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Learning about cancer: A comparative analysis of the performance of eight measures of incidental exposure to cancer information in the mass media

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Abstract

This paper considers several approaches to survey measurement of incidental exposure to the mass media relevant to cancer communication. HINTS I assessed health media exposure by measures of 'attention' and of general media use. Unsure about the best exposure measures to be used in cancer-related survey research, we carried out a study comparing alternative exposure questions to inform the construction of the HINTS II instrument. A nationally representative telephone survey included 800 respondents. We compared measures addressing: general media exposure, exposure to health media, attention to health topics, quantity of health information, general and specific cancer exposure assessed by closed- and by open-ended questions. Controlling for education, gender and age, the strongest predictor of cancer knowledge was the open-ended measure about cancer prevention (9.8%), followed by open-ended measures about diet and exercise and the parallel closed-ended questions (6.7%), attention to health topics (6.2%), quantity of health information (4.1%), and health media exposure (3.7%). General media exposure was not associated with cancer knowledge, although it predicted knowledge about non-cancer health issues salient in the media. There may be some bias in using knowledge to validate open-ended exposure measures; their utility might be exaggerated here. We propose that the closed-ended specific questions may be just as useful. Despite its good predictive power, attention may be confounded with involvement.

Rationale

This paper compares several approaches to survey measurement of incidental exposure to the mass media relevant to cancer communication. The *Health Information National Trends Survey* (HINTS I) did extensive measurement of information seeking behavior. However, it had fewer questions concerning ordinary mass mediated and other non-purposive exposure to health information, referred to as incidental exposure or scanning. It has been argued elsewhere that both incidental and actively sought out exposure to cancer are consequential for cancer-related cognitions and behaviors (see Shim et al., 2005). The HINTS I survey included questions about general media exposure, and also questions about attention to health and medical topics through various media sources. These questions may not be the ideal way to measure incidental exposure to cancer information. We propose a test of these measures against several complementary or alternative approaches in order to inform health exposure measurement in cancer communication research.

Concerns with how to define and operationalize media exposure have been enduring issues in communication scholarship. There are two main research purposes for which health information exposure has been measured. The first is in the context of the evaluation of deliberate communication interventions. Typically, the issue is whether respondents have actually been exposed to the specific messages diffused (for a recent review of that literature, see Southwell, 2002). The second context arises with studies of natural flows of health information, usually through the mass media (Fan & Holway, 1994; Hornik, 2002; Yanovitzky & Bennett, 1999; Yanovitzky & Blitz, 2000; Yanovitzky & Stryker, 2000; Stryker, 2003). The focus here is on exploring the effects of news coverage of health issues on health cognitions and behaviors over time.

The issues of measurement of exposure in the two types of studies are distinct. In the first case, one must establish that respondents have been exposed to a limited set of specific messages (e.g. identifiable public service ads). In the second, researchers are interested in exposure to classes of information, like all mentions of colon cancer in news coverage, in talk shows, or in personal discussions with friends or family. In practice, the HINTS survey is only likely to serve the second type of research. However, even within the natural flow category of research there are subtypes of studies which may demand different measures.

Reflecting the difficulty of identifying a single construct behind media exposure (Hawkins et al., 2001), media scholars have described exposure measures on four broad dimensions: their specificity about topic; their specificity about medium or source; the time frame for responses, and whether questions are closed- or open-ended in format. Specificity about topic varies along a continuum. At one end fall very general measures of exposure (e.g. assessing time spent watching television). At the other end are very specific measures (e.g. exposure to the benefits of early cancer screening). Intermediate categories are represented as well, such as moderately general (e.g. exposure to health or medical topics) or moderately specific (e.g. exposure to cancer information). Specificity about source can vary from not mentioning a source at all to indicating a medium (e.g. “on television”) and to specifying a program within a medium (e.g. “medical shows on television”). Asking about exposure in a “typical” week, for instance, may produce more stable reports than asking about recent exposure, such as in “the past week” (Price, 1993). Response alternatives typically offered can be ordinal (e.g. “never/sometimes/often”) or interval (e.g. number of days an individual reads the newspaper per week). Questions are asked either in a closed-ended format (e.g. “How much information about preventing cancer do you get from TV?”- with responses from “none” to “a

great deal") or in an open-ended one format with responses recorded verbatim (e.g. "Can you recall anything that you have seen on television within the past year about preventing cancer?"). Different measures assume different levels of cognitive involvement (Southwell, 2002; Zajonc, 1968). For instance, reports of time spent watching television assume a lower level of cognitive processing and encoding of information than measures of unaided recall of cancer information watched on television.

Which of these measures is best? The most straightforward answer is supported by many studies: if one wants to assess the effects of a specific campaign, health event or message on health cognitions and behaviors, a measure that asks about specific information from that campaign or event will be better than a measure which asks generally about exposure to health topics (Clarke & Klein, 1974; Finnegan, Viswanath, Hannan, Weisbrod, & Jacobs, 1989; Pavlik, Finnegan, Strickland, Salmon, Viswanath, & Wackman, 1993; Viswanath, Kahn, Finnegan, Hertog, & Potter, 1993). Still not every study addresses such specific outcomes.

When the research focus is not so narrow, some measures are likely more useful than others. In addition to research purpose, one must consider evidence of face and construct validity, respondent burden, and survey costs. In this study we systematically compare eight approaches to exposure measurement. In the discussion that follows the presentation of results we consider what each measure addresses on its face, the degree of respondent burden and survey cost, and most centrally, what the evidence is that the measure has high construct validity (in this case that it predicts two knowledge measures).

Few studies have compared multiple exposure measures in this way. Some studies used triangulation approaches to test the convergent validity of parallel exposure measures with maximally different methods (i.e. self-reports, diary and surveillance camera data). In general,

they showed only moderate correlations between alternative types of assessments (Bechtel, Achelpohl, & Akers, 1972). Other studies compared recalled exposure of anti-marijuana ads to ad time purchases (Southwell, Barmada, Hornik, & Maklan, 2002). A much more common approach to construct validity, found in studies of media effects as well, has been to show that variation in exposure to the mass media is associated with knowledge outcomes (Chaffee & Schleuder, 1986; Culbertson & Stempel, 1986; McLeod et al., 1996; Price & Zaller, 1993; Robinson & Levy, 1986; Schooler, Chaffee, Flora, & Roser, 1998).

Our study is the first, to our knowledge, to systematically compare a large set of alternative measures of exposure entirely for the purpose of establishing measurement validity. It offers a systematic approach to guide researchers in the selection of measures of incidental exposure to cancer information.

Research questions

Our main objective for the field study was to compare the performance of alternative and complementary measures of incidental exposure against a widely used construct validity criterion, namely cancer knowledge. We are interested in ranking the predictive power of several classes of exposure measures, after controlling for some likely confounders of the relation between exposure and cancer knowledge (i.e. education, gender, and age). Furthermore, we test the additional predictive power that various exposure measures have above and beyond the widely used time-spent measures of media use and above equally general questions of exposure to health information.

The same analyses will be conducted with knowledge of current health issues as a criterion. These current knowledge items were selected from among health news stories that had received heavy publicity in the media shortly before the survey went into the field. Several

studies (Iyengar & Kinder, 1987; Price & Czilli, 1996; Price & Zaller, 1993) showed that exposure to the news media predicted recall of current news stories, above and beyond long-term knowledge, education, and demographics. We test if incidental exposure to salient health-related news stories affects current knowledge about these issues.

A secondary goal of this project is to explore to what extent the ranking of various exposure measures in terms of their explanatory power is influenced by the linear model underlying these associations. If in fact some of the associations of exposure with knowledge are curvilinear, our approach may underestimate the predictive power of these measures. The functional form of associations is also substantively interesting for communication research, although this issue is less frequently explored (Hornik & Woolf, 1998). It is possible that cancer knowledge does not increase monotonically with increases in exposure to the mass media, for all the measures available and also for all the media channels. Most of the substantive learning may occur as individuals move from "no exposure" to "some exposure", and may plateau for high levels of exposure. Or, a negative reaction to high levels of exposure may occur due to message boredom (Bornstein, Kale, & Cornell, 1990), information overload (Lee & Lee, 2004; Keller & Staelin, 1987), fear (Hovland, Janis, & Kelly, 1953), or increased counter argumentation (Petty & Cacioppo, 1986).

Method

Data

A telephone survey was carried out in July-August 2004 with a national RDD sample of 800 adults aged 18 and over. The survey cooperation rate was 65% and the response rate was 28%. Fifty-two percent of the respondents were female; 38% of the respondents had high school education or less, 27% had some college, and the remaining 35% had a college or a graduate

degree. Seventy-five percent of respondents were White, 11% African American, and 8% Hispanic or Latino.

Measures

Cancer knowledge. Respondents were asked five cancer-related questions, about their knowledge of tests to detect colon and prostate cancer, how much race and ethnicity matter for one's risk of cancer, and about the recommended number of servings of fruits and vegetables to reduce one's risk of cancer. The knowledge items were chosen from among the pool of items asked in HINTS I and were selected because they displayed strong associations with education. Correct answers were coded as "1" and incorrect answers as "0". The five items loaded on a single factor (eigenvalue= 1.58; 32% of the variance explained). The items were averaged into a scale. The internal consistency of the items was not high (alpha=.45, *M* =.50, *SD* =.28); eliminating any of the items would not have resulted in higher internal consistency though. Given that the sum of these items was substantially related to education, we argue that they represented indicators of cancer knowledge, even if their lack of internal consistency makes it clear that each items captures different aspects of that knowledge.

Current knowledge. The three current knowledge items asked respondents to identify what disease President Reagan suffered from, the focus of the Atkins diet, and the consequences of child obesity. Correct answers were coded as "1" and incorrect answers as "0". The items loaded on one factor (eigenvalue= 1.7; 57% of the variance explained). They were averaged into a scale (alpha=.62, *M* = .83, *SD* = .28). Two other current knowledge items were not included because they were not associated with education.

General media exposure. All 800 respondents were asked to report the number of hours in a "typical" week they watch television, listen to the radio, and use the Internet, as well as the

number of days in “the past seven days” they read a newspaper, and watched national and local news on television (see Appendix).

Health media exposure. All 800 respondents were asked to report the frequency with which they read the health section of a newspaper or magazine, watch medical drama, the health section of local television news, and read health-related information on the Internet.

The sample of 800 was randomly split in half, such that half of the sample was asked to answer questions related to *attention to health topics* and the other half was asked to answer *quantity of health-related information* items. The attention questions asked respondents to report, on a 4-point scale, how much attention they pay to health or medical topics in various media sources. The quantity questions, in contrast to the attention measures, were meant to address exposure alone, stripped of the confounding effect of interest and involvement implied by the attention construct. Respondents were asked to assess the quantity of health information about how to stay healthy that they get from various media sources on a 4-point scale.

Closed-ended questions about cancer prevention. A random half of the respondents (n = 400) were asked two types of closed-ended questions about cancer prevention. First, they were asked to report on 4-point scale how much they heard about cancer prevention “in the past year” from the same media sources as above. Second, half of them (n = 200) were randomly assigned to report how much they heard about diet and cancer, and the other half (n = 200) were asked the same thing about cancer and exercise, from the same media sources. In order to get some stability in the results, the responses for each of those questions about diet and exercise were standardized and combined into a single response set for each channel.

Open-ended questions about cancer prevention. These questions were considered a contrast to the closed-ended questions about cancer prevention. The other random half of the

respondents (n = 400) were asked to generate ideas and recall what they had heard about cancer prevention in the past year. Their answers were recorded and subsequently coded so as to capture the number of distinct statements made about prevention, regardless of whether they were medically accurate or not. If a respondent said he/she had not heard anything about cancer his/her answer was coded as "0". For instance, an answer detailing that red tomatoes were good for preventing cancer, that secondary smoking caused cancer, and that regular exercise prevents cancer was coded as "3". Similarly, respondents were asked to recall what they knew about specific prevention issues, namely diet and cancer, and exercise and cancer (n = 200 each). Due to the limited range of ideas about these specific prevention issues, people were classified on each question as to whether they said (0) they had no knowledge or they did not provide any substantive information (typically they would name a source instead) (1) they provided some response that was related to prevention or (2) they provided multiple discrete ideas or elaborated their responses. Responses for diet and exercise were standardized and combined into a single set (n = 400) so as to maximize statistical power.

Analytic strategy

A series of hierarchical regression analyses were conducted to tease apart the contributions of various blocks of exposure items. We entered the items tapping exposure to various channels as a block, rather than averaging them into an index, because we were wary of the possibility that some media (e.g. television) may have a negative association with knowledge, whereas others (e.g. newspapers) are positively associated with knowledge. We did not want an index to conceal these possibly opposite effects. The first set of analyses used cancer knowledge as the outcome variable; knowledge of recently advertised general health issues (i.e., non-cancer related) was the outcome variable in the second set of analyses. General media and health media

exposure measures were entered into the first and second blocks, respectively in each set of analyses. The reason for this order of entry was based on their common usage in the exposure literature.

The first series of regressions examined all of the exposure items separately with the cancer knowledge criterion. We were interested in examining the contribution of each block of exposure items to cancer knowledge, over and above education, gender, and age. Results are presented in four tables. Table one compares the predictive power of various exposure measures against the cancer knowledge criterion. Table three follows the same logic, but with knowledge of various health issues (i.e., non-cancer related) as the outcome variable. Table two presents the means and standard deviations of exposure terms and knowledge scales. Table four synthesizes the results.

Each table presents results from nine equations. The column labeled Equation 1a&b provides a list of the associations of each exposure item with the knowledge outcome. Column 1a presents the individual bivariate associations, and 1b provides the beta coefficients for each exposure item after controlling for the effect of education, gender and age on knowledge. Equation 2 shows the percentage of variance each block of exposure items explains in knowledge, above and beyond education, gender, and age.

Equation 3 shows the effects of education, general media exposure, and the health media exposure measures. We indicate the amount of additional variance accounted for by each of the blocks of variables, entered from the top to the bottom of each equation.

Equations 4 through 9 represent similar tests of the additional predictive power associated with each of the other blocks of potential exposure measures over and above the three basic predictors (education, gender, age; general media exposure; health media exposure). Equations 4

and 5 contrast the attention block and the information quantity blocks respectively – respondents were randomly assigned to each question set.

Equations 6 and 7 present the effects of the closed-ended questions. Equation 6 refers to the block of measures of general cancer prevention exposure, while Equation 7 includes both that block and the questions sets for diet and exercise. Equations 8 and 9 are parallel to equations 6 and 7, however they represent the responses to the open-ended question that asked respondents to recall what they knew about prevention and either diet and cancer or exercise and cancer.

Finally, the functional form of the association of exposure measures with cancer knowledge was explored by two methods: means analyses and regression analyses with a quadratic term of exposure introduced as a last block.

Results

Predicting cancer knowledge

As Equation 2 in Table 1 shows, all but one of the classes of exposure measures accounted for significant variance in cancer knowledge, when education, gender, and age were controlled. Education, gender, and age were all significantly associated with knowledge. There was some variation in the predictive power of education, gender, and age across the randomly assigned subsamples. For example, for the overall sample (n = 800) education, gender and age accounted for 20.4% of the variance in cancer knowledge; for the subset (n = 400) that was randomly assigned to the closed-ended questions about cancer prevention this figure was 24.2%, whereas for the subset assigned to the parallel open-ended questions, it was 19.6%. While this difference was within the range of sampling error, given the slightly different baseline of variance in knowledge left to be accounted for, conclusions about the comparative predictive power of the various exposure measures are drawn with some tentativeness.

[TABLE 1 ABOUT HERE]

The block of general media exposure did not contribute significant variance in knowledge, despite one statistically significant item (reading the newspaper). Equation 2 also shows that the best independent predictor block at the bivariate level was the open-ended measure about cancer prevention (9.8%). The open-ended measures about diet and exercise and the parallel closed-ended questions ranked second in terms of predictive power, with similar predictive power (6.7%), suggesting that for the same level of specificity of exposure assessed, the open- versus closed-ended formats worked equally well. The attention to health topics measures came third, with 6.2% of variance, above and beyond likely confounders. The quantity of exposure and health media exposure questions performed similarly well, with 4.1% and 3.7% of variance, respectively. Much of that variance was carried, in both cases, by the print media (newspapers and magazines). For these media sources, measures of frequency of use correlated fairly highly ($r = .5$, $p<.05$) with the perceived quantity of information obtained from them.

[TABLE 2 ABOUT HERE]

Equation 3 in Table 1 shows that the health media exposure questions added 3.5% of unique variance to knowledge, above and beyond general exposure and the set of confounders. Three explanations may account for the higher predictive power of the health media exposure items when compared to the general exposure items: (a) specificity of the exposure questions (i.e., targeted to assess health media exposure versus more general exposure); (b) different response range for each scale (i.e., number of hours per week vs. a 3-point ordinal scale from "not at all" to "more than once a week," for the *general* and *health media* scales, respectively); (c) the different timeframe used to anchor the reported media use ("typical week" versus "in the past year").

In Equations 4 and 5, comparisons of the attention measure and the alternative quantity of information measure were in favor of the attention block. The overall additional variance accounted for by the attention measures was 3.1%. The quantity of information measures did not add anything above and beyond the health media exposure block, suggesting that, at least for print media sources, they overlap with the parallel health media exposure items.

Equations 6 and 7 show that the closed-ended measures of exposure to cancer-related issues (both sets of questions about cancer prevention in general, and about diet and exercise) add a total of 5.2% of variance to the variance explained by traditional measures of general and health media exposure. Their competitors are the open-ended measures. Equations 8 and 9 show a large increase in predictive power, associated particularly with the open-ended measure asking respondents to recall what they had heard or read about cancer prevention in general (7.5%). Using both open-ended questions, there is roughly 10% of variance that the open-ended measures do not share with the traditional exposure measures, whereas the comparative advantage of the closed-ended measures of cancer prevention, diet, and exercise is only 5.2%.

Tests of linearity

Finally, tests of linearity and deviation from linearity were conducted for the association of each exposure item with cancer knowledge. Statistically significant deviations from linearity, as indicated in a means analysis, were confirmed by introducing quadratic terms of exposure in regression models predicting knowledge. It was found that measuring general media exposure in terms of reported hours per week produced some curvilinear associations (Internet, TV, radio), with a significant decrease in cancer knowledge observed for high levels of use. However, adding quadratic terms in Equation 2 did not change the ranking of predictors: the total variance accounted for by the new general exposure block increased from a non significant .8% to a

marginally significant 1.4%. Similarly, for the health media exposure block, the addition of quadratic terms for newspapers and for magazines slightly increased the predictive power of the block from 3.7% to 4.6%, but without altering the hierarchy of independent predictors. Also, curvilinear associations, when found, did not seem to be clustered predominantly in one class of exposure measure or another.

Predicting current knowledge

Table 3 presents parallel analyses with current knowledge as the outcome variable. The current knowledge items were about newsworthy health issues (e.g. dieting, smoking) not explicitly presented as related to cancer.

[TABLE 3 ABOUT HERE]

By comparison with Table 1, a few contrasting results deserve attention. For the cancer knowledge outcome, exposure to specific health media mattered, but general media exposure did not (3.7% versus an insignificant .8%). The opposite pattern is observed for salient health-related news stories: general media exposure accounted for 3.4% of the variance in current knowledge, while health media exposure added only half of that (1.7%). Furthermore, the health media exposure items did not contribute any variance above and beyond general exposure, as evidenced in Equation 3, suggesting that they share much variance with the general exposure measures. The implications of this finding are addressed in the discussion section.

Discussion

The argument developed in this paper is that researchers should select measures of incidental exposure based on a complex set of validity criteria, survey costs, and respondent burden issues. We explored empirically several classes of incidental exposure measures as they predicted cancer knowledge. Whereas some of our findings confirm general patterns of results

previously obtained across the political and health communication areas, others speak mostly to research focusing on cancer communication.

In general, against a criterion of cancer knowledge, specificity counts. Measures tapping some form of specific exposure (prevention, diet and exercise) performed better than measures of health media exposure or of general media exposure, in line with much of the previous literature. Our study is unique for cancer communication in its level of detail; it goes beyond this common finding to rank and compare the performance of all measures. This enables us challenge the presumed superiority of open-ended and of the attention measures, or the claim for across the board failure of traditional measures of general media use.

The general media exposure questions which ask respondents to report their frequency of interaction with media sources do not seem very important for longer term cancer knowledge. As suggested by previous research (Bechtel et al., 1972; Price, 1993), people tend to overestimate their amount of media use. In our case as well, measures of reported time spent watching television or listening to the radio had skewed distributions, with large standard deviations (see Table 2). For instance, approximately 10% of respondents reported they watched television between 8 and 24 hours a day, suggesting that television is on whether people engage with media content or not. The poor predictive power of time-spent measures is consistent with previous results in communication research (Chaffee & Schleuder, 1986; Clarke & Kline, 1974; Culbertson & Stempel, 1986; Price & Zaller, 1993). In results not reported here it was found - consistent again with previous findings- that the time-spent measures of general media use displayed low correlations with the health exposure measures.

In that respect, compared to the general media exposure questions, the questions about exposure to the *health* media offer some advantages: they have good face validity because they

are assessed as frequency of interaction with media channels, and they account better for how much people know about cancer. At the same time, the measures of general exposure to various media did seem to be relevant predictors for knowledge of salient health-issues that received attention in the media before the survey was conducted. It is somewhat unsurprising that issues receiving intense attention in the general news media attention are recalled by people with a lot of general media exposure, whereas those general exposure measures are less relevant to longer-term cancer knowledge. If a research project is concerned about what people learn from newsworthy news stories about health issues, general exposure measures may be relevant; if the focus is on longer term and less newsworthy knowledge, exposure to health specific media may be more relevant.

At the other end of the spectrum of exposure measures, the highest predictive power was yielded by the open-ended questions asking respondents to recall what they heard or seen about prevention in general, and about the connection between diet, exercise, and cancer. It has been argued that open-ended measures reflect better minimal memory traces of media content commonly referred to as encoded exposure (Southwell, 2002). Asking respondents to recall what they heard or watched about a specific health issue reflects what was important for them, what they took away from their interaction with media content, rather than what the researchers thought was important knowledge and information (Clarke & Kline, 1974). At the same time, one can interpret the open-ended measures as representing a form of declarative knowledge (Salmon, 1986). It may be no surprise then to find that the open-ended questions perform well against a knowledge criterion since both may be defined as measures of knowledge. It may be therefore useful in future research to consider a different validity criterion (e.g. a behavior) when assessing the validity of open-ended measures of exposure.

Also, open-ended measures place a higher cognitive burden on respondents and involve higher survey costs for recording and coding answers. If such concerns loom large, the parallel closed-ended questions of exposure combine excellent predictive power with higher face validity, since they do not assess knowledge explicitly. Furthermore, when asking specifically about diet and exercise as they relate to cancer, the open-ended format does not have a net advantage any longer: the closed-ended questions performed equally well (6.7%). Our results suggest that unless the researcher is substantively interested in what specifically people recall about cancer prevention (e.g. misrepresentations of causes of cancer), the closed-ended format enables one to ask questions that perform as well as their open-ended counterparts, without confounding exposure with knowledge.

The study also compared questions which asked about quantity of information about health topics versus those which asked about attention to health topics. The use of attention measures may compensate for what Chaffee and Schleuder (1986) saw as a potential underestimation of media effects on learning as a result of reliance on time-use measures of media exposure. Conceptually, attention is considered as a prerequisite for message processing (Roser, 1990), learning, and persuasion (McGuire, 1989). The higher predictive power of the attention block justifies asking about attention rather than quantity of information.

However, despite the predictive advantage, conceptually attention may be confounded with other constructs, such as involvement or interest. As a result, correlations of attention with knowledge or other outcomes may be a consequence of involvement with the issue and can hardly be attributable to exposure to the content alone. Salmon (1986) makes this point when he describes involvement as a "more or less vague meta-concept that subsumes a class of related concepts that have both affective and cognitive derivations" (p. 244), such as salience, attention,

relevance, audience activity, and elaboration. Donohew and colleagues (1998) view an individual's need for stimulation as part of the attention construct as well. This conflation raises face validity concerns about the attention measures as exposure measures.

Also the predictive advantage of attention measures was less important (6.2%) in comparison with closed-ended measures of exposure to specific cancer topics (5.2%). Since those measures have superior face validity, they may be preferred. Table 4 summarizes our conclusions for each of the eight measures on each of the three criteria used: predictive validity for long term cancer knowledge; face validity, and likely respondent burden/survey cost. Each measure is assessed on a scale from "0" to "3", where "0" signals that the measure is the least useful, and "3" that it is the strongest in the group of measures analyzed.

[TABLE 4 ABOUT HERE]

Finally, we recognize some limitations of the study. The response rate is, at best, adequate; the sample size did not permit systematic comparisons in validity of questions across important subgroups of the population; the knowledge measures included only a limited number of questions and it may be that other questions would have produced different criterion validity outcomes. Our conclusions are framed in terms of alternative approaches to questions designed to assess exposure across media, and across topics. At the same time, there were important differences among media within question types, an issue we have only begun to explore. Although we presented some of these results here, fully developing them was beyond the scope of this paper. We focused on the effects of different question approaches, but only began to touch on additional possible elaborations: differences among media in the usefulness of question approaches, differences among media in their influence on content knowledge; differences in the functional forms of media effects against knowledge criteria; and differences within media

content types in their effects on knowledge outcomes. These all invite future analyses of these data as well as future research.

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Table 1: OLS regression predicting cancer knowledge from block of exposure measures

Blocks	Item	Eq1		Eq2	Eq 3	Eq 4	Eq 5	Eq 6	Eq 7	Eq 8	Eq 9
		a) Beta	b)Beta controls	+ΔR^2 (%)	+ΔR^2 (%)	+ΔR^2 (%)	+ΔR^2 (%)	+ΔR^2 (%)	+ΔR^2 (%)	+ΔR^2 (%)	+ΔR^2 (%)
	Education	**.43**			**20.4**	**21.2**	**20.4**	**24.2**	**24.2**	**19.6**	**19.6**
	Gender (female)	**.14**									
	Age	**.08**									
General media exposure	TV	-.07	-.03	.8	.8	1.7	.8	.8	.8	2.0	2.0
	Radio	-.04	.02								
	Internet	**.08**	-.01								
	Newspaper	**.14**	**.08**								
	National TV news	.01	.01								
	Local TV news	.02	.03								
Health media exposure	Newspaper	**.23**	**.15**	**3.7**	**3.5**	**3.5**	**3.5**	**4.1**	**4.1**	**3.7**	**3.7**
	TV drama	.03	.06								
	Local TV news	**.12**	**.10**								
	Magazines	**.22**	**.17**								
	Internet	**.12**	**.08**								
Attention to health topics	TV	**.16**	**.16**	**6.2**		**3.1**					
	Radio	**.14**	**.14**								
	Newspaper	**.16**	**.13**								
	Magazines	**.25**	**.17**								
	Internet	**.31**	**.23**								
Quantity of health information	TV	-.02	-.01	**4.1**			1.8				
	Radio	.04	.04								
	Newspaper	**.13**	**.09**								
	Magazine	**.27**	**.17**								
	Internet	**.15**	.07								
Closed-ended cancer prevention (general)	TV	**.21**	**.18**	**4.9**				**2.2**	**2.2**		
	Radio	**.11**	.05								
	Newspaper	**.20**	**.12**								
	Magazine	**.29**	**.19**								
	Internet	**.22**	**.13**								
Closed-ended cancer prevention (specific: diet and exercise)	TV	**.19**	**.16**	**6.7**					**3.0**		
	Radio	**.19**	**.12**								
	Newspaper	**.27**	**.17**								
	Magazine	**.35**	**.26**								
	Internet	**.29**	**.20**								
Open-ended cancer prevention (general)	General cancer prevention	**.40**	**.32**	**9.8**						**7.5**	**7.5**
Open-ended cancer prevention (specific: diet and exercise)	Specific cancer prevention	**.38**	**.27**	**6.7**							**2.4**
Total R^2					**.247**	**.295**	**.265**	**.313**	**.343**	**.329**	**.352**
Adjusted R^2					**.233**	**.259**	**.226**	**.277**	**.299**	**.302**	**.324**
N					**770**	**388**	**380**	**381**	**381**	**388**	**388**

Note: results in bold are statistically significant at the .05 level.

Table 2: Means and standard deviations

Measure		Mean	Standard deviation
Criterion variables and controls	Education (years)	13.70	2.12
	Gender (female)	52%	
	Age	47	18
	Cancer knowledge	.50	.28
	Current knowledge	.83	.28
General media exposure	TV (hrs/week)	28.59	27.12
	Radio (hrs/week)	19.88	26.50
	Internet (hrs/week)	13.09	21.86
	Newspaper (days/week)	3.81	3.00
	National TV news (days/week)	4.11	2.89
	Local TV news (days/week)	3.86	2.97
Health media exposure	Newspaper	1.00	.88
	TV shows/drama	.70	.88
	Local TV news	1.05	.89
	Magazines	.86	.77
	Internet	.44	.68
Attention to health topics	TV	1.53	1.01
	Radio	1.03	.99
	Newspaper	1.34	1.03
	Magazines	1.44	1.00
	Internet	1.09	1.11
Quantity of health information	TV	1.32	.92
	Radio	.66	.85
	Newspaper	1.05	.95
	Magazine	1.29	.96
	Internet	1.04	1.07
Closed-ended cancer prevention (general)	TV	1.39	1.09
	Radio	.63	.89
	Newspaper	.91	.97
	Magazine	1.16	1.05
	Internet	.69	.97
Closed-ended cancer prevention (specific: diet and exercise combined and standardized)	TV	.00	1.00
	Radio	.00	1.00
	Newspaper	.00	1.00
	Internet	.00	1.00
	Magazine	.00	1.00
Open-ended cancer prevention (general)	General prevention	1.05	1.18
Open-ended cancer prevention (diet and exercise combined and standardized)	Diet and exercise	.00	.1.00

Table 3: OLS regression results predicting current knowledge from blocks of exposure measures

Blocks	Item	Eq1		Eq2	Eq 3	Eq4	Eq5
		a)Beta	b)Beta controls	$+\Delta R^2$ (%)	$+\Delta R^2$ (%)	$+\Delta R^2$ (%)	$+\Delta R^2$ (%)
	Education	**.37**			**14.5**	**11.7**	**18.7**
	Gender (female)	**.13**					
	Age	.02					
General media exposure	TV	**-.001**	.09	**3.4**	**3.4**	**6.8**	1.8
	Radio	**-.001**	**-.001**				
	Internet	**.001**	.00				
	Newspaper	**.02**	**.01**				
	National TV news	.04	.07#				
	Local TV news	.04	.07#				
Health media exposure	Newspaper	**.05**	**.03**	**1.7**	.8	1.6	1.3
	TV drama	-.002	.002				
	Local TV news	**.03**	**.03**				
	Magazines	**.03**	.01				
	Internet	**.04**	.02				
Attention to health topics	TV	.03	.03	**4.7**		1.5	
	Radio	-.01	-.01				
	Newspaper	**.04**	**.04**				
	Magazines	**.05**	**.04**				
	Internet	**.06**	**.04**				
Quantity of health information	TV	**-.04**	**-.03**	**3.1**			**2.8**
	Radio	-.02	-.02				
	Newspaper	.03	.01				
	Magazine	**.04**	.01				
	Internet	**.04**	.01				
Total R^2					**.187**	**.216**	**.246**
Adjusted R^2					**.172**	**.175**	**.206**
N					**788**	**388**	**380**

Note: results in bold are statistically significant at the .05 level.
Note: # $p<.1$.

Table 4: Overall assessment of the eight question approaches

Question	Prediction of cancer knowledge	Face validity as measure of health or cancer media exposure	Respondent burden/ survey cost
General media exposure	0	2	2
Health media exposure	1	3	2
Attention to health topics	2	2 (Risk of confounding exposure and involvement)	3
Quantity of health information	1	3	3
Closed-ended cancer prevention (general)	2	3	3
Closed-ended cancer prevention (specific: diet and exercise combined)	2	3	3
Open-ended cancer prevention (general)	3	2 (Risk of confounding exposure and knowledge)	1
Open-ended cancer prevention (specific: diet and exercise combined)	3	2 (Risk of confounding exposure and knowledge)	1

Note: Each measure is assessed on a scale from 0 to 3, where 0 signals the measure is the least useful, and 3 that it is the strongest in the group of measures.

APPENDIX

General media exposure:

-On a typical weekday, Monday through Friday, about how many hours do you...watch television? listen to the radio? use the Internet?

-During a typical weekend, including both Saturday and Sunday, about how many hours do you... watch television? listen to the radio? use the Internet?

-In the past seven days, how many days did you read a newspaper?

-In the past seven days, how many days did you watch the national news on television?

-In the past seven days, how many days did you watch the local news on television?

Health media exposure:

-Next, we want to know about the various ways you get health information. Some newspapers or general magazines have sections that focus on health. Do you sometimes read health sections of the newspaper or of general magazines? Yes/ No/ Don't Know

-About how often have you read such health sections in the past year? Would you say ...Once or more per week/ Less than once per week / Not at all / Don't Know

-Do you sometimes watch dramatic or comedy television programs which are mostly about doctors or hospitals? Yes / No/ Don't Know

-How often have you watched such medical shows in the past year? Would you say ... Once or more per week/ Less than once per week / Not at all / Don't Know

-Some local television news programs include special segments of their newscasts which focus on health issues. Do you watch health segments on local news? Yes / No/ Don't Know

-How often have you watched health segments on local news in the past year? Would you say ... Once or more per week/ Less than once per week / Not at all / Don't Know

-Some people read magazines or newsletters that focus on health. Do you subscribe to any health magazines or newsletters? Yes / No/ Don't Know

-Do you ever read magazines or newsletters that focus on health, even if you don't subscribe to them? Yes / No/ Don't Know

-How often have you read magazines or newsletters that focus on health in the past year? Would you say ... Once or more per week/ Less than once per week / Not at all / Don't Know

-Some people notice information about health on the Internet, even when they don't have a specific concern. Have you ever read such health information on the Internet when you were not trying to find out about a specific health concern? Yes / No/ Don't Know

-About how often have you read this sort of information in the past year? Would you say ... Once or more per week/ Less than once per week / Not at all / Don't Know

Attention to health topics:

How much attention do you pay to information about health or medical topics… on TV/ on the radio/ in newspapers/ in magazines / on the internet. Would you say a lot, some, a little, or not at all?

Quantity of health information:

I am going to name some sources where people say they get information about how to stay healthy. For each one would you tell me how much information about staying healthy you get from that source. How much information about staying healthy do you

get from… TV/ the radio/ newspapers / magazines/ the internet? Would you say a lot, some, a little, or not at all?

Closed-ended questions about cancer prevention, diet, exercise and cancer:

-The next questions are about some specific health issues. I'll ask you whether you've heard about them, and where you heard about them. Have you have heard anything about preventing cancer? Yes/ No/ Don't Know

-Thinking about the past year only, how much have you heard about preventing cancer from… TV/ the radio/ newspapers / magazines/ the internet? Would you say a lot, some, a little, or not at all?

-Have you have heard anything about (diet and cancer/exercise and cancer)? Yes/ No/ Don't Know

-Thinking about the past year only, how much have you heard about (diet and cancer/exercise and cancer) from…TV/ the radio/ newspapers / magazines/ the internet? Would you say a lot, some, a little, or not at all?

Open-ended questions about cancer prevention, diet, exercise and cancer:

-The next questions are about some specific health issues related to cancer. I'll ask you what you've heard about them. In the past year, have you seen or heard or read anything about preventing cancer? Yes/ No/ Don't Know

-You said you heard about preventing cancer. Thinking about the past year only, can you recall anything that you have seen or heard or read within the past year about preventing cancer? Anything else? [RECORD VERBATIM]

-How about (exercise and cancer/diet and cancer)? Have you seen or heard or read anything about exercise recently? Yes/ No/ Don't Know

-You said you heard about (exercise and cancer/diet and cancer). Thinking about the past year only, can you recall anything that you have seen or heard or read about (exercise and cancer/diet and cancer)? Anything else? [RECORD VERBATIM]