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From the small screen to breast cancer screening: examining the effects of a television storyline on awareness of genetic risk factors

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Abstract

Background: The topic of breast cancer genetics entered the public discourse following Angelina Jolie's 2013 announcement that she carries the BRCA1 mutation and underwent a prophylactic double mastectomy to reduce her breast cancer risk. A year prior to Jolie's announcement, the teen drama *90210* ran an eight-episode story arc on the BRCA gene mutations. This study focuses on an evaluation of the impact of this particular media text within the broader context of research on the persuasive effects of entertainment narratives (i.e. entertainment education).

Method: The evaluation consisted of two complementary studies of adult women: a pre-test/post-test study using a panel sample of regular television viewers who were directed to watch a particular episode (Study 1), and a cross-sectional study using a convenience sample of frequent *90210* viewers (Study 2).

Results: In both studies, storyline exposure was associated with increased knowledge (familiarity with the BRCA gene, knowledge about mastectomy). Study 1 additionally saw evidence of increased fears regarding the consequences of the BRCA gene and intentions to talk to a doctor. In

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Disclosure statement

No potential conflict of interest was reported by the authors.

Study 2, the number of episodes viewed was positively related to both knowledge and behavior (finding out about one's family history of breast cancer).

Conclusions: These findings suggest that despite unprecedented changes in the ways audiences engage with and consume entertainment media, television narratives remain a powerful method of educating viewers about health risks and inspiring them to take action.

Keywords

Breast cancer; ovarian cancer; BRCA; health communication; health behavior; entertainment education; television; media messages

Introduction

In May 2013, actress and humanitarian Angelina Jolie made headlines when she publicly revealed in the *New York Times* that she carries the breast cancer genetic mutation known as BRCA1 [1]. Based on her genetic profile and family history, Jolie's doctors estimated her lifetime risk of developing breast cancer to be 87%, and ovarian cancer, 50%. Given her heightened risk, Jolie made the difficult decision to undergo a prophylactic (i.e. preventive) double mastectomy. Celebrity announcements such as Jolie's have the potential to bring much-needed media and public attention to health-related issues [2]. According to social cognitive theory (SCT) [3–5], individuals learn vicariously by observing others, and are more likely to enact behaviors modeled by those with whom they identify, or perceive as similar to themselves. Just as an individual may identify with a celebrity, similar mechanisms often operate with fictional characters in entertainment narratives [6]. Entertainment education (EE), an approach that involves integrating compelling entertainment storylines with educational messages, is built upon the unique persuasive power of entertainment narratives. EE has proven a highly effective strategy for raising awareness, changing attitudes, and motivating individuals to take action to improve their health and well being [7–10].

This study focuses on an evaluation of the impact of an eight-episode breast cancer storyline that aired on the teen drama *90210* [11] between March and May 2012, a full year before Jolie's announcement. The storyline in question centers on eighteen-year-old Silver's decision to take a test for the BRCA gene mutations, and the choices she must make in the wake of a positive test result. The primary objective of this study was to evaluate how exposure to this storyline influences breast cancer related knowledge, attitudes, and prevention behaviors, among both regular viewers and non-viewers of *90210*.

Entertainment education

Despite undergoing massive transformation in recent years, mass entertainment media continue to serve as a key resource for health-related information. According to an analysis of data from the 2012 Porter Novelli *HealthStyles* survey [12], more than 40% of regular viewers of prime-time TV comedies and dramas report learning something new about a health issue or disease from these shows, and more than 20% report taking action on what

they learned. Given the influence and reach of entertainment media, it is vital to the public health that the information integrated in such narratives is accurate and informative.

It has been theorized that entertainment is a particularly powerful vehicle for persuasive messages because, unlike public service announcements and other overtly persuasive formats, entertainment narratives are not generally perceived as having an agenda [13]. Theories regarding the effectiveness of EE as a communication strategy traditionally focus on two key psychological mechanisms – transportation, or absorption, into the narrative and emotional involvement with a particular character [14]. Research has shown that viewers who have a high level of involvement with characters, or who are transported into the narrative, tend to experience more knowledge gains, as well as greater shifts in attitudes and behavior [15,16].

Traditionally, EE has involved educational content being placed into entertainment messages, but strategies vary across media markets. In the U.S., where mass media are independently owned and operated, a ‘hands-off’ strategy has evolved in which the writers make all content-related decisions. Organizations such as Hollywood, Health & Society (HH&S) have been working with the U.S. entertainment industry to facilitate the inclusion of accurate information on health, climate science, and other topics in entertainment narratives. By combining the storytelling skills of Hollywood’s top writers and producers with the specialized health knowledge of a network of subject matter experts, this approach enables the development of dramatic and informative storylines that routinely reach millions of viewers, including those at disproportionate risk for a variety of health problems.

Cancer is consistently among the most frequently depicted health topics on prime time TV [17]. Data from a content analysis of popular prime time television shows [18] indicate that between 2009 and 2011, 10% of TV health storylines addressed cancer. Thus, it is unsurprising that a substantial number of EE studies have focused on cancer, and particularly breast cancer. A study of the impact of a breast cancer storyline on the Spanish-language telenovela *Ladrón de Corazones* found an increase in calls to a cancer information hotline when a PSA with the hotline number aired during the episode [19]. Another study examined the effects of two episodes related to breast cancer gene mutations on the medical dramas *ER* and *Grey’s Anatomy* that aired just weeks apart [20]. Interpreted through the lens of cultivation theory [21], this study found that exposure to both episodes had stronger effects on knowledge, attitudinal, and behavioral out-comes than either episode alone.

The storyline

The prime time soap opera *90210*, which aired on the CW Network from 2008 to 2013, was an updated spinoff of 1990s drama *Beverly Hills 90210*. Early in the process of developing this storyline, *90210*’s writers sought support from HH&S, which facilitated a series of exchanges between the show’s writers and subject matter experts from the Centers for Disease Control and Prevention (CDC). The writers made all creative decisions regarding content.

In the first episode of the storyline (episode 417), eighteen-year-old Silver goes on a routine doctor visit. The doctor reminds Silver that she has a family history of breast cancer – her

mother, grandmother, and aunt all died from the disease. Silver promises to conduct self-exams and get regular checkups, but the doctor recommends taking a test for the BRCA gene mutations. She informs Silver, 'If you have the BRCA1 or 2 mutation, your future includes up to a sixty percent chance of getting breast cancer. You'd need to consider preventative measures, such as a prophylactic mastectomy.' After struggling with the decision to get tested, Silver learns she has the mutation in episode 420. The remainder of the storyline focuses on the decisions Silver must make regarding her future in light of the positive test result, including whether to undergo a prophylactic mastectomy. The final episodes address the heightened risk of ovarian cancer associated with the BRCA gene mutations and implications for Silver's fertility. Silver meets with another doctor, who informs her that 'a lot of women put off having their ovaries removed until after they've had children' and that if she wants to have children, it would be best to do so before having either a mastectomy or an oophorectomy (surgery to remove the ovaries). It should be noted that the televised content does not distinguish between the BRCA1 and BRCA2 mutations, instead referring generally to the 'BRCA gene.' For consistency, this language was adopted for all relevant measures, and is used throughout this paper when describing the storyline or referring to the measures.

Overview of study

The present evaluation consisted of two complementary studies: a pre-test/post-test, directed-viewing study of a single episode from the storyline, using a panel sample of regular TV viewers (Study 1), and a cross-sectional study using an online convenience sample of frequent *90210* viewers (Study 2). In Study 1, it was hypothesized that viewing the target episode would increase knowledge related to the BRCA gene mutations, lead to more favorable attitudes toward BRCA gene testing, and increase intentions regarding breast cancer screening and interpersonal communication. In Study 2, it was hypothesized that higher levels of exposure to the storyline (number of episodes viewed) would be associated with greater knowledge, more favorable attitudes toward testing, stronger intentions regarding breast cancer screening and interpersonal communication, and greater likelihood of reporting taking action to learn about and/or reduce one's personal breast cancer risk. Study 2 also examined whether individual episodes were more strongly associated with specific outcomes.

Method

Participants and procedure

Use of panel samples has historically been an effective recruitment strategy in evaluating EE programs, particularly those with very large audiences where a large proportion of panel members are likely to have been exposed to the messages on their own. However, *90210*'s relatively modest audience (approximately 1.5 million in the target season [22]) demanded some creativity in the design of this evaluation. To address this challenge, two complementary studies were conducted, each of which was strategically designed to compensate for the limitations of the other. Study 1's quasi-experimental, directed-viewing approach enabled precise control over exposure, and ensured an adequate number of panel participants were exposed to the relevant content. Study 2, alternatively, offered a high level

of ecological validity and allowed for a more comprehensive examination of the relationship between exposure to the storyline and key outcomes among the target audience. Both studies underwent human subjects review and were granted exemption by the University of Southern California's Institutional Review Board.

Study 1

The authors contracted with a private market research firm, Frank N. Magid Associates, who sent recruitment emails to all women aged eighteen or older who were members of its opt-in online survey panel of regular prime-time television viewers ($N = 4617$). Members of this non-nationally representative panel typically participate in five to seven online surveys per year. The panel is continuously replenished through advertisements on various websites. A total of 496 panel members completed the online pre-test survey. Upon completion, they were instructed to view a single, content-rich episode from the larger storyline (Episode 417: 'Babes in Toyland') which was freely available online at Hulu.com, and then return for an online post-test survey within two days. The research firm linked respondents between the two survey waves using a unique panelist identification number, and provided the authors with a deidentified data set.

A total of 324 panel members completed both the pre-test and the post-test (a response rate of 7.0%). Level of education was the only significant demographic predictor of attrition; those with a lower level of education were more likely to drop out, $\chi^2(4) = 14.70$, $P = .005$. Data were excluded for participants who had already seen one or more of the episodes in the storyline at pre-test, who failed a post-test question designed to screen for those who may not have actually watched the episode, or who indicated they had been previously diagnosed with breast cancer, leaving a final sample of $N = 236$.

Study 2

The second study used an online convenience sample of regular *90210* viewers. Because the authors had an established relationship with the show, they agreed to post links to the survey on the CW Network's websites and social media properties. The authors administered data collection directly through the web-based survey platform Qualtrics. As in Study 1, only women aged eighteen years or older were eligible to participate.

Respondents were not instructed to view any specific episodes of *90210*, but rather were asked to indicate which of the eight target episodes they had seen. To widen the distribution of the number of episodes viewed, data were collected at two time points – between the fourth and fifth episodes (April 5 through 17, 2012) and following the eighth episode (May 16 through June 12, 2012) – and collapsed into a single data set. A total of 2027 individuals clicked on the survey link, and 1100 were screened out based on age or gender. Data were excluded for participants older than the CW's target demographic of 18–34, those who had been previously diagnosed with breast cancer, who were missing more than 5% of data on essential outcome measures, or duplicate responses. To maximize the homogeneity of the sample, only respondents recruited through Facebook were retained, leaving a final sample of $N = 494$.

Sample characteristics

A side-by-side comparison of the two samples is shown in Table 1. Participants in both studies predominantly described themselves as white, but the Study 2 sample was more ethnically and racially diverse, with substantial proportions of Hispanic/Latino and Asian/Pacific Islander respondents. This diversity may owe in part to the fact that nearly half of Study 2 participants indicated they reside outside the U.S. (52 different countries were represented). Study 1 respondents had a median age of 48, compared with 22 in Study 2. Education level was similar between the two samples; more than a third of participants had at least a college degree. The majority of Study 1 participants were married or living with a partner. This pattern was reversed in Study 2, with more than two-thirds describing themselves as single. Study 1 participants reported watching approximately twice as much television as those who took part in Study 2. Whereas more than ninety percent of Study 2 participants reported watching ‘every episode’ of *90210*, approximately the same proportion of Study 1 participants said they ‘never’ watch *90210*.

Measures

Both studies measured participants’ knowledge, attitudes, intentions, and self-reported actions in relation to breast cancer and the BRCA gene test. Several items were drawn from a previous study of two BRCA gene-related storylines on *ER* and *Grey’s Anatomy* [20]. The authors obtained scripts for the eight target episodes of *90210* in advance of their broadcast dates, and based on an analysis of the specific breast cancer content depicted in these episodes, various existing items were modified and additional items were included. To enable the measurement of pre-test sensitization effects, half of all Study 1 participants ($N=115$) received an abbreviated pre-test condition with demographic questions, but without any breast cancer-related content.

Knowledge

Familiarity with the BRCA gene was assessed with a dichotomous item, ‘Have you ever heard of the BRCA gene?’ To measure knowledge of family history as a risk factor for developing breast cancer, participants were asked to select from among seven response options to the question ‘Which of the following have been shown to increase risk of getting breast cancer?’ (the correct response was *family history/genetics*). Four additional Likert items rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*) addressed knowledge about the breast cancer gene (e.g. ‘If no one in my family has had breast cancer, I do not have the breast cancer gene’) and mastectomy as a preventive option (e.g. ‘Having a mastectomy is only an option after breast cancer is detected’).

Attitudes

Eighteen attitudinal items were rated on a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The attitudinal items were subjected to an exploratory factor analysis with principal axis factoring as the extraction method and varimax rotation, which produced a five-factor solution (Study 1 pre-test: 65.3% variance explained; Study 1 post-test: 66.3%; Study 2: 54.5%).

Five items adapted from the stages of mammography adoption scale [23] (Study 1 pre: $\alpha = .84$; Study 1 post: $\alpha = .85$; Study 2: $\alpha = .78$) addressed *perceived barriers to the BRCA gene test* (e.g. 'I would probably not have a test for the breast cancer gene unless I had some breast symptoms or discomfort'). Three items (Study 1 pre: $\alpha = .83$; Study 1 post: $\alpha = .81$; Study 2: $\alpha = .83$) measured *fears regarding the consequences of the BRCA gene* (e.g. 'I am fearful that if I have the breast cancer gene, I would need to undergo surgery'). Four items (Study 1 pre: $\alpha = .83$; Study 1 post: $\alpha = .86$; Study 2: $\alpha = .83$) measured *perceived importance of social support* (e.g. 'If I had the breast cancer gene, I would prefer to face it alone'). Two items (Study 1 pre: $\alpha = .87$; Study 1 post: $\alpha = .87$; Study 2: $\alpha = .88$) addressed *avoidance* (e.g. 'I would prefer not to think about my risk of developing breast cancer'). Finally, four items (Study 1 pre: $\alpha = .89$; Study 1 post: $\alpha = .90$; Study 2: $\alpha = .75$) measured *perceived importance of the test* (e.g. 'Taking a test for the breast cancer gene would give me a feeling of control over my health').

Intentions

Four statements followed the prompt 'How likely are you to do the following within the next two years' and were rated on a Likert scale from 1 (*not at all likely*) to 5 (*extremely likely*): (1) 'get a mammogram,' (2) 'recommend a breast cancer screening to a woman I know,' (3) 'talk to a doctor about getting tested for the BRCA gene mutation,' and (4) 'recommend talking to a doctor about the BRCA gene test to a woman I know.' Although these items would have formed a highly reliable scale (alphas approaching .90), a decision was made to retain them as separate items because they tapped intentions regarding different behaviors.

Actions

In Study 1, self-reported behavior was assessed at posttest only. Participants were asked, 'Did you do any of the following as a result of seeing the episode of *90210* you were asked to watch?' for each of ten possible actions, including: 'Schedule a doctor's appointment to talk about my personal risk of breast cancer,' 'Talk to a woman I know about the BRCA gene test,' 'Search for information about breast cancer online,' and 'Find out about my family history regarding breast cancer.' The behavioral prompt differed slightly for Study 2 participants, who were not directed to watch any particular episode: 'Have you done any of the following?'

Data analysis

In Study 1, to assess changes from pre-test to post-test, McNemar tests for paired samples were conducted on the two binary knowledge variables, and paired samples *t*-tests were conducted on the remaining (continuous) measures. To examine potential pre-test sensitization effects, those who completed the full pre-test were compared with those assigned to the demographics only pre-test condition using independent samples *t*-tests (continuous variables) and chi-square tests (dichotomous variables). In Study 2, the effect of the number of episodes viewed was analyzed using one-way ANOVAs for all continuous dependent variables, and chi-square tests for the binary outcomes. In addition, the effects of individual episodes were examined using multiple linear regression for the continuous dependent variables and binary logistic regression for the dichotomous dependent variables.

Results

Study 1

Knowledge—The percentage of respondents who reported having heard of the BRCA gene increased significantly from 19.0% at pre-test to 50.4% at post-test, $\chi^2(1) = 36.03$, $P < .001$. Similarly, participants were significantly more likely to correctly identify *family history/genetics* as a risk factor for breast cancer at post-test (96.7%) than pre-test (84.3%), exact significance $P < .001$. These knowledge changes from pre-to post-test are shown in Figure 1. There were also significant changes in knowledge regarding preventive mastectomy. Agreement with the statement ‘Having a mastectomy is one possible option for preventing breast cancer’ increased from pre-test ($M = 3.31$, $SD = 1.25$) to post-test ($M = 3.70$, $SD = 1.15$), $t(120) = 4.00$, $P < .001$, whereas participants were less inclined to agree that ‘Having a mastectomy is only an option after breast cancer is detected’ at post-test ($M = 2.64$, $SD = 1.28$) relative to pre-test ($M = 2.91$, $SD = 1.20$), $t(120) = -2.34$, $P = .021$. These changes are shown in Figure 2. There were no significant changes on the remaining two knowledge items.

Attitudes and intentions—The only significant attitudinal change was an increase in fears regarding the consequences of the BRCA gene from pre-test ($M = 3.00$, $SD = 1.07$) to post-test ($M = 3.23$, $SD = 1.00$), $t(120) = 3.62$, $P < .001$. Reported likelihood of ‘talking to a doctor about getting tested for the BRCA gene mutation’ within the next two years also increased significantly from pre-test ($M = 3.03$, $SD = 1.20$) to post-test ($M = 3.21$, $SD = 1.28$), $t(120) = 2.19$, $P = .031$. Changes in attitudes and intentions are shown in Figure 2.

Actions—Self-reported actions were assessed at post-test only for the full sample ($N = 236$). The most frequently reported action was finding out about one’s family history of breast cancer (20.8%). Twelve percent of participants reported talking to a woman they know about breast cancer screening (mammogram or breast exam) and 13.1% reported doing the same with regard to the BRCA gene test. Ten percent sought support from family or friends regarding breast cancer screening or detection, and 11.9% reported that they scheduled a doctor’s appointment to talk about their risk of breast cancer. With regard to information-seeking behavior, 16.5% of participants said they searched online for more information about breast cancer.

Pre-test sensitization—The only knowledge variable with a significant pre-test sensitization effect was familiarity with the BRCA gene, $\chi^2(1) = 11.60$, $P = .001$. Among participants who completed the full pre-test survey, 50.4% had heard of the BRCA gene at post-test, compared with 28.7% of those who took the demographics only pre-test. Two of the five attitudinal variables under investigation exhibited evidence of pre-test sensitization – the perceived importance of social support, $t(234) = 2.86$, $P = .005$, and avoidance, $t(234) = -2.01$, $P = .045$. Relative to the abbreviated pre-test condition, participants who took the full pre-test had higher ratings on the importance of social support and exhibited lower avoidance tendencies. However, the only attitudinal variable with a significant change from pre-test to post-test (fears) was not affected by pre-test exposure. In the domain of behavioral intentions, participants who took the full pre-test were more likely to report that

they would talk to a doctor about getting tested for the BRCA gene, $t(234) = 2.23$, $P = .026$. Likewise, those who took the full pre-test reported significantly greater likelihood of recommending talking to a doctor about the BRCA gene test to a woman they know, $t(234) = 2.21$, $P = .028$. None of the eleven behavioral outcomes assessed at post-test differed significantly as a function of pre-test exposure.

Significant results from Study 1, including changes from pre-test to post-test, and evidence of pre-test sensitization, are shown in Table 2.

Study 2

Despite administering the survey at two time points, exposure was highly skewed; almost two-thirds of respondents (65.8%) had viewed all eight episodes. As a result, it was not appropriate to treat exposure as a continuous variable when examining its relationship with outcomes. Instead, a decision was made to focus on the four episodes in the series with the most substantive breast cancer-related content (417, 418, 419, and 423). The other four episodes dealt largely with Silver's ambivalence regarding with whom to discuss her medical situation, along with a pregnancy scare that was only tangentially related to the breast cancer storyline. An ordinal exposure variable was constructed based on the number of content-rich episodes viewed, with three levels: zero key episodes, $n = 56$; one to three key episodes, $n = 91$; or all four key episodes, $n = 347$ (all Study 2 analyses were run separately with exposure – zero to eight episodes – as a continuous variable, and the results were replicated). In addition to analyzing the relationship between exposure and key outcomes, the individual relationships between each of the four key episodes and outcomes were examined.

Knowledge—The number of episodes to which viewers were exposed was significantly related to familiarity with the BRCA gene, $\chi^2(2) = 23.59$, $P < .001$, with a significant linear-by-linear association, $\chi^2(1) = 23.20$, $P < .001$. Likelihood of having heard of the BRCA gene increased with the number of episodes viewed. Exposure to the storyline significantly influenced agreement with the statement 'If someone tests positive for the breast cancer gene, it means they already have breast cancer,' $F(2,490) = 4.35$, $P = .013$. A post hoc Tukey HSD test ($P = .030$) indicated that participants who saw all four key episodes reported lower levels of agreement than those who saw one to three. Agreement with the statement 'Having a mastectomy is one possible option for preventing breast cancer' was positively associated with exposure, $F(2,491) = 4.37$, $P = .013$. Participants who saw all four episodes had significantly greater agreement with the statement than those who saw none of the key episodes, Tukey HSD: $P = .024$. The relationship between exposure and knowledge outcomes is shown in Figures 3 and 4.

Exposure to each of the four key episodes was significantly associated with familiarity with the BRCA gene; for each episode, respondents who saw the episode were nearly twice as likely to have heard of the BRCA gene than respondents who did not see the episode. Only the second episode (418) was uniquely predictive of familiarity with the BRCA gene, independent of the other episodes, Wald $\chi^2(1) = 4.52$, $P = .033$, $\text{Exp}(B) = .131$. Seeing episode 418 increased the odds of having heard about the BRCA gene nearly eight times,

relative to those who did not see the episode. There was no significant association between viewing specific episodes and correctly identifying family history as a risk factor for breast cancer. Exposure to each of the four individual episodes was inversely associated with agreement that ‘If someone tests positive for the breast cancer gene, it means they already have breast cancer.’ That said, none of the individual episodes made a significant unique contribution to this variable beyond the other episodes. Similarly, each episode was significantly associated with agreement that ‘Having a mastectomy is one possible option for preventing breast cancer.’ Again, none of the episodes made a unique contribution to the prediction of this variable.

Attitudes and intentions—None of the attitudinal or behavioral intention variables exhibited significant relationships with exposure. The only attitudinal outcome associated with individual episode exposure was barriers to the BRCA gene test. Perceived barriers to testing were significantly reduced among viewers of episode 423. Viewing this episode did not make a unique contribution to predicting perceived barriers to the BRCA gene test beyond the other episodes. In terms of behavioral intentions, none of the individual episodes had a significant overall relationship with any of outcome variables. However, episode 419 made significant unique contributions to predicting the reported likelihood of both getting a mammogram and talking to a doctor about the BRCA gene test, independent of the other three episodes. Viewers of episode 419 were more likely to report that they would take both actions in the future.

Actions—Storyline exposure was significantly associated with finding out about one’s family history of breast cancer, $\chi^2(2) = 8.59$, $P = .014$, with a significant linear-by-linear association $\chi^2(1) = 7.99$, $P = .005$. The likelihood of finding out about one’s family history of breast cancer increased with the number of episodes viewed (Figure 3). The same outcome was significantly associated with exposure to three of the four individual episodes (418, 419, and 423). None of the episodes made a significant independent contribution to the prediction of finding out about one’s family history.

Significant results from Study 2, including the relationships between outcomes and exposure to the four key episodes, and between outcomes and exposure to each individual episode, are shown in Table 2.

Discussion

The primary objective of this study was to evaluate how exposure to a breast cancer storyline on the television series *90210* influenced breast cancer-related knowledge, attitudes, and prevention behaviors, among both regular and non-regular viewers.

In Study 1, it was hypothesized that viewing the target episode would increase knowledge related to the BRCA gene mutations, lead to more favorable attitudes toward BRCA gene testing, and increase intentions regarding breast cancer screening and interpersonal communication. This hypothesis was largely supported in terms of knowledge outcomes; familiarity with the BRCA gene, identification of family history or genetics as a risk factor for breast cancer, and knowledge of mastectomy as a possible preventive option all increased

significantly from pre-to post-test. The only knowledge outcome exhibiting evidence of pre-test sensitization effect was familiarity with the BRCA gene, but the change from pre-test to post-test (19.0 to 50.4%, a nearly three-fold increase) was substantially larger than the 'boost' attributable to pre-test exposure (50.4% vs. 28.7%). The impact of the target episode on attitudes and intentions was mixed; the only significant changes from pre-to post-test were increases in fears and intentions to talk to a doctor about getting tested for the BRCA gene.

In Study 2, it was hypothesized that higher levels of exposure to the storyline (number of episodes viewed) would be associated with greater knowledge, more favorable attitudes toward testing, stronger intentions regarding breast cancer screening and interpersonal communication, and greater likelihood of taking action to learn about and reduce one's personal breast cancer risk. Consistent with this hypothesis, significant relationships were found between exposure and a variety of knowledge and behavioral outcomes (familiarity with the BRCA gene, knowledge of mastectomy as a possible preventive option, finding out about one's family history of breast cancer).

Moreover, each of the four key episodes had some association with knowledge, attitudes, intentions, or actions. Episode 417 was selected as the target episode for Study 1 because it appeared, at face value, to be the most content rich. The results of Study 2 suggest, however, that 418 or 419 may have been a better choice, as the outcomes associated with exposure to 417 were largely limited to knowledge. Episode 418, in which Silver decides to schedule her test, independently predicted familiarity with the BRCA gene, beyond the contributions of the other episodes. The episode in which Silver returns to the doctor and takes the test, 419, was uniquely predictive of intentions to both get a mammogram and talk to a doctor about the test.

In both studies, the strongest behavioral outcome was finding out about one's family history of breast cancer. In Study 1, exposure to the target episode also increased intentions to talk to a doctor about the BRCA gene test. Given that genetic testing for the BRCA1 and BRCA2 mutations is not recommended for all women, these information-seeking behaviors may represent an ideal level of preventive action-taking, particularly for young adult women. The finding regarding the unique contribution of episode 419 to mammography intentions is somewhat surprising, given that the episode does not mention mammograms at any point. However, this highlights the power of entertainment narratives to motivate viewers to take preventive actions to protect their health and well being.

Strengths and limitations

The triangulation approach used in this project has the advantage of lending support to findings that are consistent across the two studies. For example, exposure to the *90210* storyline heightened knowledge regarding the BRCA gene and mastectomy as a preventive option, but had limited influence on attitudes and behavioral intentions. These findings were replicated across both the panel sample of regular TV viewers (Study 1) and those who are close in age to the characters and could be described as *90210* 'super-fans' (Study 2). Moreover, the two studies were designed such that the strengths of one approach compensate for the limitations of the other. Whereas the quasi-experimental design of Study 1 gave the

authors precise control over exposure, Study 2 had a high level of ecological validity, in that participants were not asked to participate in any artificial tasks (beyond the survey itself). Moreover, the absence of a pre-test to potentially sensitize participants to the storyline's breast cancer content heightened the internal validity of Study 2.

There was evidence of pre-test sensitization effects in Study 1, though these effects were fairly modest relative to those attributable to exposure. In basic research, pre-test sensitization would be viewed as a methodological flaw (i.e. a threat to internal validity), in that it undermines the ability to attribute outcomes to the intervention or treatment. In the case of health communication interventions, however, any factor that moves an individual along the knowledge-attitude-behavior continuum is potentially advantageous, whether these shifts are due to pre-test exposure or the intervention itself. These findings suggest pre-test surveys may, under some circumstances, enhance awareness (e.g. familiarity with the BRCA gene) and lead to modest shifts in attitudes and behavioral intentions. These changes might be directly attributable to pre-test exposure, or they could be a result of the pre-test priming participants for the intervention by making key concepts salient (this question was beyond the scope of the present study).

Additional limitations include the fact that the Study 1 sample was composed of non-viewers who were predominantly outside the show's target demographic. Moreover, Study 1 participants completed the post-test within two days of viewing the target episode. It is possible that the behavioral outcomes would have been stronger had the post-test been administered later, but attrition would also have been more likely, further reducing the sample size for pre-test/post-test comparisons. In Study 2, greater variability in storyline exposure would have allowed exposure to be treated as a continuous predictor. The ordinal exposure variable may be a less-than ideal substitute, but the analyses were run both ways (ordinal vs. continuous exposure variable) and all results were replicated. Finally, neither study measured well-established mediators of narrative impact, such as perceived similarity, parasocial interaction, identification, and transportation [14].

Implications

This study illustrates some of the unique challenges facing EE approaches working in conjunction with the U.S. entertainment industry. Although many entertainment professionals welcome the idea of developing compelling storylines around a variety of health issues, it is important to remember that their goals may not be fully aligned with those of the public health community. This particularly storyline succeeds in conveying factual information about breast cancer risk, but falls somewhat short in presenting a nuanced perspective on BRCA gene testing and subsequent risk-management approaches. In episode 417, the doctor briefly mentions Silver's family history of breast cancer in the context of advising her to get tested for the BRCA gene, but a viewer might come away with the impression that all women should be tested. This message is not entirely consistent with current evidence-based practice, which recommends genetic testing only for those with a family history of breast or ovarian cancer [24]. Silver, like Angelina Jolie, has the luxury of being wealthy, but in the real world, the BRCA gene test (not to mention mastectomy and reconstructive surgery) may be cost-prohibitive. Testing can range from hundreds to

thousands of dollars and may not be covered by health insurance [25]. Similarly, alternative risk-management approaches for those who test positive, such as enhanced screening and chemoprevention, are not discussed in the storyline; rather, preventive mastectomy is presented as though it were the only option.

That said, the results of this evaluation provide further support for the notion that exposure to entertainment narratives with serious messages can have profound effects on viewers, from raising awareness about health risks to motivating action, and can highlight the advantages of EE over more didactic approaches to health communication. Given the enormous reach of entertainment narratives and the proven track record of EE as a health communication approach [7–10,15,16,20], those who are invested in health promotion and disease prevention efforts, and have the requisite access to the entertainment industry, may consider using this communication tool alongside other traditional and emerging communication strategies. Much dialogue in the health communication field has focused on trends such as the end of mass media as audiences become increasingly fragmented, and the need for practitioners to shift their communication efforts from traditional media (e.g. TV, film) to mobile, digital, and social media in order to reach the generation of ‘digital natives’ who are now young adults. One of the strongest features of the EE approach is that it can be easily integrated with these emerging communication tools. This strategy may prove particularly valuable when targeting youthful audiences with a highly developed skepticism toward persuasive messages.

Conclusions

This study highlights a number of potential directions for future EE research and evaluation efforts. First, the only attitudinal variable significantly associated with exposure to the storyline was fear regarding the consequences of the BRCA gene, in Study 1. Research on fear appeals in health communication suggests the effectiveness of such appeals depends largely on whether the message includes information about self-efficacy (i.e. belief that I can perform a response to this problem) and response efficacy (i.e. belief that this response will be effective) [26]. When such information is missing, fear can evoke defensive processing or avoidance of fear-inducing messages. Some have suggested that transportation into an entertainment narrative could potentially offer a means of overcoming the detrimental effects of fear [14]. On the other hand, fear-inducing messages, in the absence of information on efficacious responses, could result in a maladaptive level of anxiety. Future research might examine the precise role of subjective fear in relation to transportation, self-efficacy, and key outcomes. Second, evidence of pre-test sensitization effects in Study 1 underscores the need to measure or statistically control for these effects whenever using pre-test/post-test designs, but also raises the question of whether surveys administered prior to the ‘intervention’ (whether used for data collection purposes or to make key concepts salient) might be an effective component of health communication interventions. Finally, through the use of web and social media analytics, future research and evaluation efforts may be expanded, supplementing traditional survey methods with a variety of engagement measures and behavioral indicators.

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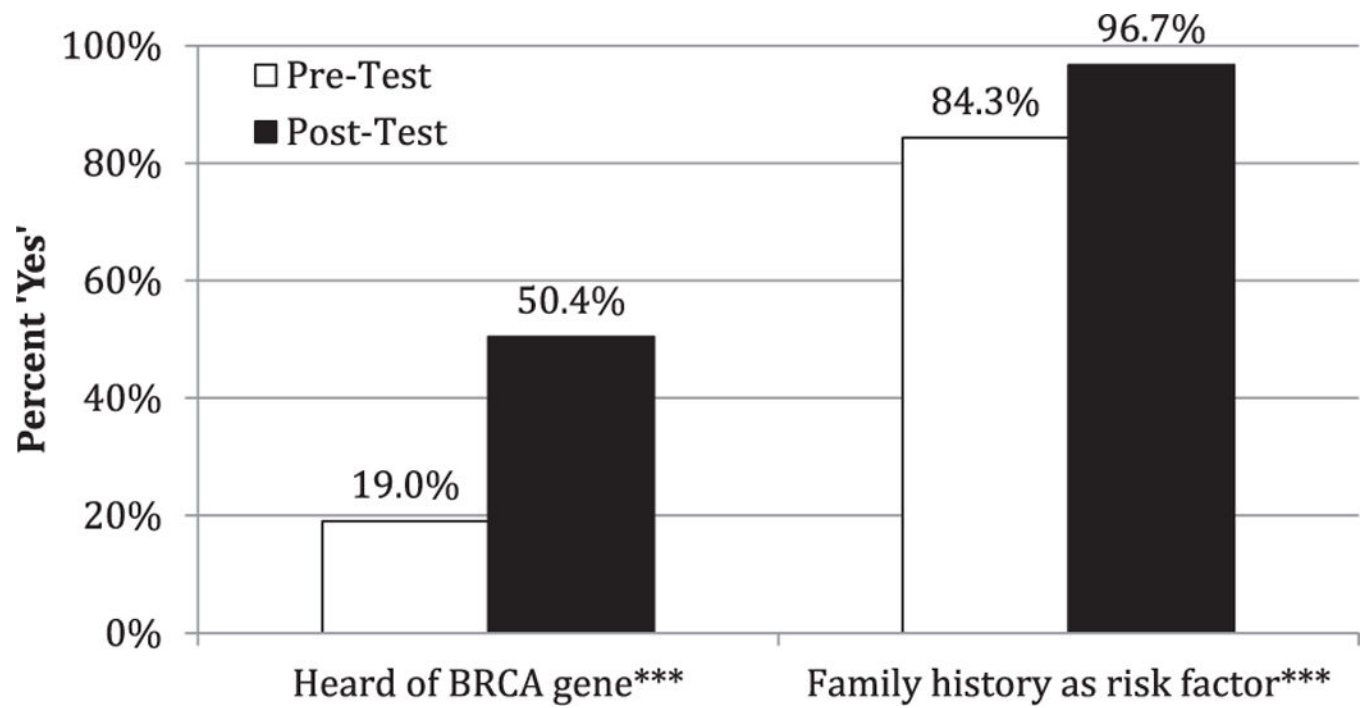


Figure 1.

Changes in knowledge from pre-test to post-test (Study 1).***P<.001.

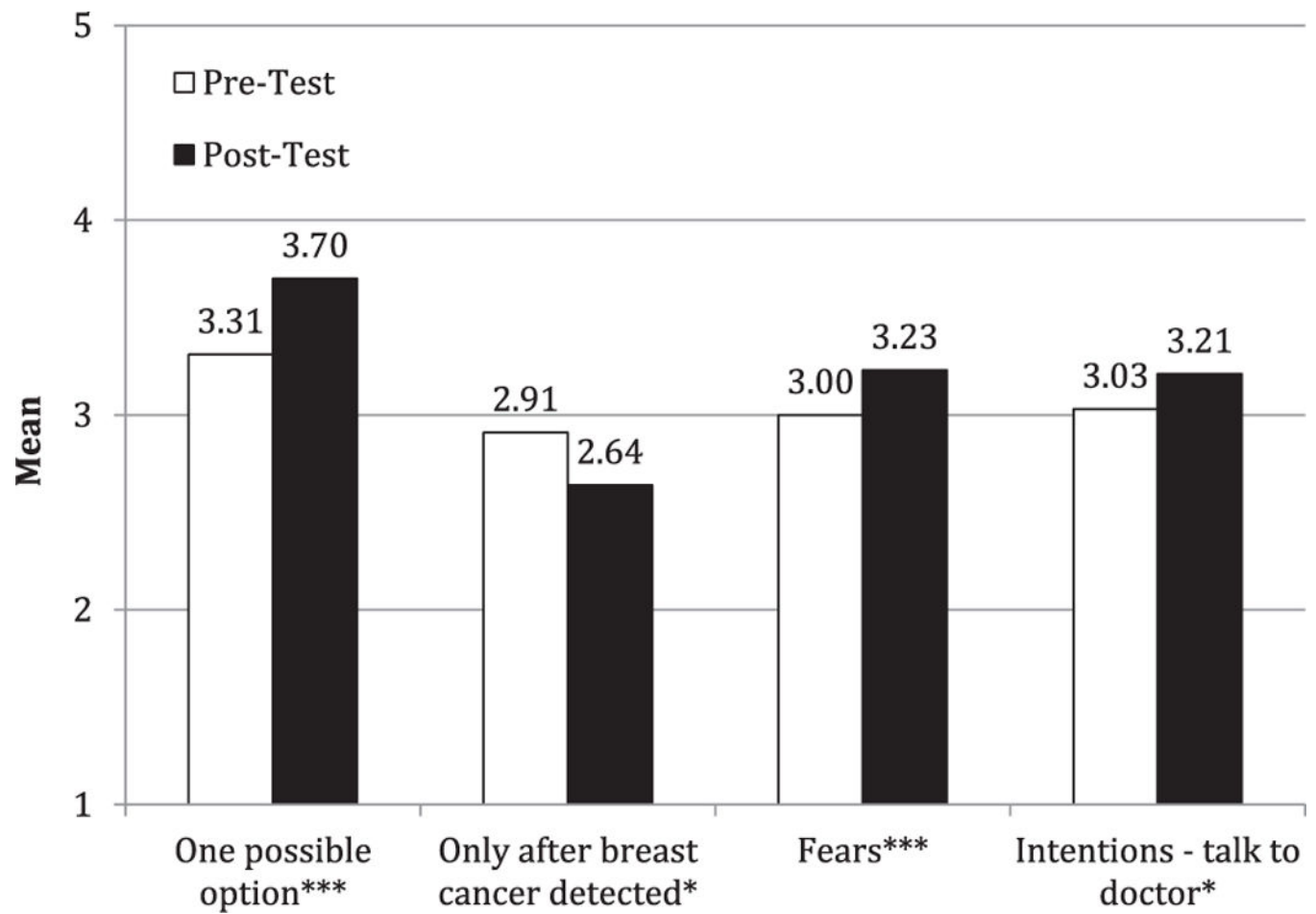


Figure 2. Changes in knowledge, attitudes, and intentions from pre-test to post-test (Study 1). * $P < .05$, *** $P < .001$

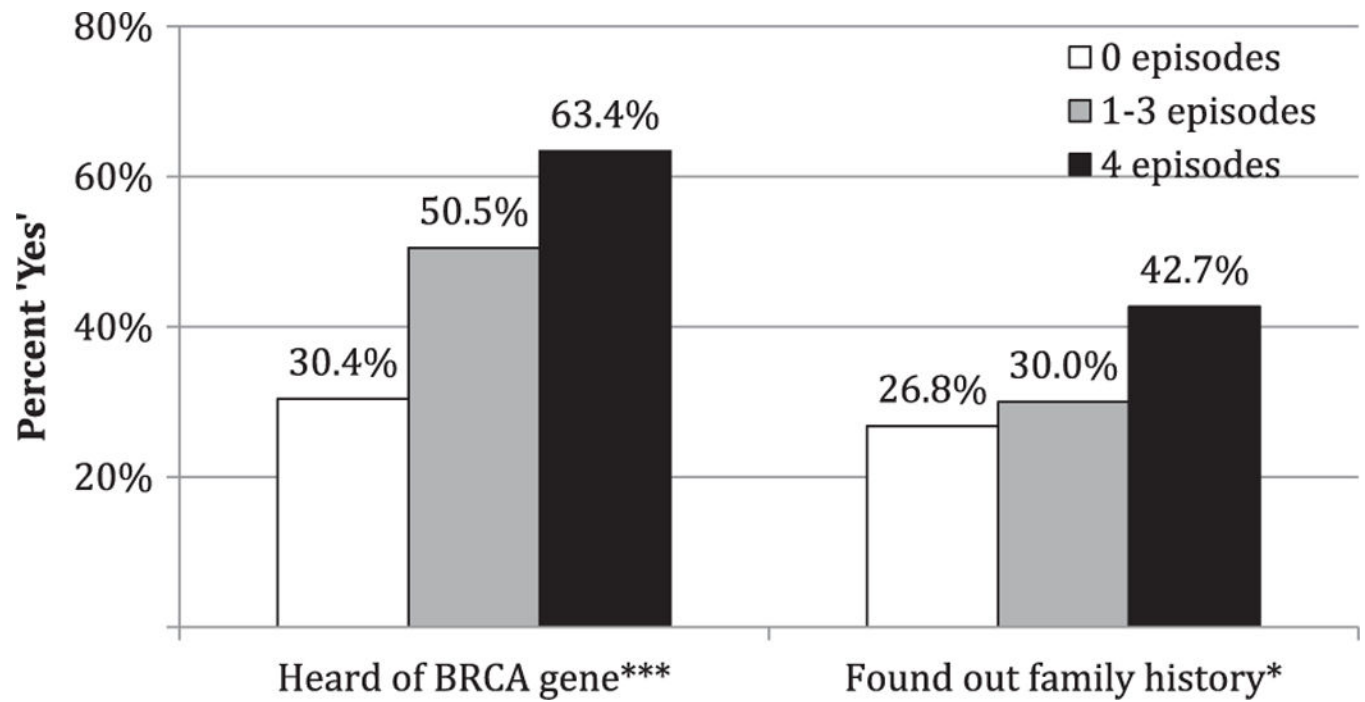


Figure 3.
Relationship between exposure and knowledge and behavioral outcomes (Study 2). * $P < .05$,
*** $P < .001$.

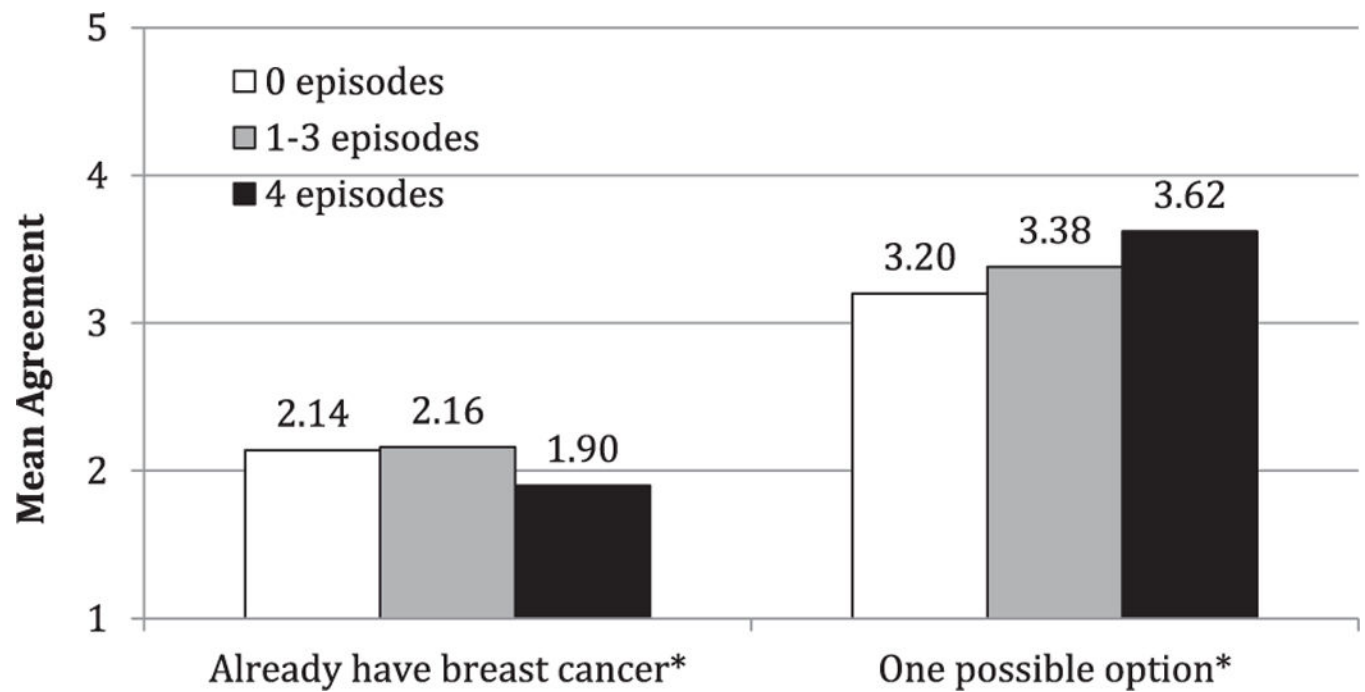


Figure 4.
Relationship between exposure and knowledge outcomes (Study 2). *P<.05.

Table 1.

Sample characteristics.

	Study 1 (N = 236)	Study 2 (N = 494)
Demographics		
Age	Median = 48	Median = 22
Race/Ethnicity	White: 83.5%; Black: 9.3%; Hispanic/Latino: 5.1%; Asian/Pacific Islander: 0.8%; Other: 4.2%	White: 73.7%; Black: 4.3%; Hispanic/Latino: 8.7%; Asian/Pacific Islander: 8.1%; Other: 6.1%
Geographic distribution	39 states represented ; No respondents reside outside U.S	38 states represented; Reside outside U.S.: 46.0%; 52 countries represented
Health-Related Characteristics		
Work in health profession	3.8%	12.1%
Health status	Good/Very good/Excellent: 72.1%	Good/Very good/Excellent: 88.6%
Cancer experience	Diagnosed: 4.2%; Close family: 51.3%; Close friend: 31.4%	Diagnosed: 1.4%; Close family: 60.5%; Close friend: 25.5%
Breast cancer experience	Close family: 27.5%; Close friend: 26.7%	Close family: 29.4%; Close friend: 18.0%
TV Viewing Habits		
Hours/week TV	Median = 20	Median = 10
Hours/week prime time TV	Median = 13.5	Median = 6
90210 viewing frequency	Every episode: 0.4%; 1–3 episodes/month: 6.7%; Never: 92.8%	Every episode: 92.1%; 1–3 episodes/month: 7.3%; Never: 0.2%
Exposure to 90210 BRCA storyline	N/A	4.17: 86.2%; 4.18: 86.0%; 4.19: 86.4%; 4.20: 85.0%; 4.21: 74.1%; 4.22: 73.3%; 4.23: 73.1%; 4.24: 69.0%

Table 2.

Results: Study 1 and Study 2.

	Study 1		Study 2	
	Pre/Post Change	Pre-Test Sensitization	Overall Exposure	Individual Episode Exposure
Knowledge				
Have you ever heard of the BRCA gene?	***	**	***	417 ***; 418 ***; 419 ***; 423 ***
Family history/genetics (risk factor)	***			
If someone tests positive for the breast cancer gene, it means they already have breast cancer			*	417 *; 418 *; 419 *; 423 **
Having a mastectomy is one possible option for preventing breast cancer	***		*	417 *; 418 *; 419 *; 423 **
Having a mastectomy is only an option after breast cancer is detected	*			
Attitudes				
Fears regarding BRCA gene test	***			
Perceived importance of social support		**		
Avoidance		*		
Perceived barriers to testing				423 *
Intentions				
Talk to a doctor about getting tested for the BRCA gene mutation	*	*		
Recommend talking to a doctor about the BRCA gene test to a woman I know		*		
Actions				
Find out about family history of breast cancer			*	418 *; 419 *; 423 **

*
P < .05**
P < .01***
P < .001