.09, $p < .05$), while the analysis of the combined exposure showed that with each episode viewed, respondents were 33% more likely to be aware of the BRCA gene (AOR = 1.33, $p < .05$).

Knowledge of the BRCA gene mutation as a risk for getting breast cancer was also significantly associated with all three exposure conditions. The analysis of *ER* alone showed that with each episode viewed, respondents were 30% more likely to agree that having the BRCA gene mutation increases one's risk of getting breast cancer (AOR = 1.31, $p < .05$). Similarly, viewers of *Grey's Anatomy* were more than twice as likely as nonviewers to agree that the BRCA gene mutation is a breast cancer risk (AOR = 2.08, $p < .01$), while the analysis of the combined exposure shows that with each episode viewed, respondents were more than 50% more likely to agree that the BRCA gene mutation increases one's risk of breast cancer (AOR = 1.56, $p < .001$).

Table 3. Adjusted odds ratios indicating predictors of knowledge of the BRCA gene

	ER	Grey's Anatomy	Combined
Baseline score	16.16***	1.40	1.38
Wave 2 score	–	20.85***	20.12***
Age	1.02*	1.01	1.01
Education	1.37**	1.29*	1.32*
Income	1.01	1.25[+]	1.25[+]
Minorities	1.65	.32**	.32**
Hours of TV viewing	.99[+]	1.00	1.00
Respondent had cancer	.67	.55	.59
Family/friend had cancer	1.59*	1.61*	1.56[+]
Index of other breast cancer expo	1.23**	1.36***	1.35***
ER exposure	1.50***	1.12	–
Grey's Anatomy exposure	–	2.09*	–
Combined exposure	–	–	1.33*
Adjusted R^2	.27	.53	.53

[+]$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

Knowledge of the BRCA gene mutation as a risk for ovarian cancer was not associated with viewing *ER*; however, it was positively associated with exposure to the *Grey's Anatomy* episode. Viewers of *Grey's Anatomy* were more than four times as likely as nonviewers to agree that having the BRCA gene mutation increases one's risk of ovarian cancer (AOR = 4.47, $p < .001$). Similarly, analyses of the combined viewing showed that with each episode watched respondents were more than 50% more likely to agree that the BRCA gene mutation increases one's risk of ovarian cancer (AOR = 1.54, $p < .001$).

Respondents' knowledge of the role of family history or genetics as a risk for getting breast cancer was not significantly associated with any of the exposure conditions. This likely was due to ceiling effects because baseline knowledge of this risk factor already was more than 80% for every exposure condition, and it remained steady across the three waves of data collection.

Attitudes. Exposure to the *ER* storyline was associated with two attitudes, while exposure to *Grey's Anatomy* was not associated with any of the attitude items. The analysis of *ER* viewers showed that with each episode of *ER* watched, respondents were significantly more likely to agree that "Having a mastectomy is a good option for preventing breast cancer" (ß = .10, $p < .05$). In addition, *ER* exposure was marginally associated with the statement, "It is important to detect breast cancer early" (ß = .07, $p < .10$).

Similarly, as Table 4 illustrates, there were significant associations between the combined exposure variable and two attitude items. Viewing more of the BRCA episodes predicted agreement with the following statements: (1) "Having a mastectomy is a good option for preventing breast cancer" (ß = .18, $p < .001$), and (2) "If someone is diagnosed with breast cancer, he or she should get a second opinion" (ß = .09, $p < .05$).

Table 4. Standardized betas indicating predictors of agreement with two attitudes about breast cancer and combined exposure

	"Having a mastectomy is a good option for preventing breast cancer"	"If someone is diagnosed with cancer, he or she should get a second opinion"
Baseline score	.22***	.23***
Wave 2 score	.41***	.45***
Age	−.03	.10*
Education	−.04	.00
Income	.01	.01
Minorities	.00	.02
Hours of TV viewing	−.12**	−.08*
Respondent had cancer	.03	.03
Family/friend had cancer	−.01	−.01
Index of other breast cancer exposure	.01	.05
Combined exposure	.18***	.09*
Adjusted R^2	.34	.35

*$p < .05$; **$p < .01$; ***$p < .001$.

Behavioral Intentions. Of the four items that measured respondents' intentions to undergo breast cancer screening, there was one marginally significant association with exposure to *ER* alone, while there were no significant associations between viewing the *Grey's Anatomy* storyline and any of the items. The more episodes of the *ER* storyline watched, the more respondents indicated their intention to get tested for the BRCA gene (ß = .06, $p < .10$). Analyses of the combined exposure variable showed an even stronger association with this outcome: the more episodes viewers watched across both shows, the more respondents intended to get tested for the BRCA gene (ß = .08, $p < .05$).

Behaviors. Behaviors were measured by examining the association between exposure to the storylines and respondents' self-reported behaviors after watching an episode of *ER* or *Grey's Anatomy*. The two questions asked, "Did you do any of the following as a result of seeing *ER/Grey's Anatomy?*" This analysis excluded respondents who indicated that they never watched *ER* or *Grey's Anatomy*; therefore, the analysis compared storyline viewers with nonstoryline viewers among respondents who watched *ER* or *Grey's Anatomy* or both at least occasionally. To test the effects of the storylines, we regressed the individual outcomes on the control and exposure variables. The results indicate that exposure to the *ER* and *Grey's Anatomy* storylines individually was not significantly associated with any behavior change outcomes. Analysis of the combined exposure to the *ER* and *Grey's Anatomy* storylines, however, resulted in one significant association: with each increase in BRCA episodes watched, viewers were nearly 10 times more likely to report that they scheduled a breast cancer screening as a result of seeing an episode of *Grey's Anatomy* (AOR = 9.91, $p < .05$).

Indices were created that summed the actions that *ER* and *Grey's Anatomy* viewers reported taking as a result of seeing an episode of *ER* or *Grey's Anatomy* in the last month. These indices ranged from zero to three and were regressed on the control and exposure variables to examine a more general association between exposure to the storylines and behavior change related to breast cancer. The results showed that there was no association between viewing the *ER* BRCA storyline individually with behavior change; however, *Grey's Anatomy* marginally was associated with behavior change: viewers of the *Grey's Anatomy* storyline were more likely to change their behaviors related to breast cancer than nonviewers (ß = .11, $p < .10$). Combined exposure was even more strongly associated with behavior change that viewers attributed to watching both *ER* and *Grey's Anatomy*. In other words, the more BRCA episodes respondents watched, the more they reported behavior change related to breast cancer as a result of watching *ER* (ß = .18, $p < .01$) and *Grey's Anatomy* (ß = .17, $p < .01$).

Discussion

This study examined the audience impact of exposure to two breast cancer genetics storylines depicted on two primetime TV programs during the fall 2005 TV season.

The results indicate that the individual *ER* and *Grey's Anatomy* storylines were similarly effective in the number of outcome variables they impacted. Despite the similarities in their health messages, however, the storylines influenced different variables. Table 5 summarizes the variables that were significantly associated with all three viewing conditions. On the knowledge items, all three viewing conditions were

Table 5. Summary of outcome variables significantly associated with each exposure condition

	ER	Grey's Anatomy	Combined
Knowledge			
BRCA gene mutation	✓	✓	✓
BRCA as breast cancer risk	✓	✓	✓
BRCA as ovarian cancer risk	—	✓	✓
Attitudes			
It is important to detect breast cancer early	✓	—	—
Having a mastectomy is a good option for preventing breast cancer	✓	—	✓
If someone is diagnosed with cancer, he or she should get a second opinion	—	—	✓
Behavioral intentions			
Get tested for BRCA gene	✓	—	✓
Behavioral change			
Scheduled a breast cancer screening	—	—	✓
Cumulative behavior change	—	✓	✓

associated with knowledge of the BRCA gene mutation and knowledge of the gene mutation as a risk for breast cancer. Although viewing *Grey's Anatomy* individually and the combined viewing were associated with knowledge of the BRCA gene mutation as a risk for ovarian cancer, viewing *ER* alone was not significantly associated with this knowledge item. It seems likely that viewers of *ER* alone may not have associated ovarian cancer risk with the BRCA gene mutation because the protagonist of the storyline did not have her ovaries removed, whereas on *Grey's Anatomy* the patient was concerned about her risk of ovarian cancer and so she also chose to have a prophylactic oophorectomy.

On the attitude measures, exposure to the *ER* storyline was significantly associated with two items: having a positive attitude toward preventative mastectomy and, less robustly, with agreeing with the importance of early detection of breast cancer. Exposure to *Grey's Anatomy*, on the other hand, was not associated with any of the attitude items, while combined exposure significantly impacted two attitude items: (1) having a positive attitude toward preventative mastectomy; and (2) agreeing that if someone is diagnosed with breast cancer he or she should get a second opinion.

The measurements of behavioral intentions showed a marginally significant association between viewing *ER* alone and intention to get tested for the BRCA gene mutation. Viewing *Grey's Anatomy* was not associated with any behavioral intentions, while the combined viewing showed a more robust association with respondents' intention to get tested for the BRCA gene.

Finally, the measurements of behavior change showed no association with viewing *ER* alone, while viewing *Grey's Anatomy* alone was marginally associated with behavior change. The combined exposure condition, moreover, showed a positive association with viewers scheduling a breast cancer screening and with an overall higher index measurement of behavior change.

The differences in the outcome variables impacted by the individual storylines may be accounted for by the brief description of the two storylines presented earlier. The *Grey's Anatomy* storyline may have had less of an impact on viewers' attitudes about preventative mastectomy because it depicted more discussion among the characters as to whether surgery was the most appropriate response to a positive BRCA test. Further, a social cognitive explanation may suggest that the *Grey's Anatomy* storyline did not model the potential positive outcomes of the preventative surgery as well as the *ER* storyline. For example, the *ER* story concluded with the patient's romantic interest still pursuing her, despite her mastectomy. Therefore, romantic love was offered as a reward for the patient's willingness to undergo the mastectomy, whereas on *Grey's Anatomy* the patient's reward for undergoing the surgery was the reluctant support of her husband.

This study has limitations that influence its generalizability. As a quasiexperiment, participants were not randomly assigned to each condition; therefore, we run the risk of selectivity biases that may confound the results. Using the Internet to disseminate our survey also has limitations. First, our sample is restricted to individuals who have a computer and are comfortable using it to respond to online surveys. In addition, our response rates are low, and we were unable to compare those who responded with those who did not. The low response rates, however, are not unusual for this type of data collection strategy. Further, most subjects who initiated the survey went on to complete it, with an average attrition rate of 9.5% across the three waves.

Caution also is urged when interpreting the findings about minority women due to the small number who responded to the survey. Future studies should examine the impact of E-E storylines on other populations of interest, such as individuals from under-represented populations who also may have disproportionate risk for certain diseases or illnesses. In addition, the sample size of viewers who saw all three BRCA storyline episodes is small; therefore, additional research is needed with a more even distribution of respondents across all exposure conditions.

This study provides further evidence that E-E can be an effective vehicle to communicate key facts about complex health issues. While E-E programs run the risk of communicating unintended negative health messages due to health communication researchers' lack of control over the storyline, they also have a powerful advantage in their ability to model healthy behaviors through popular characters on a regular basis. The *ER* storyline, for example, depicted a doctor who had not had a mammogram, despite her genetic risks for breast cancer. While this potentially could communicate a negative health message to viewers, this character represented a classic transitional role model who overcame her fear and ultimately had a mammogram by the episode's conclusion. According to Bandura (2004), transitional role models are one of the most powerful influencers because they model the process of change. Therefore, the storyline concluded by communicating—through modeling—a positive, empowering message.

The study's most important contribution may be that exposure to both storylines was associated with change on more outcome measures than viewing either storyline alone. This supports Sherry's (2002) suggestion that media theory can be used to structure effective E-E programs. Following a cultivation perspective, this study illustrates that an additive effect can be found when viewers are exposed to multiple storylines with a similar theme across different TV programs. These findings have practical relevance to health communication practitioners by suggesting that in

the United States, where there is extensive competition for audience attention, an effective E-E strategy may entail multiple health storylines with similar health messages dispersed across multiple media outlets. This study adds to the growing body of literature that illustrates that E-E programs can be an effective means of public health communication with domestic audiences.

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