Evaluating Psychological Traits, Communication, and the Persuasiveness of Screening-Related Health Messages

John Monu

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David R. Flum

Farhood Farjah

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Abstract

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John Monu

Chair of the Supervisory Committee:

David R. Flum

Department of Health Services

Preventable diseases account for up to 40% of deaths in the U.S., however, preventive services such as immunization and screening remain underutilized. Lung cancer and hepatitis C virus (HCV) screening—despite their known mortality benefit—are two examples of this underutilization. We first examine lung cancer screening and the role knowledge, attitudes, and beliefs play among those at high-risk for the disease. We then examine the role of health-related communications in both lung cancer and HCV screening. Psychological theories suggest that health-related communications are more persuasive when aligned with an individual's character traits—for instance, someone who prefers the "forest" rather than the "trees" (e.g. high construal) and is motivated by a desire to improve health (e.g. promotion focus) may prefer messages

consistent with these psychological states. However, it is unknown whether these theories hold among individuals at high-risk for lung cancer or HCV.

We first used crowdsourcing to survey the knowledge, attitudes, and beliefs regarding lung cancer screening among individuals the United States Preventive Services Task Force (USPSTF) considers high-risk. In a follow-up study we randomized these individuals to view a lung cancer screening advertisement image consistent with one of four psychological states arising from a combination of two types of construal levels and two types of regulatory focus (high construal/promotion focus; high construal/prevention focus; low construal/promotion focus; and low construal/prevention focus). We assessed participants' likelihood of undergoing lung cancer screening after viewing the image and determined each participant's character traits using validated instruments. In a separate study we identified individuals eligible for HCV screening by Centers for Disease Control birth cohort criteria (1945-1965) and randomized them to view an HCV screening advertisement image consistent with one of four psychological states arising from combinations of high/low construal level and promotion/prevention regulatory focus. We assessed willingness to undergo HCV screening after viewing the image and measured participants' character traits. We used Amazon's crowdsourcing platform—Mechanical Turk (MTurk)—to recruit subjects for all three studies.

Of 240 USPSTF screen-eligible respondents that qualified for our first study (median age 60, 62% current smoker, median 42 pack-years smoked), 106 (44%) reported knowledge of a screening test. However, only 36 of them (35%) correctly identified low-dose computed tomography as the appropriate test. Two hundred twenty-two respondents (93%) reported believing in the notion that early-detection of lung cancer saves lives and 165 (69%) were willing to undergo lung cancer screening if it was recommended by their physician. In our

follow-up lung cancer screening study, the high construal/promotion focus image led to a greater likelihood of screening compared to images representing other psychological states (p-value=0.04). High construal/promotion focus was the most prevalent character trait (40%), whereas low construal/prevention focus was least prevalent (17%). Among the 307 HCV screen-eligible individuals in our final study (median age 63 years, 68% female), we found the low construal/promotion focus image led to the greatest willingness to screen (p-value=0.04). High construal/promotion focus was the most prevalent character trait (40%). Low construal/promotion and low construal/prevention focus were least prevalent (16%).

Although few individuals at high-risk for lung cancer are aware of lung cancer screening, the majority believe early-detection of lung cancer saves lives and would pursue screening if recommended by their primary physician. Health systems may increase lung cancer screening rates by developing patient and physician educational interventions. When developing patient educational interventions for preventive health behaviors such as lung cancer or HCV screening, the psychological focus of health-related messages is important. Lung cancer screen-eligible individuals tend to prefer messages that provide a broad overview of screening and focus on its benefits. HCV screen-eligible individuals also prefer a focus on health benefits but desire more detailed messages. This knowledge may inform the design of more effective patient-facing communications that lead to higher rates of screening.

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INTRODUCTION:

It is estimated that up to 40% of all deaths in the U.S. are the result of preventable diseases[1]. Given the importance of clinical preventive services—such as immunizations, disease screenings, and behavioral counseling—on reducing this proportion, there is an interest in communicating knowledge of prevention, early detection, and treatment of these diseases to individuals at high-risk for them.

There is clear evidence that clinical preventive services remain greatly underutilized, however. For instance, the Centers for Disease Control and Prevention's (CDC) National Health Interview Survey reported that only 44% of all adults regularly receive influenza vaccination and less than a third are routinely screened for tobacco use[2]. Integral to improving utilization of preventive services is how clinicians communicate disease risk and the potential benefits of prevention or early detection to patients.

Over the past two years, for my Master of Public Health degree, I have been interested in understanding this area of communication and how it can be improved. To accomplish this, I applied two methodologies: survey methods and communication science theory. I examined two diseases with available screening tests—lung cancer and hepatitis C virus (HCV). My goal was to understand how we can improve communication, and as a result screening, for an acute illness and a chronic infectious condition.

The following three studies will present this work. First exploring the knowledge, attitudes, and beliefs of individuals at high risk for lung cancer, then applying communication science theory to understand the effects of visual communication strategies on lung cancer and HCV screening participation.

ARTICLE 1: Evaluating Knowledge, Attitudes, and Beliefs about Lung Cancer Screening Using Crowdsourcing

INTRODUCTION:

Lung cancer is the leading cause of cancer-related death in the United States[3]. Screening with low-dose computed tomography (LDCT)—despite its proven mortality benefit[4]—remains vastly underutilized, occurring in less than 5% of screen eligible individuals[5,6]. Factors that may contribute to low screening rates include the knowledge, attitudes, and beliefs of individuals at high-risk for lung cancer[7]. A better understanding of these factors will inform the design of interventions that aim to increase lung cancer screening rates.

Several areas of uncertainty remain, however. Lack of knowledge of screening may be an important barrier to screening[8-13], but the frequency of awareness of screening among individuals at high-risk of lung cancer is not well-characterized. Another area of uncertainty is whether there is a relationship between willingness to screen and one's self-perceived risk of lung cancer or belief in the efficacy of lung cancer screening. Prior studies have reported a relationship between these factors[14-18]; however, the findings may not be generalizable because the studies surveyed population subgroups (e.g. Veterans, socioeconomically disadvantaged populations, ethnic minorities) and in some cases screen-ineligible individuals (e.g. non-smokers). Collecting information about knowledge, attitudes, and beliefs in a broad population of high-risk individuals is challenging. Crowdsourcing platforms may be one way to obtain this information[19-21]. Although prior studies have used crowdsourcing to study knowledge, attitudes, and beliefs in various contexts[22-24], this has not been done for lung cancer screening.

Using Amazon's Mechanical Turk (MTurk) crowdsourcing platform to recruit survey participants, we characterized knowledge, attitudes, and beliefs regarding lung cancer screening

among individuals at high-risk for lung cancer based on United States Preventive Services Task Force (USPSTF)[25] criteria. We hypothesized that a minority of high-risk individuals know about lung cancer screening and more specifically about LDCT. Additionally, we hypothesized that a self-perceived high risk of lung cancer and belief in the efficacy of screening are both associated with a greater willingness to be screened. Lastly, we elicited preferred methods of learning about lung cancer screening in the event that we observed our hypotheses and with the goal of informing the development of future interventions.

MATERIALS AND METHODS:

Survey Development

We developed survey questions informed by the Consolidated Framework for Implementation Research (CFIR)[26] and a conceptual model for lung cancer screening participation[7]. CFIR is a meta-theoretical framework based on published theories that provides a pragmatic structure for analyzing existing and potential barriers to or facilitators of implementation. Its comprehensive structure comprising five domains interact and influence healthcare intervention implementation. One core domain, "Characteristics of Individuals", addresses characteristics of individuals involved in the intervention process. As we were interested in high-risk individuals' knowledge, attitudes and beliefs, we focused on the constructs of the intervention's "relative advantage" and the influence of "patient needs and resources" in this survey[27]. In addition, a recently published conceptual model for lung cancer screening participation identified cognitive variables (e.g. knowledge of a screening test) and health beliefs (e.g. perceived benefits of screening) to be factors potentially impacting lung cancer screening[7]. Our survey had an additional goal to elicit preferred modalities of receiving information about

lung cancer screening (e.g. communication from a physician, electronic medical record notification, etc.). Respondents were asked to rank seven methods of receiving additional information on lung cancer screening, with 1 being the most useful and 7 being the least useful. Our survey was developed, pilot tested among research staff, and refined over 18 iterations. The final survey consisted of 31 items (Appendix A).

Study Population

Our study population represents a convenience sample of individuals who were registered participants in the Amazon MTurk crowdsourcing marketplace between January and February 2018 and who lived in the United States. We first asked five questions to determine participant age and smoking history (Appendix B) and provided $0.25 as compensation. Then, we offered respondents $\geq$50 years of age with a $\geq$20 pack-year smoking history $2.00 to complete our full survey. We primarily analyzed respondents at high-risk for lung cancer who met the USPSTF eligibility criteria for screening (age 55-80 years, former or current 30 pack-year smokers, former smokers who quit within the last 15 years)[25]. The reason we offered the survey to a broader and younger group of current/former smokers was to conduct a planned sensitivity analysis to determine if responses varied by different eligibility criteria (see below). We excluded respondents who reported requiring home oxygen supplementation or a prior history of lung cancer (Figure 1). This study was exempted from human subjects review by the University of Washington Human Subjects Division Institutional Review Board (STUDY00003234).

Survey Deployment

Participants took the survey using Qualtrics, an online commercial survey platform. In order to optimize data quality, we prevented respondents from taking the survey more than once by using internet browser-specific "cookies" that blocked multiple attempts from the same internet device or user account. We also used a Completely Automated Public Turing Test to Tell Computers and Humans Apart (CAPTCHA) verification test at the beginning and end of our survey to avoid automated survey responses[28]. Our survey included forced responses, however, respondents had the option of selecting "prefer not to answer."

Statistical Analysis

Respondent characteristics were summarized using means or medians for normally distributed and non-normally distributed continuous variables, respectively. Frequencies were calculated for categorical variables. We also conducted a sensitivity analysis comparing responses across varying eligibility criteria including the Center for Medicare and Medicaid Services (CMS) and National Comprehensive Cancer Network's (NCCN) category 2 criteria (i.e. individuals ≥50 years of age, ≥20 pack-year smoking history, and additional risk factors that increase the estimated 6-year lung cancer risk to >1.3%)[29]. Chi-square and t-tests were used to compare demographic, knowledge, attitude, and belief variables. Respondent rankings of preferred methods of learning about screening were reported as mean rank with standard deviation (SD). All statistical analysis was conducted using R (version 3.4.4.).

RESULTS:

A total of 1,886 individuals accepted our invitation to answer five questions about their age and smoking history. We invited 584 current or former smokers age 50 years or older with at

least a 20 pack-year smoking history to take the full survey. The final cohort included 240 respondents meeting USPSTF criteria for being high-risk for lung cancer (Figure 1).

Table 1 shows the demographic, clinical, and risk-factor information of our USPSTF-eligible study population. The median age was 60 years and the majority of respondents were white and current smokers, and had health insurance, at least a high school education, and income greater than $25,000 per year. Respondents had a median 42 pack-year smoking history. Among former smokers, the median years since quitting was 5 years. Thirty-three (14%) respondents reported that their primary care provider had brought up lung cancer screening and 24 (10%) reported having received lung cancer screening. Of these 24 subjects, 12 reported undergoing computed tomography (CT).

One hundred six respondents (44%) reported knowledge of a screening test. Among those claiming knowledge of a screening test, 36 respondents (35%) correctly identified LDCT as the appropriate test (Table 2). Twenty-two respondents (9.2%) did not think a screening test exists. Most respondents (n=114, 48%) reported being unsure about the existence of a test.

Regarding attitudes, 165 respondents (69%) reported being willing to undergo lung cancer screening if it was recommended by their physician (Table 2). Of the 75 respondents (31%) unwilling to participate in screening, 69 (92%) reported wanting more information on screening before deciding.

In terms of beliefs, 222 respondents (93%) reported believing in the notion that early-detection of lung cancer saves lives. The proportion of respondents who believe that early-detection of any cancer is life-saving was similarly high (89%). The majority of respondents believed they were high-risk for lung cancer (69%) (Table 2). Respondents who reported a willingness to be screened were more likely to believe that they were at high risk for lung cancer

($p=0.02$) and believe in the efficacy of lung cancer screening ($p<0.001$) compared to those who were undecided about or unwilling to be screened (Table 3).

Table 4 summarizes the learning preferences of USPSTF-eligible respondents. Talking to a primary care physician was ranked highest in terms of preferred method of learning more about screening. Receiving a message through their electronic health record was ranked second, and an informational letter in the mail was ranked third. Receiving information through social media was ranked as least useful.

There were an additional 54 individuals who met NCCN category 2 criteria for being at high-risk for lung cancer (individuals ≥50 years of age, ≥20 pack-year smoking history, and additional risk factors that increase the estimated 6-year lung cancer risk to >1.3%) and who did not meet USPSTF criteria (Appendix C). Our sensitivity analysis of these individuals revealed similar results (Appendix D). All 240 respondents who met USPSTF high-risk criteria also met CMS high-risk criteria.

DISCUSSION:

In this study of high-risk individuals on a crowdsourcing platform, we found that a minority of individuals are aware of lung cancer screening. We also found that a self-perceived high risk of lung cancer and belief in the efficacy of early-detection are associated with a willingness to screen. Lastly, an assessment of the learning preferences of this population revealed that individuals prefer talking with their primary care physician more than any other method of learning about lung cancer screening.

Qualitative studies of high-risk individuals have identified lack of knowledge as a barrier to lung cancer screening[8-13]. The rate of awareness of lung cancer screening varies across studies,

ranging from 10-41%[10,13,30,31]. These studies were done in mixed populations of screen-eligible and ineligible individuals[10,30], or in segments of the screen-eligible population (e.g. blacks, whites, or those who have undergone lung cancer screening and had benign findings)[13,31]. While important, these studies limit our ability to apply their findings to a broader context. They may also have been limited by traditional recruitment strategies. Regardless, the rate of awareness in our investigation is consistent with these prior studies and generally low. As there is little messaging of lung cancer screening overall, subgroups of high-risk individuals and screen-ineligible (i.e. based on risk) individuals are no more or less likely to have knowledge of screening compared to a broader population. One unique contribution of our study is that we disentangle individuals who simply claim knowledge of a screening test from those that know the actual test used to screen. Knowledge of LDCT as the screening test is substantially lower than knowledge of a screening test. The significance of our findings and other studies is that there is little ability for individuals to self-advocate without knowledge of screening. One way to overcome this barrier is to develop patient-facing education interventions that increase knowledge of lung cancer screening.

A conceptual model of lung cancer screening participation identified self-perceived risk of lung cancer and a belief in the efficacy of early-detection as important facilitators of screening[7]. As only one other prior study has shown a relationship between these two factors and willingness to screen[30], our study provides additional empirical support for this conceptual model. Other studies have reported on the prevalence of self-perceived risk and belief in the efficacy of early-detection without linking these factors to a willingness to screen. A self-perceived risk of lung cancer varies considerably across prior studies—from 10-74%[10,18,32-34]. One possible explanation for this significant variation is that self-perception of lung cancer risk

is the result of a complex interplay of several factors, including: knowledge of lung cancer risk factors; perception of smoking-related stigma associated with risky behaviors; and cognitive acceptance or denial of the critical role smoking plays in lung cancer development[9,35]. Other studies have found that a majority of individuals believe early-detection of lung cancer saves lives, but rates of belief range from 66-94%[10,16,32-34,36]. Potential reasons for this variability may include the sampling of different populations or the use of different survey methods., These findings suggest that in addition to increasing knowledge about lung cancer screening, patient-facing interventions that highlight the efficacy of early-detection and provide individuals personalized risk information may increase willingness to screen.

In anticipation of an opportunity to develop such interventions, we found that individuals' preferred source of learning about lung cancer screening is their primary care physician. Prior studies examining colorectal cancer screening and various medical conditions in older adults also report that physicians are the preferred source of health information, compared to other communication strategies (e.g. family, friends, magazines, newspapers, brochures, television, or the internet)[37,38]. This finding is informative because it suggests that interventions should not only be directed towards patients, but also their primary care physicians.

This study has several limitations. First, we assume the MTurk population is representative of high-risk individuals, but that might not be a valid assumption. While we do not have access to a cohort of high-risk individuals to compare sociodemographic and clinical characteristics, the National Lung Screening Trial (NLST) provides a sample of 53,454 high-risk individuals in a pragmatic trial setting. Our MTurk cohort was different from the NLST population in a few ways: MTurk had a lower proportion of men, former smokers, individuals whose highest education level was high school, some college, or a graduate degree, and a higher

proportion of American Indian/Alaska Natives, and asbestos exposure. Another important limitation of our study is that we implemented our survey using the online MTurk platform. This does not allow for the calculation of a response rate. Without this, we are unable to evaluate the possibility of non-response bias in our study. Additionally, the accuracy of respondent-provided information cannot be confirmed; we are relying on self-reported sociodemographic and clinical risk factors. As online compensation mechanisms may incentivize individuals to create computer programs or "bots" that rapidly complete surveys, we took measures to prevent this by using a "CAPTCHA" test to ensure surveys were completed by a human. We did not find any evidence of automated activity in our free-text survey responses. Lastly, respondents' stated preference to participate in screening may differ from their revealed preference in an actual clinical setting.

A strength and novel aspect of our study is the use of a crowdsourcing platform to conduct survey research in individuals at high-risk for lung cancer. This approach allows researchers to potentially reach a broad range of individuals and it may lower the threshold for survey participation. Additionally, it is relatively inexpensive and allows for efficient and timely collection of data (i.e. we completed our survey data collection within 2 months at a cost of $3,000). Crowdsourcing platforms may be an important adjunct to conventional methods of surveying individuals at high-risk for lung cancer.

CONCLUSIONS:

Our findings support patient and physician-facing interventions to increase knowledge pertaining to lung cancer screening. Specifically, among individuals meeting USPSTF eligibility criteria, efforts to increase knowledge of the availability of LDCT screening and the efficacy of screening as well as providing personalized risk information about lung cancer may increase

willingness to screen. As patients have identified physicians as their preferred source of health-related information, it is equally important to educate physicians—particularly primary care providers—about their key role in promoting lung cancer screening awareness.

ARTICLE 2: Psychological Traits and the Persuasiveness of Lung Cancer Screening Health Messages

INTRODUCTION:

Lung cancer screening saves lives[4,49] but is greatly underutilized, occurring in 4% of eligible individuals[5]. One barrier to screening is a lack of awareness of screening among the eligible population[50]. Health systems and patient advocacy groups have attempted to increase awareness through media campaigns and advertisements for lung cancer screening[51-53]. It is not known whether some messages are more effective than others.

Psychological theories suggest that health-related communication is more persuasive when it aligns with an individual's unique character traits—for instance, a person who prefers to focus on the "forest" rather than the "trees" (e.g. high construal trait) and is motivated by a desire to gain health benefits (e.g. promotion focus trait) is more likely to be persuaded by health-related messages that are consistent with these psychological traits[54-56]. This theory has not been applied to a population of individuals at high-risk for lung cancer. Furthermore, the distribution of these character traits in this population are unknown.

This study aims to test the effect of four different advertisement images (corresponding to four combinations of two different character traits) on the self-reported likelihood of undergoing screening among individuals at high-risk for lung cancer. A secondary aim is to determine the frequency of the four combinations of character traits in this population. We hypothesize that different types of images have an effect on the self-reported likelihood of undergoing screening, and that the most effective image aligns with the most prevalent character trait.

MATERIALS AND METHODS:

Participant Population

We previously conducted a study on lung cancer screening knowledge, attitudes, and beliefs among screen-eligible individuals using Amazon's crowdsourcing platform, Mechanical Turk (MTurk). MTurk is a crowdsourcing recruitment tool for survey research[19-20]. Screen eligibility was defined by United States Preventative Services Task (USPSTF) criteria (age 55-80 years, former or current 30 pack-year smokers, former smokers who quit within the last 15 years)[25]. In addition to smoking history data, we collected demographic, clinical, and other lung cancer risk-factor information. All two hundred forty-three individuals from that study were invited to participate in this study. We offered participants $4 as compensation. All study materials were approved by the University of Washington Institutional Review Board (STUDY00003234) and informed consent was waived.

Study Design

Using the proprietary built-in "Question Randomization" feature of the online survey platform Qualtrics, we randomized participants to view a lung cancer screening advertisement image consistent with one of four psychological traits arising from a combination of two types of construal levels (high, low) and two types of regulatory focus (promotion, prevention). We then asked them about their likelihood to undergo lung cancer screening. Likelihood was measured on a five-point Likert scale with 1 representing "very likely to screen" and 5 representing "very unlikely to screen."

Character Trait Determination

To achieve our secondary aims, we measured participant construal level and regulatory focus scores using standardized instruments—the Behavior Identification Form (BIF)[57] and the Regulatory Focus Questionnaire (RFQ)[58], respectively. The BIF determined if participants were of high or low construal level—referring to a preference for either "big picture" concepts or "detail-oriented" information, respectively. BIF scores range from 0 to 10; scores less than 5 represent a low construal and scores 5 or greater represent a high construal, based on the instrument developers' recommended score interpretation. The RFQ determined if participants were promotion- or prevention-focused—signifying whether participants were primarily motivated by the prospect of gaining "good" versus preventing "bad" outcomes, respectively. RFQ scores range from -4 to +4; scores less than 0 represent a prevention focus and scores 0 or greater represent a promotion focus. This method of interpreting RFQ scores is recommended by the instrument developer and has been used in several studies[59-61]. The four possible combinations of character traits (high construal/promotion focus; high construal/prevention focus; low construal/promotion focus; and low construal/prevention focus) represent the psychological traits represented by the advertisements we randomized participants to view.

Image Selection

To select images for our study, we used Google's search engine to conduct an image search for "lung cancer screening advertisement" and "lung cancer screening ad." We then downloaded the first 100 image results. We excluded images that did not have free-to-use licenses from our image search by choosing this setting from Google's "usage right" options. Each image was viewed by five individuals in our research group and independently characterized by its construal level and regulatory focus. There were 8 images where the group

agreed on both the construal level and regulatory focus of the advertisement. Of these, we selected four images to use in our study.

Study Deployment

We invited individuals to participate in our study over 14 weeks, between September and December 2018. After our initial invitation, every two weeks we sent email reminders to individuals that had not yet completed our study. We repeated this email reminder process until we went two weeks without obtaining additional participants. The study was completed using Qualtrics' online survey platform. In order to control for data quality, we prevented respondents from participating more than once by using internet browser-specific "cookies" that blocked multiple attempts from the same internet device or user account.

Statistical Analysis

We reported means with standard deviations (SD) or medians with interquartile ranges (IQR) for normally distributed and non-normally distributed continuous variables, respectively. Frequencies with binomial exact confidence intervals (CI) were calculated for categorical variables. Mean likelihood scores were compared using analysis of variance (ANOVA). We used Kruskal-Wallis tests to evaluate differences in medians. All statistical analysis was conducted using R (version 3.4.4.).

RESULTS:

Of the 240 individuals we invited to participate, 191 (79%) responded to our invitation and completed our study. Table 5 shows the demographic, clinical, and risk-factor information of

our participants. The median age was 60 years, the majority of participants were white and current smokers, had health insurance, at least a high school education, and income greater than $25,000 per year. Participants had a median 44 pack-year smoking history. Among former smokers, the median time since quitting was 6 years. We performed an analysis of the four image types, and across all demographic, clinical, and risk-factor variables there were no differences between groups (Table 5). We compared the demographic, clinical, and risk-factor variables of the 49 individuals who did not respond to our study invitation, to our 191 study participants. Non-responders had significantly lower rates of reported COPD (6% vs 22%, p=0.02), but were otherwise similar to participants in our study (Appendix F).

Overall, the mean likelihood of screening score was 2.7 (standard deviation [SD] $\pm$ 1.1). The image consistent with a high construal and promotion focus led to the greatest self-reported likelihood of screening, receiving the lowest mean score (2.2 $\pm$ 1.0, p=0.04). The high construal and prevention-focused image had the lowest likelihood of screening, with a mean score of 2.9 $\pm$ 1.0 (Table 6). Of those viewing the high construal and promotion-focused image, 26 participants (60%) reported being “likely” or “very likely” to undergo lung cancer screening. Among those viewing the high construal and prevention-focused image, 13 participants (30%) reported being likely to undergo screening.

Figure 1 shows the frequency of the four combinations of character traits in this population. High construal with a promotion focus was the most prevalent character trait combination with 77 participants (40%, 95% CI 33-48%) possessing these traits. Low construal with a prevention focus was the least prevalent trait combination, seen in only 33 participants (17%, 95% CI 12-23%).

DISCUSSION:

We found that advertisement images affect the likelihood of undergoing lung cancer screening. Images consistent with a high construal level trait and promotion focus result in greater likelihood of screening. In our population of individuals at high risk of lung cancer, the most prevalent character trait is high construal with a promotion focus.

The psychological theory underlying our findings suggests that images can influence behavior, however, it is unknown if the context in which these images are viewed modify this effect or not. Previous studies have found relationships between the effectiveness of health-related messages and construal level or regulatory focus[62-68]. However, participants in these studies differ from screen-eligible individuals in several important ways (e.g. lacking a history of long-term smoking and the high-risk of lung cancer seen in the screen-eligible population) and these differences may modify the findings of prior studies. Despite these differences, we found that images bearing specific character traits—high construal level and a promotion focus—influenced the behavior of our screen-eligible participants. In a population that is older and less healthy than those traditionally used to test psychological theory, images consistent with certain traits increase the likelihood of lung cancer screening participation.

Construal level and regulatory focus are two traits that have individually been shown to influence the persuasive of messages, however, combinations of these traits are infrequently studied—particularly in the context of health promotion. A few previous works have combined these traits and evaluated their effect on the persuasiveness of advertisements[56,68,69]. Of these, only one study has evaluated the combination of construal level and regulatory focus on the persuasiveness of health-related messages[68]. That study found advertisement images encouraging healthy diets were most persuasive when they were consistent with a high construal and

promotion focus. Our study shows—for the first time in a population of screen-eligible individuals—that health-related messages about lung cancer screening are most effective when using images that combine features consistent with a high construal level and promotion regulatory focus traits. One possible explanation for these consistent findings is that individuals' prefer to construe health-related messages at a high level and are motivated by the possibility of gaining better health. We provide additional empirical evidence that combining high construal level and promotion focus features increases the persuasiveness of health-related messages.

Theories predict that high construal/promotion focus or low construal/prevention focus will be the most prevalent traits in a general population; it is unknown if images consistent with these traits will be more persuasive in a population of screen-eligible individuals. The "fit from construal hypothesis" suggests that individuals with a high construal are more likely to be promotion-focused, while individuals with a low construal are more likely to be prevention-focused[56]. We found that individuals with high construal and a promotion focus were more prevalent than those with high construal and a prevention focus—supporting the fit from construal hypothesis. Interestingly, the relationship between low construal and regulatory focus did not align with the fit from construal hypothesis; among those with a low construal, prevention focus was less prevalent than promotion focus. One reason for this finding might be that the fit from construal hypothesis was developed from studies of a different population—individuals participating in psychological research. These findings suggest contextual factors may modify aspects of the interactions between construal level and regulatory focus in different populations.

This study has several limitations. We assumed the MTurk population is representative of high-risk individuals. Although there is no standard by which we can readily verify our

assumption of generalizability, we previously compared this population to the large pragmatic National Lung Screening Trial. Compared to that sample of 53,456 high-risk individuals, we found that the MTurk population had a greater proportion of women, current smokers, those with at least a high school education, American Indian or Alaska Natives, and those with a history of asbestos exposure. Additionally, there may be bias arising from our 21% non-responder rate. While we do not have information on the psychological character traits of non-responders, we can compare their demographic, clinical, and risk factors with those of responders. Although the only significant difference was a lower rate of COPD among non-responders, they appear to also have higher income and a greater proportion of women. If the observed differences are not due to chance, there are potentially important differences between responders and non-responders, if higher income women without COPD have a higher or lower likelihood of screening. Among responders, COPD status, income, and sex were not associated with likelihood of screening; while this does not prove a lack of bias from non-responders, we have no clear evidence that potential differences in demographics affect likelihood of screening. Another limitation is that participants' stated preference to participate in screening may differ from their revealed preference in a clinical setting. The accuracy of respondent-provided information also cannot be confirmed; we are relying on self-reported sociodemographic and clinical risk factors. Lastly, the images obtained from our internet search vary in numerous ways besides their construal level and regulatory focus. We could not control for other characteristics of these images (e.g. fonts, design, colors) or determine how they might affect likelihood of screening.

CONCLUSIONS:

In summary, our findings suggest that individualized messages may increase lung cancer screening participation. We provide additional empirical support that the combination of high construal and promotion focus features improves the persuasiveness of health-related messages. To overcome the potential issue of generalizability, health systems may sample their population to determine the most prevalent character trait then deploy messages consistent with those characteristics. This presents an opportunity to modify lung cancer screening participation using image advertisements.

ARTICLE 3: Construal Level, Regulatory Focus, and the Persuasiveness of Hepatitis C Screening Advertisement Images

INTRODUCTION:

Chronic hepatitis C virus (HCV) infection is a major risk factor for cirrhosis and hepatocellular carcinoma[70]. Complications of HCV infection remain the leading indication for liver transplantation in the United States[71]. There are approximately 3.9 million people infected with HCV in the U.S., and up to 85% are unaware of their HCV status[72]. Identifying and treating HCV infections prior to the onset of cirrhosis, cancer, or other complication is imperative to reducing the associated morbidity and mortality. It is estimated that early treatment of HCV-infected individuals could prevent over 320,000 deaths by the year 2060[73]. The majority of HCV-infected individuals are known to have been born between the years of 1945 and 1965[74]. It is theorized that these individuals became infected prior to the widespread adoption of infection control procedures such as screening blood and blood products—for this reason, the current recommendations by the Centers for Disease Control and Prevention (CDC) and the United States Preventive Services Task Force (USPSTF) is routine one-time HCV-screening of all individuals in this birth cohort[72,75]. Despite these recommendations, less than 13% of individuals in this cohort have been screened for HCV[76].

These low rates of screening exist even after large national media campaigns to raise awareness—such as the CDC's 2012 "Know More Hepatitis" campaign[77]. The factors underlying the effectiveness of this and other HCV screening media messages are not known. Psychological theories have identified various character traits as influential in decision making these theories suggest that health-related messages may be more persuasive when they align with an individual's character traits. For instance, a person who prefers to focus on the "forest" rather

than the "trees" (e.g. high construal level trait) and is motivated by a desire to prevent bad outcomes rather than gain good ones (e.g. prevention regulatory focus trait), appears to be more persuaded by health messages that mirror these characteristics[54-56]. It is unknown whether such theories apply to a cohort of HCV screen-eligible individuals, or what the distribution of such character traits are in this population.

Using Amazon's Mechanical Turk (MTurk) online crowdsourcing marketplace, we aim to test the effect of various HCV screening-related advertisement images (corresponding to four combinations of two character traits) on an HCV screen-eligible individual's stated willingness to screen (determined through web-based survey). Our secondary aim was to characterize the frequency and interplay of these four traits in this population.

METHODS:

Study Population

Our study population consisted of individuals eligible for HCV screening who were registered participants in the Amazon MTurk crowdsourcing marketplace between March and April 2019 who lived in the United States. MTurk is an online crowdsourcing recruitment tool for survey research[19-20]. HCV screen eligibility was defined by CDC and USPSTF birth cohort criteria (birth year 1945-1965). We first asked participants their birth year, then allowed those who fit the eligibility criteria to complete our full survey. We offered participants $2 as compensation. All study materials were approved by the University of Washington Institutional Review Board (STUDY00006771).

Study Design

Using a feature of the online survey platform Qualtrics, we randomized participants to view an HCV screening advertisement image consistent with one of four psychological traits; these traits were a combination of construal levels (high, low) and two types of regulatory focus (promotion, prevention). We then asked participants about their willingness to undergo HCV screening. Willingness was measured on a five-point Likert scale with 1 representing "very willing to screen" and 5 representing "very unwilling to screen."

Character Trait Determination

To determine the character traits of our participants, we measured construal level and regulatory focus using standardized instruments: the Behavior Identification Form (BIF)[57] and the Regulatory Focus Questionnaire (RFQ)[58]. The 10-item BIF and the 11-item RFQ measure construal level and regulatory focus, respectively. The BIF score, which ranges from 0 to 10, determined if participants were of high or low construal level—referring to a preference for either "big picture" concepts or "detail-oriented" information, respectively. BIF scores less than 5 represent a low construal while scores 5 or greater represent a high construal. The RFQ score, which ranges from -4 to +4, determined if participants were promotion- or prevention-focused—signifying whether participants were primarily motivated by the prospect of gaining "good" versus preventing "bad" outcomes, respectively. RFQ scores less than 0 represent a prevention focus while scores 0 or greater represent a promotion focus. The four combinations of character traits (high construal/promotion focus; high construal/prevention focus; low construal/promotion focus; and low construal/prevention focus) represent the psychological traits of the four image advertisements we randomized participants to view.

Image Selection

To select images for our study, we used Google's search engine to conduct image searches for "hepatitis c screening ad," "hepatitis c screening poster," "HCV screening ad," and "HCV screening poster." We then downloaded the first 20 image results that were advertisements for HCV screening. Using MTurk, we asked 100 HCV screen-eligible individuals to characterize the construal level and regulatory focus of each image by classifying them as either "big picture" or "little picture" and as "approaching good heath" or "avoiding illness." These 100 individuals were all excluded from taking our full survey. The four images most frequently classified as having one of the four combinations of traits (high construal/promotion focus; high construal/prevention focus; low construal/promotion focus; and low construal/prevention focus) were used in our study.

Statistical Analysis

We report means with standard deviations (SD) or medians with interquartile ranges (IQR) for normally distributed and non-normally distributed continuous variables, respectively. Frequencies with confidence intervals (CI) were calculated for categorical variables. Mean likelihood scores were compared using analysis of variance (ANOVA). We used Kruskal-Wallis tests to evaluate differences in medians. All statistical analysis was conducted using R (version 3.5.3).

RESULTS:

Of the 307 individuals who completed our study (median age 63 years, 68% of participants female), most were white (91%), had health insurance (91%), at least a high school education (96%), and income greater than $25,000 per year (73%) (Table 7).

Figure 2 shows the frequency of the four combinations of character traits in this population. High construal with a promotion focus was the most prevalent character trait combination with 122 participants (40%, 95% confidence interval [CI] 34-46%) possessing these traits. Low construal with a promotion focus and low construal with a prevention focus were the least prevalent trait combinations, each seen in only 50 participants (16%, 95% CI 12-21%). After being shown one of the four advertisement images, 194 (63%) reported being "willing" or "very willing", 172 (56%) were interested, and 144 (47%) were likely to undergo HCV screening.

The image consistent with a low construal and promotion focus led to the greatest amount of willingness to screen; 75% (95% CI 64-84%, p=0.04) of participants reported being willing to screen after viewing this image. The high construal, promotion-focused image resulted in the least amount of willingness to screen (54%, 95% CI 42-66%) (Table 8). Unlike "willingness" to screen, "interest in screening" and "likelihood of screening" did not vary significantly by image type (p=0.92, p=0.14 respectively). Interestingly, concordance between image characteristics and the character traits of the individual viewing the image did not result in a greater willingness to screen compared to non-concordant pairings (56% vs 66%, p=0.12).

Those reporting willingness to screen for HCV were more likely to have undergone other health maintenance activities, such as colon cancer screening (79% vs 63%, p<0.01), receive annual influenza vaccinations (65% vs 42%, p<0.01), and among women, have undergone breast cancer screening (96% vs 81%, p<0.01) compared to those reporting an unwillingness to screen

for HCV (Table 7). However, there was no correlation between individual character traits and participation in other health behaviors not requiring clinician input/orders. (Appendix H).

DISCUSSION:

In this randomized study of different visual communication approaches for HCV screening among a population at higher-risk for HCV, certain images did positively and negatively affect willingness to undergo HCV screening. Images consistent with a low construal and promotion focus resulted in the greatest willingness to screen, however, the most prevalent character trait in the population was high construal combined with a promotion focus. Interestingly, a match between the character traits of the individual and the characteristics of an image did not appear to be as important as the image itself. Similarly, willingness to screen for HCV was less related to individual character traits, and more correlated with other health maintenance behaviors. The selection of advertisement images that are low construal and promotion focus related to HCV screening and linking to other health maintenance behaviors may be important targets for future initiatives aimed at improving screening rates for HCV.

Most HCV-infected individuals are unaware of their infection and the majority are born between 1945 and 1965[72,77]. Although nationwide advertising campaigns have attempted to raise awareness of HCV screening among this high-risk population[77], few eligible individuals undergo screening[76]. Comparatively, rates for screening of other important conditions, such as colon cancer screening, are close to 60%[43]. This difference between the utilization rate of other health promotion activities and rates of HCV screening provides an opportunity to explore if the effectiveness of messaging around HCV screening can be improved. Effective messaging requires an understanding of communication science and cognitive psychology related to health

promotion. Numerous studies have found relationships between the effectiveness of health-related messages and the psychological constructs of construal or regulatory focus[62-68]. Construal level relates to a tendency to focus on the "forest" rather than the "trees" (e.g. high construal level trait). Regulatory focus refers to what motivates one's actions, such as a desire to prevent bad outcomes rather than gain good ones (e.g. prevention regulatory focus trait). Few studies have examined the combination of these two traits and the differential effectiveness of advertisements that tap into these characteristics[56,68,69]. While much of this research has focused on consumer advertising in non-healthcare related purchasing, there is increasing interest in adapting findings from the field of communication science to improve healthcare messaging, especially as it relates to health promotion. Health promotion messaging focused on construal level and regulatory focus has not been examined in HCV screening, an activity recommended for over 75 million individuals[78].

Our study shows that health-related messages in this population are most effective when they combine a low construal level and promotion regulatory focus. One other study has evaluated combinations of construal level and regulatory focus in health-related messages[68]. In that study, advertisement images promoting healthy diets were found to be most effective when of a high construal and promotion focus, compared to other combinations of construal and regulatory focus. One possible explanation why that study found high construal messages—rather than low construal messages as we found for HCV screening—most effective, is that the concept of healthy eating is more familiar to audiences than screening for asymptomatic HCV infections. Individuals might prefer information on HCV screening to be provided in more detail, or at a lower level, given their relative unfamiliarity with the subject. Interestingly, of the 16 HCV screening advertisement images used in the CDC's "Know More Hepatitis Campaign," we

found that only 19% were of a low construal and 25% were predominantly promotion-focused. This knowledge may be used to design more effective image advertisements that increase HCV screening participation.

The "fit from construal hypothesis" described by Lee et al.[56] suggests that individuals with a high construal are more likely to be promotion-focused, while individuals with a low construal are more likely to be prevention-focused, however, the actual prevalence of these trait combinations has not been reported in prior studies. In our study, high construal with a promotion focus was more prevalent (40%) than high construal with a prevention focus (28%)—which supports the fit from construal hypothesis. However, low construal with a prevention focus was not more prevalent (16%) than low construal with a promotion focus (16%). One potential reason for the difference between our findings and the fit from construal hypothesis is that this hypothesis was developed in a different population—individuals participating in psychology research. Individuals at high-risk for HCV may differ from psychology research participants in ways that affect the interactions between construal and regulatory focus.

Participants in our study were more likely to report a willingness to screen for HCV if they self-reported colon cancer screening (79% vs 63%), breast cancer screening (96% vs 81%), or annual influenza vaccination (65% vs 42%), compared to those who did not report these. One reason for this finding might be that individuals view HCV screening as similar to cancer screenings or other health maintenance behaviors. Interestingly, there was no association between regularly flossing teeth and willingness to screen ($p=0.49$). Unlike cancer screening or influenza vaccination, flossing teeth is not a behavior recommended or required by physicians for health maintenance. It also requires frequent/daily repeating to achieve the potential benefits compared to the more episodic or one-time screening activities. This suggests that HCV

screening is perceived as similar to other physician-recommended health maintenance behaviors and this too may be an opportunity to "bundle" promotion of HCV with other health maintenance.

This study has important limitations. We do not know if the MTurk population was representative of individuals born between 1945 and 1965. While we have no way of verifying assumptions about this population, we know from other studies that found when compared to the U.S. population, MTurk participants are less racially diverse, more highly educated, and proportionally include more women[21]. Another limitation is that we could not control or standardize how construal and regulatory focus were depicted in the images we obtained from our internet search. Additionally, these images varied in several ways besides their construal level and regulatory focus; we could not control for other aspects of these images (e.g. fonts, design, colors) or determine how they might affect willingness to screen. Lastly, participants' stated preference to screen in an online survey may differ from their revealed preference in a clinical setting.

CONCLUSIONS:

In summary, our findings suggest that intentional selection of advertising images that are low construal and promotion-focused may increase HCV screening participation. Screen-eligible individuals appear to respond to visual messages that focus on the details of HCV screening while highlighting the potential benefits compared to higher level and prevention focused approaches. Additionally, linking messaging about HCV screening and other physician-recommended health maintenance or screening behaviors might improve the appeal of these

messages. Health system leaders and public health campaigners can use this knowledge to design more effective HCV screening-related messages for high-risk individuals.

CONCLUSION:

We explored two diseases that have a screening test associated with them and found there is a need for improving our understanding of behavioral psychology and the role it plays in communicating preventive health behaviors. Our final two studies evaluate how we can communicate health-related messages better. We learned that most individuals are promotion-focused, however, a significant proportion of existing health messages regarding lung cancer and HCV feature a prevention focus. This suggests that there may be a disconnect between what individuals prefer in health-related messages and the characteristics of currently available messages.

In these two disease at least, future efforts should focus on providing promotion-focused messages. We provide additional evidence supporting existing communication science theory while applying it in novel clinical contexts. Our studies reveal that in both acute and chronic conditions, how we communicate information about screening matters. The interface of psychology and communication science in this era of advertising provides new opportunities for collaboration in healthcare. We provide a few examples of how such a multidisciplinary approach to improving screening can lead to greater participation by individuals at risk for these conditions.

REFERENCES:

1. Murphy SL, Xu J, Kochanek KD, Curtin SC, Arias E. Deaths: final data for 2015. Natl Vital Stat Rep 2017;66(6):1–75.
2. CDC. Summary health statistics: National Health Interview Survey, 2016. Atlanta, GA: US Department of Health and Human Services, CDC;2016.
3. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. CA Cancer J Clin. 2019;69(1):7–34.
4. The National Lung Screening Trial Research Team. Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening. N Engl J Med. 2011;365(5):395–409.
5. Jemal A, Fedewa SA. Lung cancer screening with low-dose computed tomography in the United States—2010 to 2015. JAMA Oncology. 2017;3(9):1278–1281.
6. Pham D, Bhandari S, Oechsli M, Pinkston C, Kloecker G. Lung Cancer Screening Rates: Data from the Lung Cancer Screening Registry [Abstract]. J Clin Oncol 2018;36(Suppl):6504.
7. Carter-Harris L, Davis LL, Rawl SM. Lung Cancer Screening Participation: Developing a Conceptual Model to Guide Research. Res Theory Nurs Pract. 2016;30(4):333–352.
8. Mishra SI, Sussman AL, Murrietta AM, et al. Patient perspectives on low-dose computed tomography for lung cancer screening, New Mexico, 2014. Prev Chronic Dis. 2014;13(E108):1–10.
9. Carter-Harris L, Ceppa DP, Hanna N, Rawl SM. Lung Cancer Screening: What Do Long-term Smokers Know and Believe? Health Expect. 2015;20(1):59-68.
10. Crothers K, Kross EK, Reisch LM, et al. Patients' Attitudes Regarding Lung Cancer Screening and Decision Aids. A Survey and Focus Group Study. Ann Am Thorac Soc. 2016;13(11):1992-2001.
11. Cardarelli R, Roper KL, Cardarelli K, et al. Identifying community perspectives for a lung cancer screening awareness campaign in Appalachia Kentucky: the Terminate Lung Cancer (TLC) Study. J Cancer Educ. 2017;32(1):125–134.
12. Simmons VN, Gray JE, Schabath MB, Wilson LE, Quinn GP. High-risk community and primary care providers knowledge about and barriers to low-dose computed topography lung cancer screening. Lung Cancer 2017;106:42–49.
13. Roth JA, Carter-Harris L, Brandzel S, Buist DSM, Wernli KJ. A qualitative study exploring patient motivations for screening for lung cancer. Guo NL, ed. PLoS ONE. 2018;13(7):e0196758.
14. Tanner NT, Egede LE, Shamblin C, et al. Attitudes and beliefs toward lung cancer screening among US veterans. Chest. 2013;144:1783–1787.
15. Delmerico J, Hyland A, Celestino P, et al. Patient willingness and barriers to receiving a CT scan for lung cancer screening. Lung Cancer. 2014;84(3):307-309.
16. Jonnalagadda S, Bergamo C, Lin JJ, Lurslurchachai L, Diefenbach M, Smith C, Nelson JE, Wisnivesky JP. Beliefs and attitudes about lung cancer screening among smokers. Lung Cancer. 2012;77(3):526–31.
17. Lillie SE, Fu SS, Fabbrini AE, et al. What factors do patients consider most important in making lung cancer screening decisions? Findings from a demonstration project conducted in the Veterans Health Administration. Lung Cancer. 2017;104:38–44.

18. Silvestri GA, Nietert PJ, Zoller J, Carter C, Bradford D. Attitudes towards screening for lung cancer among smokers and their non-smoking counterparts. Thorax. 2007;62(2):126-130.
19. Buhrmester M, Kwang T, Gosling S. Amazon's Mechanical Turk: A New Source of Inexpensive, Yet High-Quality, Data? Perspectives On Psychological Science. 2011;6(1):3–5.
20. Simons DJ, Chabris CF. Common (Mis)Beliefs about Memory: A Replication and Comparison of Telephone and Mechanical Turk Survey Methods. PLoS ONE. 2012;7(12):e51876.
21. Bartek MA, Truitt AR, Widmer-Rodriguez S, et al. The Promise and Pitfalls of Using Crowdsourcing in Research Prioritization for Back Pain: Cross-Sectional Surveys. J Med Internet Res. 2017;19(10):e341.
22. Farrell L, Brennan L, Lanham M. Knowledge, Attitudes, and Perceptions of Infertility: A National Survey. Fertility and Sterility. 2018;110(4):e6.
23. Naylor W, Parsons ECM. An Online Survey of Public Knowledge, Attitudes, and Perceptions Toward Whales and Dolphins, and Their Conservation. Frontiers in Marine Science. 2018;5:153.
24. Taylor LE, Antshel KM. Factors Associated with Parental Treatment Attitudes and Information-Seeking Behaviors for Childhood ADHD. Journal of Attention Disorders. 2019;108705471882173.
25. U.S. Preventive Services Task Force. Lung cancer: Screening. http://www.uspreventiveservicestaskforce.org/uspstf/uspslung.htm. Accessed January 17, 2018.
26. Damschroder L, Aron D, et al. Fostering Implementation of Health Services Research Findings Into Practice: A Consolidated Framework for Advancing Implementation Science. Implementation Science. 2009;4(1),50.
27. CFIR. The Consolidated Framework for Implementation Research. https://cfirguide.org. Accessed January 18, 2018.
28. Ahn VL, Blum M, Langford J. Telling Humans and Computers Apart Automatically. Communications of the ACM. 2004;47(2),56–60.
29. Wood, D.E. et al. Lung Cancer Screening, Version 3.2018, NCCN Clinical Practice Guidelines in Oncology. Journal of the National Comprehensive Cancer Network: JNCCN. 2018;16(4),412–441.
30. Percac-Lima S, Ashburner JM, Atlas SJ, et al. Beliefs about lung cancer, knowledge, and interest in lung screening among community health center patients. Park Journal of Clinical Oncology. 2016;34(15): e13051-e13051.
31. Carter-Harris L, Slaven JE Jr, Monahan PO, Shedd-Steele R, Hanna N, Rawl SM. Understanding lung cancer screening behavior: racial, gender, and geographic differences among Indiana long-term smokers. Prev Med Rep 2018;10:49–54.
32. Cataldo, J. High-risk older smokers' perceptions, attitudes, and beliefs about lung cancer screening. Cancer Medicine. 2016;5(4),753–759.
33. Flynn AE, Peters MJ, Morgan LC. Attitudes towards Lung Cancer Screening in an Australian High-Risk Population. Lung Cancer Int. 2013;2013:789057.
34. Bui NC, Lee YY, Suh M, et al. Beliefs and Intentions to Undergo Lung Cancer Screening among Korean Males. Cancer Res Treat. 2017;50(4):1096-1105.

35. Gressard L, DeGroff AS, Richards TB, et al. A Qualitative Analysis of Smokers' Perceptions about Lung Cancer Screening. BMC Public Health. 2017;17(1):589.
36. Smits SE, McCutchan GM, Hanson JA, Brain KE. Attitudes towards lung cancer screening in a population sample. Health Expect. 2018;21(6):1150-1158.
37. Couper MP, Singer E, Levin CA, et al. Use of the Internet and Ratings of Information Sources for Medical Decisions: Results from the DECISIONS Survey. Medical Decision Making. 2010;30(5_suppl):106–114.
38. Sak G, Schulz PJ. Exploring Health Information-Seeking Preferences of Older Adults With Hypertension: Quasi-Experimental Design. JMIR Cardio. 2018;2(1):E12.
39. Quaife SL, Marlow LA, McEwen A, Janes SM, Wardle J. Attitudes towards lung cancer screening in socioeconomically deprived and heavy smoking communities: Informing screening communication. Health Expectations. 2017;20(4):563–573.
40. Almadi MA, Mosli MH, Bohlega MS, Al Essa MA, AlDohan MS, Alabdallatif TA, et al. Effect of public knowledge, attitudes, and behavior on willingness to undergo colorectal cancer screening using the health belief model. Saudi J Gastroenterol. 2015;21:71–7.
41. Carter-Harris L, Tan AS, Salloum RG, Young-Wolff KC. Patient-Provider Discussions about Lung Cancer Screening Pre- and Post-Guidelines: Health Information National Trends Survey (HINTS). Patient education and counseling. 2016;99(11):1772-1777.
42. Tammemagi M, Church T, et al. Evaluation of the Lung Cancer Risks at which to Screen Ever- and Never-Smokers: Screening Rules Applied to the PLCO and NLST Cohorts. PLoS Medicine. 2014;11(12).
43. White A, Thompson TD, White MC, et al. Cancer Screening Test Use — United States, 2015. MMWR Morb Mortal Wkly Rep 2017;66:201–206.
44. Peer E, Vosgerau J, Acquisti A. Reputation as a sufficient condition for data quality on Amazon Mechanical Turk. Behav Res Methods. 2013;46(4):1023-1031.
45. Detterbeck FC, Mazzone PJ, Naidich DP, Bach PB. Screening for Lung Cancer: Diagnosis and Management of Lung Cancer, 3rd ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2013;143(5Suppl):e78S-e92S.
46. Wender R, Fontham E, Barrera E, et. al. American Cancer Society Lung Cancer Screening Guidelines. CA Cancer J Clin. 2013;63(2):107–117.
47. Bach PB, Mirkin JN, Oliver TK, et al. Benefits and harms of CT screening for lung cancer: a systematic review. JAMA. 2012;307:2418-29.
48. The Centers for Medicare & Medicaid Services. Decision Memo for Screening for Lung Cancer with Low Dose Computed Tomography (LDCT). https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=274. Accessed January 10, 2018.
49. De Koning H, Van Der Aalst C, Ten Haaf K, et al. Effects of Volume CT Lung Cancer Screening: Mortality Results of the Nelson Randomized-controlled Population Based Trial. 2018 World Conference on Lung Cancer. Abstract PL02.05. Presented September 25, 2018.
50. Lewis JA, Petty WJ, Tooze JA, et al. Low-Dose CT Lung Cancer Screening Practices and Attitudes among Primary Care Providers at an Academic Medical Center. Cancer Epidemiol Biomarkers Prev. 2015;24(4):664–670.

51. Cardarelli R, Reese D, Roper KL, et al. Terminate Lung Cancer (TLC) Study - A mixed-methods population approach to increase lung cancer screening awareness and low-dose computed tomography in Eastern Kentucky. Cancer epidemiology. 2017;46:1-8.
52. Jessup DL, Glover Iv M, Daye D, et al. Implementation of Digital Awareness Strategies to Engage Patients and Providers in a Lung Cancer Screening Program: Retrospective Study. J Med Internet Res. 2018;20(2):e52.
53. Lung Cancer Alliance. About Screening. 2018. http://lungcanceralliance.org/risk-early-detection/about-screenings.
54. Han D, Duhachek A, Agrawal N. Coping and construal level matching drives health message effectiveness via response efficacy or self-efficacy enhancement. Journal of Consumer Research. 2016;43(3):429-447.
55. Keller P. Regulatory Focus and Efficacy of Health Messages. Journal of Consumer Research. 2006;33(1):109-114.
56. Lee AY, Keller PA, Sternthal B. Value from Regulatory Construal Fit: The Persuasive Impact of Fit Between Consumer Goals and Message Concreteness. J Consum Res. 2010;36(5):735–747.
57. Vallacher RR, Wegner, DM. Levels of Personal Agency: Individual Variation in Action Identification. Journal of Personality and Social Psychology. 1989;57:660–671.
58. Higgins ET, Friedman R, Harlow RE, et al. Achievement Orientations from Subjective Histories of Success: Promotion Pride Versus Prevention Pride. European Journal of Social Psychology. 2001;31(1):3–23.
59. Camacho CJ, Higgins ET, Luger L. Moral Value Transfer from Regulatory Fit: What Feels Right Is Right and What Feels Wrong Is Wrong. Journal of Personality and Social Psychology. 2003;84(3):498–510.
60. Cesario J, Higgins ET. Making Message Recipients "Feel Right": How Nonverbal Cues Can Increase Persuasion. Psychological Science. 2008;19(5):415–420.
61. Molden DC, Higgins ET. Categorization under Uncertainty: Resolving Vagueness and Ambiguity with Eager Versus Vigilant Strategies. Social Cognition. 2004;22(2):248–277.
62. Higgins ET. Making a Good Decision: Value from Fit. Am Psychol. 2000;55(11):1217–1230.
63. Keller J, Bless H. Regulatory Fit and Cognitive Performance: The Interactive Effect of Chronic and Situationally Induced Self-regulatory Mechanisms on Test Performance. Eur J Soc Psychol. 2006;36(3):393–405.
64. Uskul AK, Sherman DK, Fitzgibbon J. The Cultural Congruency Effect: Culture, Regulatory Focus, and the Effectiveness of Gain- Vs. Loss-framed Health Messages. J Exp Soc Psychol. 2009;45:535–541.
65. Kees J, Burton S, Tangari AH. The Impact of Regulatory Focus, Temporal Orientation, and Fit on Consumer Responses to Health-related Advertising. Journal of Advertising. 2010;39:19–34.
66. Ronteltap A, Sijtsema SJ, Dagevos H, de Winter MA. Construal Levels of Healthy Eating. Exploring Consumers' Interpretation of Health in the Food Context. Appetite. 2012;59(2):333–340.
67. Peng J, He F, Zhang Y, Liu Q, Miao D, Xiao W. Differences in Simulated Doctor and Patient Medical Decision Making: A Construal Level Perspective. PLoS One. 2013;8(11):e79181.

68. Lin CY. Promote Health or Prevent Disease? The Effects of Health-related Advertising on Eating Behavior Intention. Int J Environ Res Public Health. 2015;12(4):3517–3534.
69. Chun S, Youn HS. The Effects of Construal Level and Regulatory Focus on the Attitude toward Financial Products. Journal of the Korean Operations Research and Management Science Society. 2014;39(1):69–81.
70. Westbrook RH, Dusheiko G. Natural History of Hepatitis C. Journal of Hepatology 2014; 61(1 Suppl):S58–68.
71. Kim WR, Lake JR, Smith JM, et al. Liver. American Journal of Transplantation: Official Journal of the American Society of Transplantation and the American Society of Transplant Surgeons 2016; 16 Suppl 2:69–98.
72. Smith BD, Morgan RL, Beckett GA, et al. Recommendations for the Identification of Chronic Hepatitis C Virus Infection Among Persons Born During 1945–1965. MMWR Recomm Rep. 2012;61(RR-4):1–32.
73. Rein DB, Smith BD, Wittenborn JS, et al. The Cost-Effectiveness of Birth-Cohort Screening for Hepatitis C Antibody in U.S. Primary Care Settings. Ann Intern Med. 2012;156(4):263-270.
74. Armstrong GL, Wasley A, Simard EP, et al. The Prevalence of Hepatitis C Virus Infection in the United States, 1999 through 2002. Ann Intern Med. 2006;144:705–714.
75. Moyer VA and the US Preventive Services Task Force. Screening for Hepatitis C Virus Infection in Adults: U.S. Preventive Services Task Force Recommendation Statement. Ann Intern Med. 2013;159(5):349-57.
76. Kasting ML, Giuliano AR, Reich RR, et al. Hepatitis C Virus Screening Trends: Serial Cross-Sectional Analysis of the National Health Interview Survey Population, 2013–2015. Cancer Epidemiol Biomarkers Prev. 2018;27(4):1–11.
77. Jorgensen C, Carnes CA, Downs A. "Know More Hepatitis:" CDC's National Education Campaign to Increase Hepatitis C Testing among People Born Between 1945 and 1965. Public Health Reports. 2016;131(Suppl 2):29-34.
78. U.S. Census Bureau, Population Division. Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipios: April 1, 2010 to July 1, 2014, Population Division. 2015.
79. Denniston MM, Klevens RM, McQuillan GM, Jiles RB. Awareness of Infection, Knowledge of Hepatitis C, and Medical Follow-Up Among Individuals Testing Positive for Hepatitis C: National Health and Nutrition Examination Survey 2001-2008. Hepatology. 2012;55(6):1652–1661.
80. Volk ML, Tocco R, Saini S, Lok AS. Public Health Impact of Antiviral Therapy for Hepatitis C in the United States. Hepatology. 2009;50:1750–5.

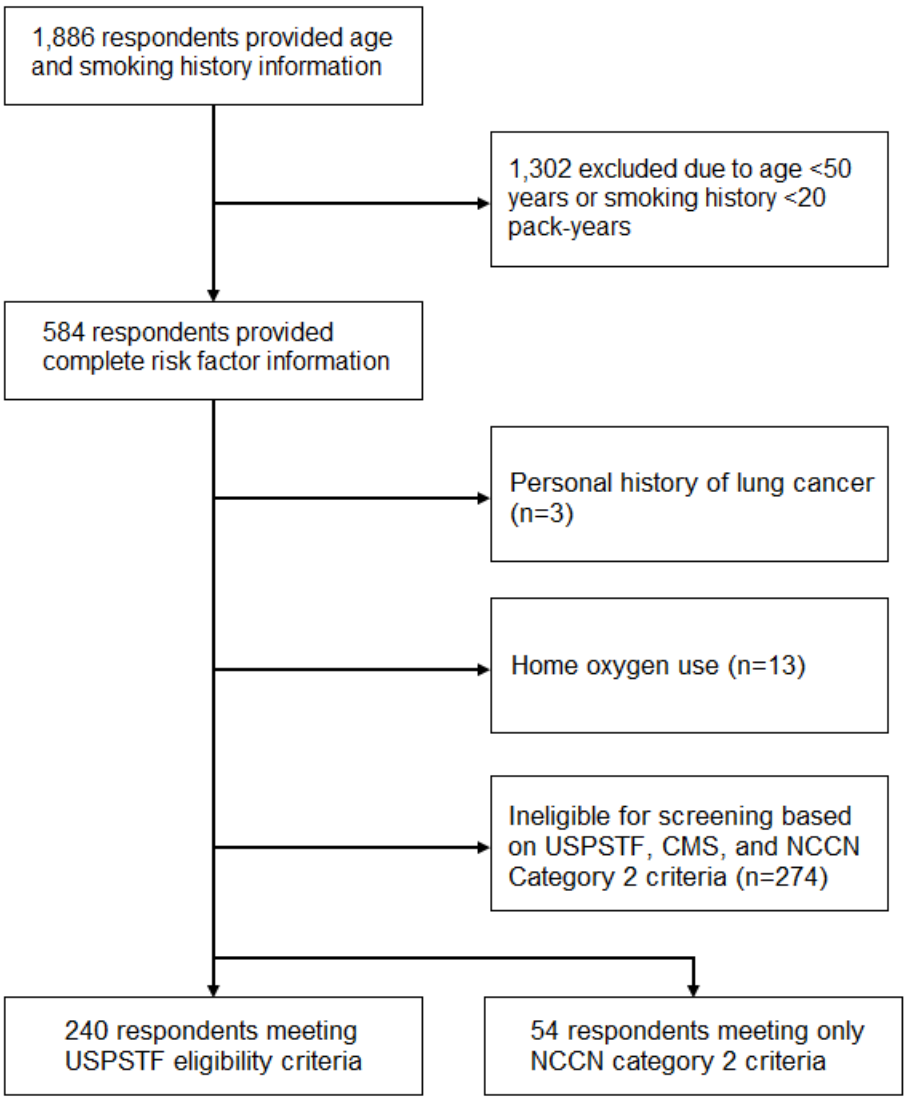


Figure 1. Flowchart for Inclusion and Analysis of Mechanical Turk (MTurk) Respondents
United States Preventive Services Task Force (USPSTF); Centers for Medicare & Medicaid Services (CMS); National Comprehensive Cancer Network NCCN)

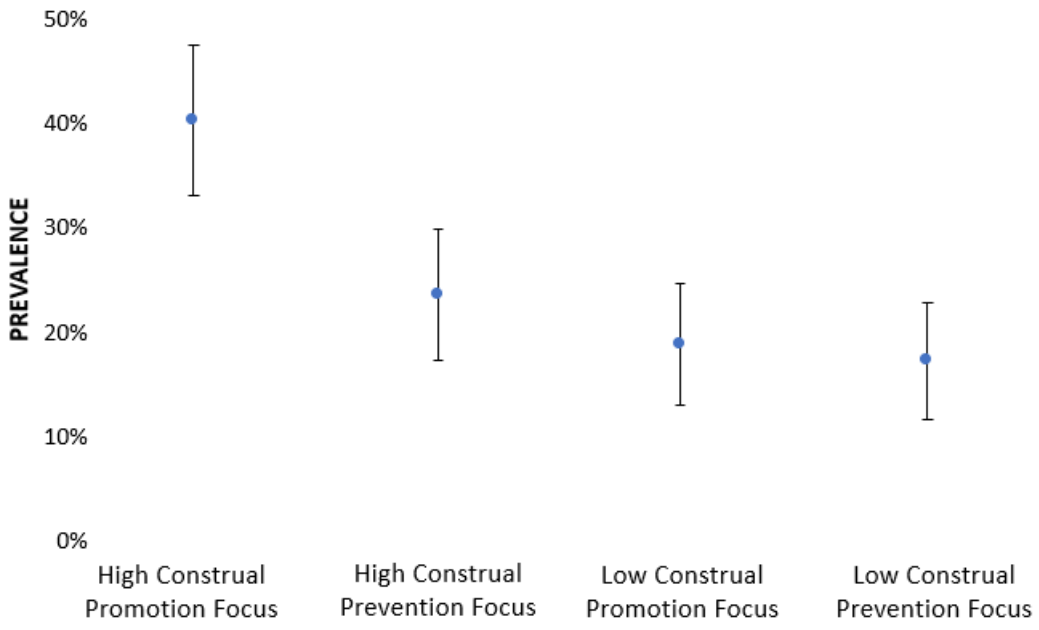
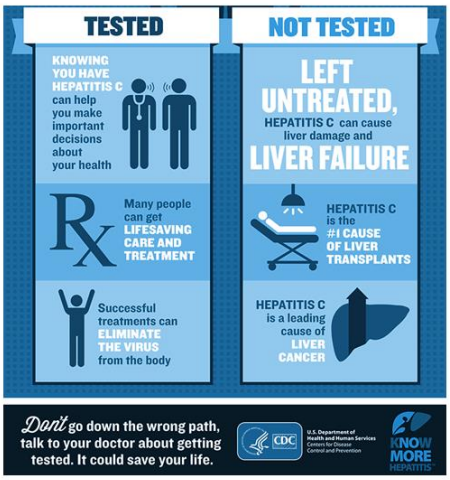


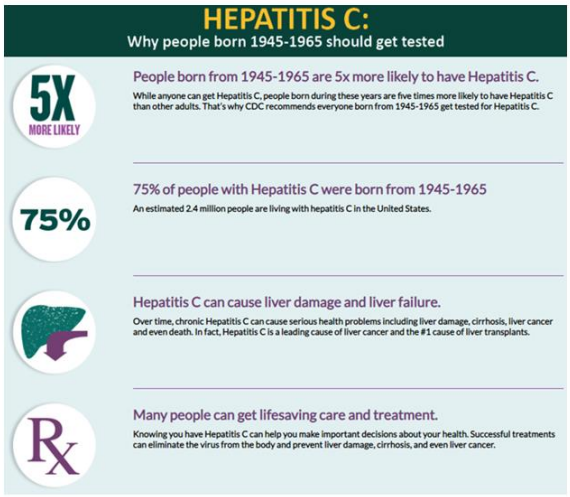
Figure 2. Character Traits of Lung Cancer Screen-Eligible Participants

Participants' character traits as assessed by the Behavioral Identification Form and Regulatory Focus Questionnaire. Error bars represent 95% confidence intervals.

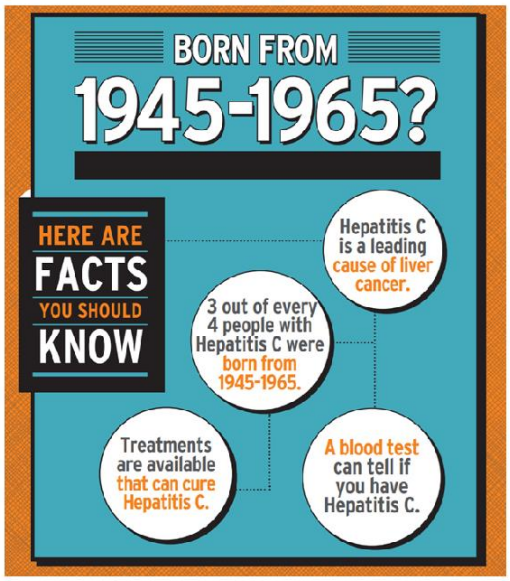
High construal, promotion focus



Low construal, promotion focus



High construal, prevention focus



Low construal, prevention focus

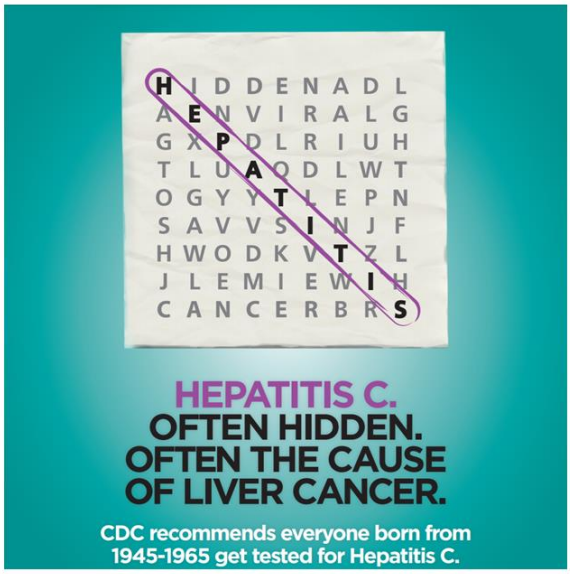


Figure 3. Hepatitis C Virus (HCV) Screening Image Advertisements

The high construal promotion focus image describes the big picture around HCV screening and focuses on potential benefits, such as early-detection and eliminating HCV. The low construal prevention focus image provides detailed information on HCV screening with a focus on the benefits of treatment. The high construal prevention focus image provides brief facts on HCV but mentions liver cancer first—at the top of the image—while treatment and cure of HCV is only mentioned near the bottom. The low construal prevention focus image hides the word "hepatitis" in a word search puzzle that details several features of HCV such as the fact that it is "hidden," "viral," affects the "liver," and can cause "cancer," without mention of potential benefits of screening.

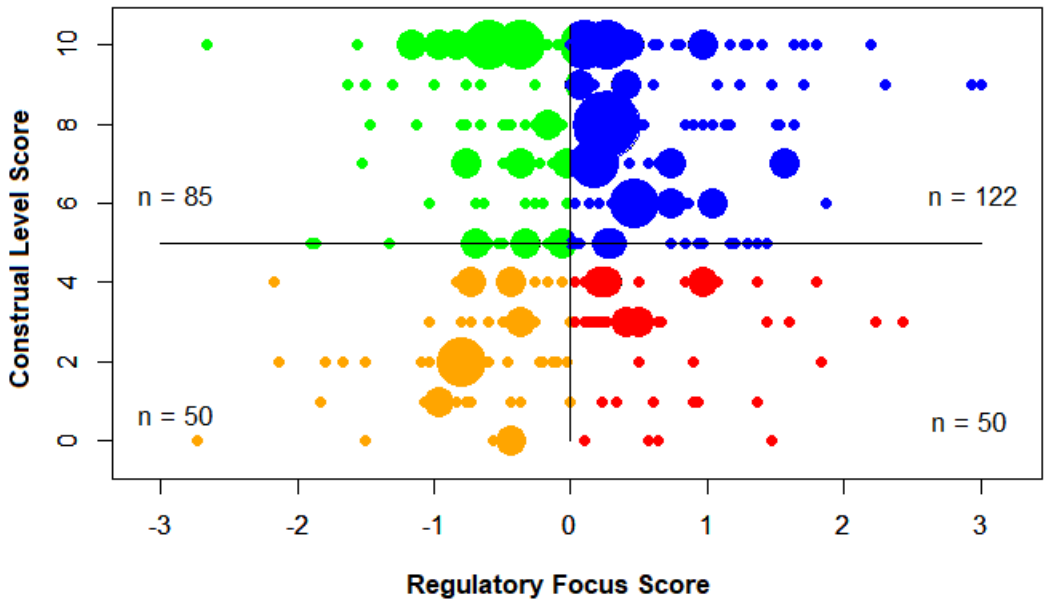


Figure 4. Character Traits of Hepatitis C Virus Screen-Eligible Participants

Participants' character traits as assessed by the Behavioral Identification Form and Regulatory Focus Questionnaire. Blue dots = high construal, promotion focus; green dots = high construal prevention focus; orange dots = low construal, prevention focus; red dots = low construal, promotion focus.

Table 1. MTurk Respondent Characteristics

	MTurk Respondents Meeting USPSTF Criteria (n=240) n (%, IQR)	MTurk Respondents Meeting Only NCCN Category 2 Criteria (n=54) n (%, IQR)
Median Age	60 (7)	60 (13)
Women	173 (72%)	23 (43%)
Race		
White	219 (91%)	47 (87%)
American Indian/Alaska Native	4 (1.7%)	4 (7.4%)
Asian	2 (0.4%)	0 (0%)
Native Hawaiian/Pacific Islander	0 (0%)	0 (0%)
Black	9 (3.7%)	3 (5.6%)
Other	6 (2.5%)	0 (0%)
Hispanic	4 (1.7%)	1 (1.9%)
Highest education		
Less than high school	5 (2.1%)	1 (1.9%)
High school graduate/GED	37 (15%)	14 (26%)
Post-high school training, excluding college	57 (24%)	15 (28%)
Associate's degree or some college	80 (33%)	9 (17%)
Bachelor's degree	44 (18%)	12 (22%)
Graduate school	17 (7.0%)	3 (5.6%)
BMI		
Median	26 (7)	25 (9)
Current Smoker	148 (62%)	23 (57%)
Pack-years		
Median	42 (12)	40 (33)
Years Quit*		
Median	5 (8)	19 (23)
Prior malignancy (excluding lung cancer, BCC or	7 (2.9%)	9 (17%)

SCC)		
Chronic pulmonary disease		
Chronic bronchitis/emphysema	41 (17%)	22 (41%)
Pulmonary fibrosis	1 (0.4%)	2 (3.7%)
Exposures		
Silica	7 (2.9%)	0 (0%)
Asbestos	41 (17%)	10 (19%)
Family history of lung cancer	60 (25%)	24 (44%)
Insurance		
Employer-based commercial	83 (35%)	11 (20%)
Non-employer-based commercial	29 (12%)	2 (3.7%)
Medicare	55 (2%)	20 (37%)
Medicaid/other state program	26 (11%)	10 (19%)
TRICARE/VA/Military	13 (6.3%)	3 (5.6%)
Alaska Native/Indian/Tribal Health Services	0 (0%)	0 (0%)
Other	2 (0.8%)	2 (3.7%)
None	28 (12%)	6 (11%)
Income (%)		
<$25,000	67 (28%)	14 (26%)
$25,000-$49,999	75 (3%)	24 (44%)
$50,000-$74,999	52 (22%)	8 (15%)
$75,000-$99,999	26 (11%)	4 (7.4%)
$100,000-$149,999	13 (5.4%)	3 (5.6%)
$150,000-$199,999	2 (0.8%)	1 (1.9%)
≥$200,000	0 (0%)	0 (0%)
Decline to answer	5 (2.1%)	0 (0%)

*Calculated among former smokers (n=92)
Mechanical Turk (MTurk)
United States Preventive Services Task Force (USPSTF)
National Comprehensive Cancer Network NCCN)
Interquartile range (IQR)
Body-mass index (BMI)
General Education Development (GED)
Basal cell carcinoma (BCC)
Squamous cell carcinoma (SCC)
Veterans' Affairs (VA)

Table 2. Knowledge, Attitudes, and Beliefs

	MTurk Respondents Meeting USPSTF Criteria (n=240) % [95% CI]	Respondents Meeting Only NCCN Category 2 Criteria (n=54) % [95% CI]
Knowledge		
Responded "there is a test to screen for lung cancer"	44 [37-50]	41 [28-55]
Correctly identified LDCT as the lung cancer screening test*	35 [26-45]	36 [17-59]
Attitudes		
Willing to undergo lung cancer screening	69 [63-75]	72 [58-84]
Beliefs		
Believe that early-detection of cancer saves lives	89 [85-93]	96 [87-100]
Believe that early-detection of lung cancer saves lives	93 [89-96]	98 [90-100]
Believe they are at high-risk for lung cancer	69 [62-74]	56 [41-69]

Mechanical Turk (MTurk)
United States Preventive Services Task Force (USPSTF)
National Comprehensive Cancer Network (NCCN)
Confidence interval (CI)
Low-dose computed tomography (LDCT)
*Proportion calculated among individuals who responded there is a test to screen for lung cancer

Table 3. Relationship Between Willingness to Screen and Perceived Risk of Lung Cancer and Efficacy of Screening Among Respondents Meeting USPSTF Criteria for High Risk

	Unwilling to be screened (n = 6) n (%)	Want more information prior to deciding on screening (n = 69) n (%)	Willing to be screened (n = 165) n (%)	p-Value
Belief that one is at high risk of lung cancer	2 (33)	41 (59)	121 (73)	0.02
Belief in the efficacy of lung cancer screening	1 (17)	61 (88)	160 (97)	<0.01

United States Preventive Services Task Force (USPSTF)

Table 4. Preferred Method of Learning about Lung Cancer Screening Among Respondents Meeting USPSTF Criteria

Learning Method	Mean Rank*	SD
Primary healthcare provider	1.5	1.3
Electronic health record message	3.3	1.5
Notification in the mail	4.1	1.3
Local news segment or television special	4.3	1.5
Phone call	4.5	1.8
Magazine/newspaper article	4.7	1.7
Social media (e.g. Facebook, Twitter, Instagram)	6.0	1.6

United States Preventive Services Task Force (USPSTF)
Standard deviation (SD)
*1 = most preferred, 7 = least preferred

Table 5. MTurk Participant Characteristics by Image Type

Image type	All Participants (n=191)	High construal, Promotion focus (n=43)	High construal, Prevention focus (n=43)	Low construal, Promotion focus (n=49)	Low construal, Prevention focus (n=56)	p-Value
	n (%, IQR)	n (%, IQR)	n (%, IQR)	n (%, IQR)	n (%, IQR)	
Age						
Median	60 (7)	60 (5)	59 (5)	60 (7)	61 (8)	0.51
Women	132 (69%)	29 (67%)	30 (70%)	34 (69%)	39 (70%)	0.99
Race						
White	174 (91%)	39 (91%)	39 (91%)	46 (94%)	50 (89%)	0.60
American Indian/Alaska Native	2 (1.0%)	1 (2.3%)	0 (0.0%)	0 (0.0%)	1 (1.8%)	
Asian	2 (1.0%)	0 (0.0%)	0 (0.0%)	1 (2.0%)	1 (1.8%)	
Native Hawaiian/Pacific Islander	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Black	8 (4.2%)	3 (7.0%)	2 (4.7%)	2 (4.1%)	1 (1.8%)	
Other	6 (3.1%)	0 (0.0%)	2 (4.7%)	0 (0.0%)	3 (5.4%)	
Hispanic	3 (1.6%)	0 (0.0%)	0 (0.0%)	1 (2.0%)	2 (3.6%)	0.62
Highest education						
Less than high school	4 (2.1%)	2 (4.7%)	1 (2.3%)	1 (2.0%)	0 (0.0%)	0.47
High school graduate/GED	26 (14%)	6 (14%)	7 (16%)	6 (12%)	7 (13%)	
Post-high school training, excluding college	46 (24%)	11 (26%)	13 (30%)	7 (14%)	15 (27%)	
Associate's degree or some college	65 (34%)	19 (44%)	12 (28%)	18 (37%)	16 (29%)	
Bachelor's degree	36 (18%)	4 (9.3%)	9 (21%)	11 (22%)	12 (21%)	
Graduate school	14 (7.3%)	1 (2.3%)	1 (2.3%)	6 (12%)	6 (11%)	
BMI						
Median	27 (7)	28 (5)	27 (5)	26 (7)	25 (7)	0.07
Current Smoker	114 (60%)	29 (67%)	26 (61%)	33 (67%)	26 (46%)	0.09
Pack-years						
Median	44 (13)	45 (18)	40 (14)	44 (20)	45 (12)	0.06

Years Quit*						
Median	6 (8)	4 (6)	4 (11)	10 (5)	6 (7)	0.19
Prior malignancy (excluding BCC or SCC)	8 (4.2%)	3 (7.0%)	0 (0.0%)	1 (2.0%)	4 (7.1%)	0.21
Chronic pulmonary disease						
Chronic bronchitis/emphysema	41 (22%)	15 (35%)	7 (16%)	9 (18%)	10 (18%)	0.15
Pulmonary fibrosis	2 (1.0%)	0 (0.0%)	0 (0.0%)	2 (4.1%)	0 (0.0%)	0.16
Exposures						
Silica	6 (3.1%)	1 (2.3%)	3 (7.0%)	1 (2.0%)	1 (1.8%)	0.61
Asbestos	31 (16%)	7 (16%)	5 (12%)	13 (27%)	6 (11%)	0.12
Family history of lung cancer	47 (25%)	10 (23%)	13 (30%)	13 (27%)	11 (20%)	0.66
Insurance						
Employer-based commercial	68 (36%)	14 (33%)	15 (35%)	17 (35%)	22 (39%)	0.86
Non-employer-based commercial	22 (12%)	5 (12%)	6 (14%)	7 (14%)	4 (7.1%)	
Medicare	42 (22%)	11 (26%)	7 (16%)	11 (22%)	13 (23%)	
Medicaid/other state program	27 (14%)	8 (19%)	6 (14%)	8 (16%)	5 (8.9%)	
TRICARE/VA/Military	12 (6.3%)	1 (2.3%)	5 (12%)	2 (4.1%)	4 (7.1%)	
Alaska Native/Indian/Tribal Health Services	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Other	1 (0.5%)	0 (0.0%)	0 (0.0%)	1 (2.0%)	0 (0.0%)	
None	17 (8.9%)	4 (9.3%)	3 (7.0%)	3 (6.1%)	7 (13%)	
Income (%)						
<$25,000	61 (32%)	17 (40%)	16 (37%)	15 (31%)	13 (23%)	0.75
$25,000-$49,999	52 (27%)	11 (26%)	8 (19%)	16 (33%)	17 (30%)	
$50,000-$74,999	37 (19%)	7 (16%)	9 (21%)	7 (14%)	14 (25%)	
$75,000-$99,999	22 (12%)	2 (4.7%)	6 (14%)	7 (14%)	7 (13%)	
$100,000-$149,999	13 (6.8%)	4 (9.3%)	3 (7.0%)	4 (8.2%)	2 (3.6%)	
$150,000-$199,999	1 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.8%)	
≥$200,000	0 (0.0%)	2 (4.7%)	1 (2.3%)	0 (0.0%)	2 (3.6%)	
Decline to answer	5 (2.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	

*Calculated among former smokers (n=92)
Mechanical Turk (MTurk)
Body-mass index (BMI)
General Education Development (GED)
Basal cell carcinoma (BCC)
Squamous cell carcinoma (SCC)
Veterans' Affairs (VA)

Table 6. Likelihood of Screening by Image Type

Image type	High construal, Promotion focus (n=43)	High construal, Prevention focus (n=43)	Low construal, Promotion focus (n=49)	Low construal, Prevention focus (n=56)	p-Value
Mean score: likelihood of screening* (SD)	2.2 (1.0)	2.9 (1.0)	2.7 (1.1)	2.8 (1.2)	0.04

Standard deviation (SD)
*1=very likely to screen; 5=very unlikely to screen

Table 7. Likelihood of Screening and Individual Character Trait-Image Congruence

	Character Trait-Image Congruence (n=44) % (95% CI)	Character Trait-Image Incongruence (n=147) % (95% CI)	p-Value
Likely to screen	48 (33-63)	44 (35-52)	0.62

Confidence interval (CI)

Table 8. HCV Screen-Eligible MTurk Participant Characteristics

	All Participants (n=307)	Willing (n=194)	Unwilling (n=113)
	n (%, IQR)	n (%, IQR)	n (%, IQR)
Age			
Median	63 (7)	63 (7)	63 (6)
Women	210 (68%)	136 (70%)	74 (65%)
Race			
White	279 (91%)	176 (91%)	103 (91%)
American Indian/Alaska Native	5 (1.6%)	3 (1.5%)	2 (1.8%)
Asian	2 (0.7%)	0 (0.0%)	2 (1.8%)
Native Hawaiian/Pacific Islander	0 (0.0%)	0 (0.0%)	0 (0.0%)
Black	15 (4.9%)	11 (5.7%)	4 (3.5%)
Other	6 (2.0%)	5 (2.6%)	1 (0.9%)
Hispanic	9 (2.9%)	7 (3.6%)	2 (1.8%)
Highest education			
Less than high school	3 (1.0%)	3 (1.5%)	0 (0.0%)
High school graduate/GED	29 (9.4%)	16 (8.2%)	13 (12%)
Post-high school training, excluding college	65 (21%)	42 (22%)	23 (20%)
Associate’s degree or some college	61 (20%)	44 (23%)	17 (15%)
Bachelor's degree	97 (32%)	57 (29%)	40 (35%)
Graduate school	52 (17%)	32 (16%)	20 (18%)
Insurance			

Employer-based commercial	96 (31%)	66 (34%)	30 (27%)
Non-employer-based commercial	34 (11%)	20 (10%)	14 (12%)
Medicare	111 (36%)	74 (38%)	37 (33%)
Medicaid/other state program	16 (5.2%)	10 (5.2%)	6 (5.4%)
TRICARE/VA/Military	11 (3.6%)	8 (4.1%)	3 (2.7%)
Alaska Native/Indian/Tribal Health Services	0 (0.0%)	0 (0.0%)	0 (0.0%)
Other	9 (2.9%)	5 (2.6%)	4 (3.5%)
None	28 (9.1%)	10 (5.2%)	18 (16%)
Income (%)			
<$25,000	76 (25%)	41 (21%)	35 (31%)
$25,000-$49,999	86 (28%)	58 (30%)	28 (25%)
$50,000-$74,999	61 (20%)	40 (21%)	21 (19%)
$75,000-$99,999	45 (15%)	30 (15%)	15 (13%)
$100,000-$149,999	18 (5.9%)	11 (5.7%)	7 (6.2%)
$150,000-$199,999	9 (2.9%)	7 (3.6%)	2 (1.8%)
≥$200,000	7 (2.3%)	3 (1.5%)	4 (3.5%)
Decline to answer	5 (1.6%)	4 (2.1%)	1 (0.9%)
Character traits			
High Construal, Promotion-Focused	122 (40%)	83 (43%)	39 (35%)
Low Construal, Promotion-Focused	50 (16%)	33 (17%)	17 (15%)
High Construal, Prevention-Focused	85 (28%)	49 (25%)	36 (32%)
Low Construal, Prevention-Focused	50 (16%)	29 (15%)	21 (19%)
Other health behaviors			
Screen for colon cancer	225 (73%)	154 (79%)	71 (63%)
Screen for breast cancer*	191 (91%)	131 (96%)	60 (81%)

Annual influenza vaccination	173 (56%)	126 (65%)	47 (42%)
Regularly floss teeth	177 (58%)	109 (56%)	68 (60%)

Hepatitis C virus (HCV)
Mechanical Turk (MTurk)
General Education Development (GED)
Veterans' Affairs (VA)
*Among women

Table 9. Willingness to Screen for HCV by Image Type

Image type	All Participants (n=307) % (95% CI)	High construal, Promotion focus (n=72) % (95% CI)	Low construal, Promotion focus (n=84) % (95% CI)	High construal, Prevention focus (n=80) % (95% CI)	Low construal, Prevention focus (n=71) % (95% CI)	p-Value
Interested	56 (50-62)	53 (41-65)	58 (47-69)	56 (45-67)	56 (44-68)	0.92
Likely to screen	47 (41-53)	40 (29-53)	54 (42-65)	51 (40-63)	39 (28-52)	0.14
Willing to screen	63 (58-69)	54 (42-66)	**75 (64-84)**	63 (51-73)	59 (47-71)	0.04

Hepatitis C virus (HCV)
Confidence interval (CI)

APPENDIX A: Survey Questions and Responses by Individuals at High-Risk for Lung Cancer Based on USPSTF Criteria (n=240)

Question 1

Has your doctor ever told you that you have any of the following? Check all that apply.

- Lung cancer - **0 (0%)**
- Any other cancer (except for basal cell or squamous cell skin cancer) - **8 (3.3%)**
- COPD or emphysema - **43 (17%)**
- Pulmonary fibrosis or IPF - **2 (0.8%)**
- No, I have never been told I have any of the above - **195 (81%)**

Question 2

Are you currently on long-term home oxygen therapy?

- Yes - **0 (0%)**
- No - **240 (100%)**

Question 3

Which of the following have you ever had major contact with, either at work or at home? Check all that apply.

- Radon - **6 (2.1%)**
- Silica - **7 (2.5%)**
- Cadmium - **3 (1.1%)**
- Asbestos - **40 (14%)**
- Arsenic - **3 (1.1%)**
- Beryllium - **3 (1.1%)**
- Chromium - **4 (1.4%)**
- Diesel fumes - **38 (13%)**
- Nickel - **2 (0.7%)**
- I do not think I have ever had major contact with any of the above - **164 (58%)**
- I don’t know - **15 (5.3)**

Question 4

Do you have any first-degree relatives (parents, siblings or children) who have/had lung cancer?

- Yes - **60 (25%)**
- No - **180 (75%)**

Question 5

True or false: There is a test doctors can use to find lung cancer early to improve the chances of curing the cancer

- True - **104 (43%)**
- False - **22 (9.2%)**
- I don't know - **114 (48%)**

Question 5a is shown only to respondents who answer "true" to Question 5

Question 5a

What is the test used to find lung cancer early to improve the chances of curing the cancer?

- Chest X-ray - **28 (27%)**
- Chest CT (CAT) scan - **35 (35%)**
- Chest MRI - **16 (15%)**
- Blood test - **9 (8.7%)**
- I don't know - **16 (16%)**

Question 6

Has a doctor/healthcare provider ever talked to you about getting a test to look for early lung cancer?

- Yes - **33 (14%)**
- No - **207 (86%)**

Question 7

Have you ever had a test to look for early lung cancer?

- Yes - **24 (10%)**
- No - **203 (85%)**
- I don't know – **13 (5.4%)**

If answer is "yes" to Question 7

Question 7a

What test did you have to look for early lung cancer?

- Chest X-ray - **12 (50%)**
- Chest CT (CAT) scan - **12 (50%)**
- Chest MRI - **0 (0%)**
- Blood test - **0 (0%)**

Please indicate how much you agree with the following statements (Strongly agree, Agree, Neutral, Disagree, or Strongly disagree)

Question 8

I believe that tests looking for early cancers are helpful.

- Strongly agree - **144 (60%)**
- Agree - **70 (29%)**
- Neutral - **20 (8.3%)**
- Disagree - **6 (2.5%)**
- Strongly disagree - **0 (0%)**

Question 9

I believe that tests looking for early lung cancer have the potential to save lives.

- Strongly agree - **142 (59%)**
- Agree - **80 (33%)**
- Neutral - **13 (5.4%)**
- Disagree - **5 (2.1%)**
- Strongly disagree - **0 (0%)**

Question 10

I am at a high risk of getting lung cancer.

- Strongly agree - **53 (22%)**
- Agree - **111 (46%)**
- Neutral - **43 (18%)**
- Disagree - **18 (7.5%)**
- Strongly disagree - **6 (2.5%)**
- I don’t know - **9 (3.8%)**

The following questions (11-15) will focus on your thoughts about smoking and lung cancer

Question 11

If you obtained a test looking for lung cancer and NO lung cancer was found, would you be motivated to stop smoking?

- Yes - **109 (45%)**
- No - **65 (27%)**
- I don't know - **66 (28%)**

Question 12

If you obtained a test looking for lung cancer and lung cancer was found, would you continue smoking?

- Yes - **24 (10%)**
- No - **130 (54%)**
- I don't know - **86 (36%)**

Question 13

If you obtained a test looking for lung cancer and an abnormality of the lung was found that was not cancer, would you continue smoking?

- Yes - **35 (15%)**
- No - **127 (53%)**
- I don't know - **78 (33%)**

Question 14

If your doctor or healthcare provider recommended it, would you get a CT scan to look for early lung cancer?

- Yes - **165 (69%)**
- No - **6 (2.5%)**
- I would want more information before deciding - **69 (29%)**

<u>If answer is "yes" to Question 14</u>

Question 14a

Why would you get the CT scan? Check all that apply.

- My doctor/healthcare provider recommended it - **130 (33%)**
- I am worried I might have lung cancer - **50 (13%)**
- If I have lung cancer, finding it early will make it easier to treat - **132 (33%)**

- I believe CT scans are a safe way to look for lung cancer - **78 (20%)**
- Other: _____ - **3 (0.8%)**

If answer is "no" to Question 14

Question 14b

Why would you not get the CT scan? Check all that apply.

- I don't think I am at risk for lung cancer - **2 (20%)**
- I don't want to know whether or not I have lung cancer - **3 (30%)**
- I am worried about the cost of the scan - **2 (20%)**
- I am worried the scan will find something else wrong with me - **1 (10%)**
- I am worried about radiation from the scan - **0 (0%)**
- Other: _____ - **2 (20%)**
    - "I don't believe in witch hunts, knock on enough doors, one will open."
    - "I would not accept treatment if I did have lung cancer."

Question 15

If you wanted more information about a scan that finds lung cancer early, how would you want to receive this information? Rank the following from most to least useful (1 = most useful; 7 = least useful):

- Through social media (e.g. Facebook, Twitter, Instagram) - **Mean rank: 6**
- Talking to your primary doctor - **Mean rank: 1.5**
- Receiving a phone call - **Mean rank: 4.5**
- Receiving a message through your electronic health record - **Mean rank: 3.3**
- Receiving a notification in the mail - **Mean rank: 4.1**
- Watching a local news segment or television special about this - **Mean rank: 4.3**
- Reading about this in a magazine/newspaper you subscribe to - **Mean rank: 4.7**
- Other (optional): _____

Question 16

Imagine you visit your doctor/healthcare provider for a regular checkup. They ask you to schedule a test as part of this checkup. What part of the test would matter most to you? Rank the following from most to least important (1 = most important; 5 = least important), if you belief multiple factors are equally important, assign them the same rank:

- Convenience of completing the test - **Mean rank: 4**
- The out-of-pocket cost of the test - **Mean rank: 3**
- A high chance the test will save my life - **Mean rank: 2.3**

- The accuracy of the test - **Mean rank: 2.3**
- The risk of harms associated with the test - **Mean rank: 3.5**
- Other: _____

Question 17

Where do you get your health/medical information from? Check all that apply.

- My primary doctor/healthcare provider - **218 (36%)**
- The internet - **175 (29%)**
- Television - **65 (11%)**
- Radio - **11 (1.8%)**
- Friends/family - **82 (13%)**
- Health magazine or newsletter - **51 (8.3%)**
- None of the above - **2 (0.3%)**
- Other: _____ - **10 (1.6%)**

The following questions (18-22) will focus on other parts of your health besides your lungs

Question 18

Sigmoidoscopy, colonoscopy and fecal occult blood testing are all exams to look for signs of cancer or other health problems in the colon. Have you ever had any of these exams?

- Yes - **141 (59%)**
- No - **99 (41%)**
- I don't know - **0 (0%)**

If answer is "yes" to Question 18

Question 18a

What was the main reason you decided to get a colon cancer test? Check all that apply.

- My doctor/healthcare provider recommended it - **137 (69%)**
- A relative/friend recommended it - **8 (4.0%)**
- I heard about the test on television - **3 (1.5%)**
- I read about the test in a newsletter/magazine - **7 (3.5%)**
- I was worried I might have colon cancer - **12 (6.1%)**
- It was easy to schedule the test - **21 (11%)**
- Other: _____ - **10 (5.1%)**

Question 19

What is your sex?

- Male - **67 (28%)**
- Female - **172 (72%)**
- Prefer not to answer - **1 (0.4%)**

Question 20

Do you identify your gender as being the same as your sex?

- Yes - **240 (100%)**
- No, please specify: _____ - **0 (0%)**

Question 20a (shown to female respondents only)

A mammogram is an x-ray of each breast to look for breast cancer. Have you ever had a mammogram?

- Yes - **138 (80%)**
- No - **33 (19%)**
- I don't know - **1 (0.6%)**

If answer is "yes" to Question 20a

Question 20b

What was the main reason you decided to get a mammogram? Check all that apply.

- My doctor/healthcare provider recommended it - **128 (63%)**
- A relative/friend recommended it - **8 (4%)**
- I heard about the test on television - **2 (1%)**
- I read about the test in a newsletter/magazine - **4 (2%)**
- I was worried I might have breast cancer - **19 (8.4%)**
- It was easy to schedule the mammogram - **24 (12%)**
- Other: _____ - **17 (8.4%)**

Question 21

When did you last receive an influenza (flu) vaccine?

- Within the past year - **90 (38%)**
- With the past 1 to 2 years - **19 (7.9%)**

- Within the past 2 to 5 years - **16 (6.7%)**
- More than 5 years ago - **45 (19%)**
- Not sure - **12 (5%)**
- Never - **58 (24%)**

Question 22

Suppose it is time for the yearly flu shot. Which of the following is most likely to lead to you getting the flu shot? Rank the following from most to least likely (1 = most useful; 4 = least useful):

- Your doctor/healthcare provider scheduling an appointment for you - **Mean rank: 1.8**
- Receiving a reminder email or electronic health record message to schedule an appointment - **Mean rank: 2.7**
- A reminder from your pharmacist when you pick up your prescriptions - **Mean rank: 2.9**
- A family member or friend recommending it - **Mean rank: 3**
- Other: _____

<u>The following are general questions about you</u>

Question 23

What is your height in feet and inches?

- Feet: _____ - **Mean height: 66 inches**
- Inches: _____

Question 24

How much do you weigh in lbs?

- Weight: _____ - **Mean weight: 172 lbs**

Question 25

Are you of Hispanic, Latino, or Spanish origin?

- Yes - **4 (1.7%)**
- No - **236 (98%)**

Question 26

What is your race or origin? Please check all that apply

- American Indian or Alaska Native - **4 (1.6%)**
- Black or African American - **10 (4%)**
- Asian - **2 (0.8%)**
- Native Hawaiian or Other Pacific Islander - **0 (%)**
- White - **225 (91%)**
- Some other race: _____ - **6 (2.4%)**

Question 27

What is your current employment status?

- Employed, full time - **85 (35%)**
- Employed, part-time - **44 (18%)**
- Employed, but on sick leave or maternity leave - **0 (0%)**
- Unemployed, looking for work - **13 (5.4%)**
- Unemployed, NOT looking for work - **7 (2.9%)**
- Disabled, due to medical condition, permanently or temporarily - **20 (8.3%)**
- Disabled, for other reasons - **3 (1.3%)**
- Student - **1 (0.4%)**
- Retired - **53 (22%)**
- Other: _____ - **14 (5.8%)**
- Prefer not to answer - **0 (0%)**

Question 28

What is the highest education level that you have attained?

- Less than High School - **5 (2.1%)**
- High school graduate or GED - **37 (15%)**
- Some college, no degree - **80 (33%)**
- Occupational/technical/vocational program - **18 (7.5%)**
- Associate degree: academic program - **39 (16%)**
- Bachelor's degree - **44 (18%)**
- Master's degree (e.g., M.A., M.S., M.Eng., M.Ed., M.B.A.) - **11 (4.6%)**
- Professional school degree (e.g., M.D., D.D.S., D.V.M., J.D.) - **2 (0.8%)**
- Doctoral degree (e.g., Ph.D., Ed.D.) - **4 (1.7%)**
- Prefer not to answer - **0 (0%)**

Question 29

How many people are currently living in your household, including yourself?

- Number of people: _____ - **Mean: 2.2**
- Of these people, how many are children (individuals under 18 years of age)? _____ - **Mean: 0.2**
- Of these people, how many are adults? _____ - **Mean: 1.9**
- Of the adults, how many bring income into the household? _____ - **Mean: 1.7**

Question 30

Which of these categories best describes your total combined family income for the past 12 months?

- Less than $5,000 - **7 (2.9%)**
- $5,000 through $11,999 - **12 (5.0%)**
- $12,000 through $15,999 - **15 (6.3%)**
- $16,000 through $24,999 - **33 (14%)**
- $25,000 through $34,999 - **37 (15%)**
- $35,000 through $49,999 - **38 (16%)**
- $50,000 through $74,999 - **52 (22%)**
- $75,000 through $99,999 - **26 (11%)**
- $100,000 through $149,999 - **13 (5.4%)**
- $150,000 through $199,999 - **2 (0.8%)**
- $200,000 and greater - **0 (0%)**
- Prefer not to answer - **5 (2.1%)**

Question 31

What is the primary source of your health care coverage?

- A plan purchased through an employer or union (includes plan purchased through another person's employer) - **83 (35%)**
- A plan that you or another family member buys on your own (includes Affordable Care Act or Obamacare coverage) - **29 (12%)**
- Medicare - **55 (23%)**
- Medicaid or other state program - **26 (11%)**
- TRICARE (formally CHAMPUS), VA, or Military - **15 (6.3%)**
- Alaska Native, Indian Health Service, Tribal Health Services - **0 (0%)**
- Some other source - **2 (0.8%)**
- None (no coverage) - **28 (12%)**
- Prefer not to answer - **2 (0.8%)**

APPENDIX B: Short Questionnaire to Determine Respondents' Age and Smoking History

Question 1

How many cigarettes have you smoked in your entire life?

- None, I have never smoked cigarettes
- 1-99 cigarettes (less than 5 packs)
- 100 or more cigarettes (at least 5 packs)

Question 2

How old are you (in years)?

- Age: _____

Question 3

About how many total years have you smoked in your life?

- Total years smoking: _____

Question 4

On average, how many packs do/did you smoke in one day?

- Average packs a day: _____

Question 5

Have you quit smoking?

- Yes
- No

Question 5a (if "Yes" to Question 1)

How old were you when you quit?

- Age: _____

Appendix C: MTurk Respondent Characteristics

	MTurk Respondents Meeting USPSTF Criteria for High Risk (n=240)	MTurk Respondents Meeting Only NCCN Category 2 Criteria for High Risk (n=54)
	n (%, IQR)	n (%, IQR)
Age		
Median	60 (7)	60 (13)
Women	173 (72%)	23 (43%)
Race		
White	219 (91%)	47 (87%)
American Indian/Alaska Native	4 (1.7%)	4 (7.4%)
Asian	2 (0.4%)	0 (0%)
Native Hawaiian/Pacific Islander	0 (0%)	0 (0%)
Black	9 (3.7%)	3 (5.6%)
Other	6 (2.5%)	0 (0%)
Hispanic	4 (1.7%)	1 (1.9%)
Highest education		
Less than high school	5 (2.1%)	1 (1.9%)
High school graduate/GED	37 (15%)	14 (26%)
Post-high school training, excluding college	57 (24%)	15 (28%)

Associate's degree or some college	80 (33%)	9 (17%)
Bachelor's degree	44 (18%)	12 (22%)
Graduate school	17 (7.0%)	3 (5.6%)
BMI		
Median	26 (7)	25 (9)
Current Smoker	148 (62%)	23 (57%)
Pack-years		
Median	42 (12)	40 (33)
Years Quit*		
Median	5 (8)	19 (23)
Prior malignancy (excluding lung cancer, BCC or SCC)	7 (2.9%)	9 (17%)
Chronic pulmonary disease		
Chronic bronchitis/emphysema	41 (17%)	22 (41%)
Pulmonary fibrosis	1 (0.4%)	2 (3.7%)
Exposures		
Silica	7 (2.9%)	0 (0%)
Asbestos	41 (17%)	10 (19%)
Family history of lung cancer	60 (25%)	24 (44%)

Insurance		
Employer-based commercial	83 (35%)	11 (20%)
Non-employer-based commercial	29 (12%)	2 (3.7%)
Medicare	55 (2%)	20 (37%)
Medicaid/other state program	26 (11%)	10 (19%)
TRICARE/VA/Military	13 (6.3%)	3 (5.6%)
Alaska Native/Indian/Tribal Health Services	0 (0%)	0 (0%)
Other	2 (0.8%)	2 (3.7%)
None	28 (12%)	6 (11%)
Income (%)		
<$25,000	67 (28%)	14 (26%)
$25,000-$49,999	75 (3%)	24 (44%)
$50,000-$74,999	52 (22%)	8 (15%)
$75,000-$99,999	26 (11%)	4 (7.4%)
$100,000-$149,999	13 (5.4%)	3 (5.6%)
$150,000-$199,999	2 (0.8%)	1 (1.9%)
≥$200,000	0 (0%)	0 (0%)
Decline to answer	5 (2.1%)	0 (0%)

*Calculated among former smokers (n=92)
Mechanical Turk (MTurk)
United States Preventive Services Task Force (USPSTF)
National Comprehensive Cancer Network NCCN)
Interquartile range (IQR)
Body-mass index (BMI)
General Education Development (GED)
Basal cell carcinoma (BCC)
Squamous cell carcinoma (SCC)
Veterans' Affairs (VA)

Appendix D: Knowledge, Attitudes, and Beliefs

	MTurk Respondents Meeting USPSTF Criteria for High Risk (n=240) % [95% CI]	Respondents Meeting Only NCCN Category 2 Criteria for High Risk (n=54) % [95% CI]
Knowledge		
Responded "there is a test to screen for lung cancer"	44 [38-51]	41 [28-55]
Correctly identified LDCT as the lung cancer screening test*	35 [26-45]	36 [17-59]
Attitudes		
Willing to undergo lung cancer screening	69 [63-75]	72 [58-84]
Beliefs		
Believe that early-detection of cancer saves lives	89 [85-93]	96 [87-100]
Believe that early-detection of lung cancer saves lives	93 [89-96]	98 [90-100]
Believe they are at high-risk for lung cancer	69 [62-74]	56 [41-69]

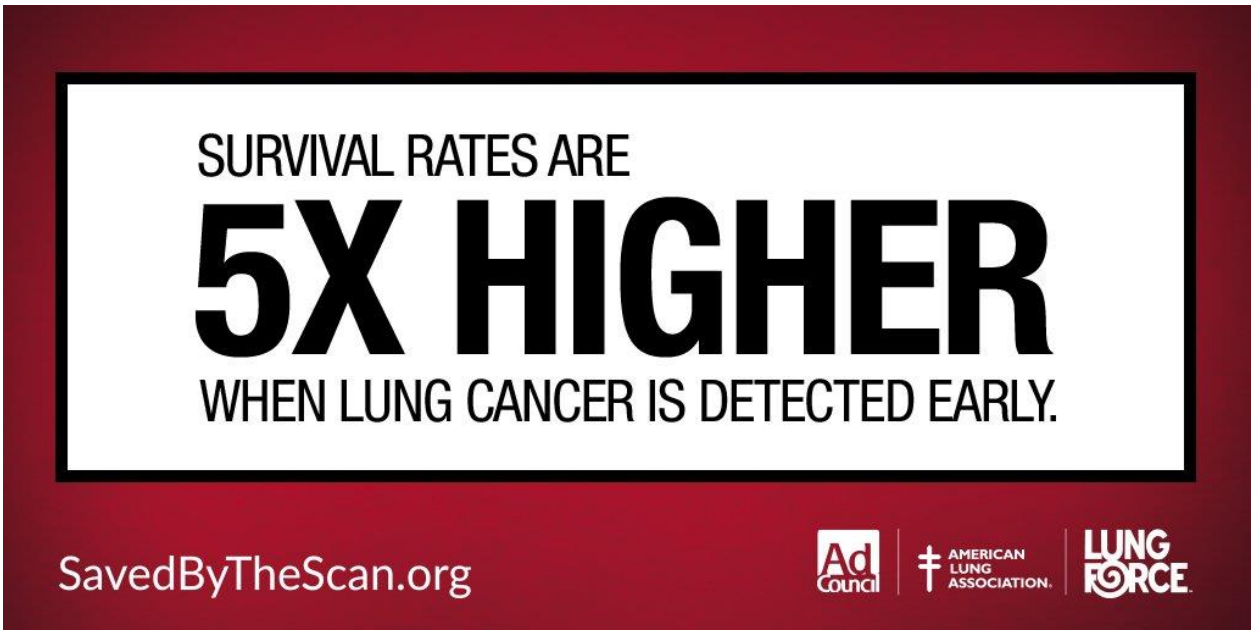
Mechanical Turk (MTurk)
United States Preventive Services Task Force (USPSTF)
National Comprehensive Cancer Network NCCN)
Confidence interval (CI)
Low-dose computed tomography (LDCT)
*Proportion calculated among individuals who responded there is a test to screen for lung cancer

APPENDIX E: Study Questions

The following image is an advertisement for a test that looks for early lung cancer, or "lung cancer screening."

(Randomized to one of the following four images)

High construal, promotion focus image:



High construal, prevention focus image:

Low construal, promotion focus image:

Low construal, prevention focus image:

Question 1

After viewing this image, how likely are you to undergo lung cancer screening?

- Very likely
- Likely
- Not sure
- Unlikely
- Very unlikely

Any behavior can be described in many ways. For example, one person might describe a behavior as "writing a paper," while another person might describe the same behavior as "pushing keys on the keyboard." Yet another person might describe it as "expressing thoughts." This form focuses on your personal preferences for how a number of different behaviors should be described. Below you will find several behaviors listed. After each behavior will be two different ways in which the behavior might be identified.

Here is an example:

1. Attending class
    - sitting in a chair
    - looking at a teacher

Your task is to choose the identification, a or b, that best describes the behavior for you. Of course, there are no right or wrong answers. People simply differ in their preferences for the different behavior descriptions, and we are interested in your personal preferences. Remember, choose the description that you personally believe is more appropriate in each pair.

Question 2

Picking an apple

- Getting something to eat
- Pulling an apple off a branch

Question 3

Painting a room

- Applying brush strokes

- Making the room look fresh

Question 4

Locking a door

- Putting a key in the lock
- Securing the house

Question 5

Voting

- Influencing the election
- Marking a ballot

Question 6

Filling out a personality test

- Answering questions
- Revealing what you're like

Question 7

Taking a test

- Answering questions
- Showing one's knowledge

Question 8

Greeting someone

- Saying hello
- Showing friendliness

Question 9

Resisting temptation

- Saying "no"
- Showing moral courage

Question 10

Traveling by car

- Following a map
- Seeing countryside

Question 11

Talking to a child

- Teaching a child something
- Using simple words

This set of questions asks you **HOW FREQUENTLY** specific events actually occur or have occurred in your life. Please answer each question on a scale of (1) "never or seldom" to (5) "very often"

Question 12

Compared to most people, are you typically unable to get what you want out of life?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 13

Growing up, would you ever "cross the line" by doing things that your parents would not tolerate?

- 1 (never or seldom)
- 2

- 3 (sometimes)
- 4
- 5 (very often)

Question 14

How often have you accomplished things that got you "psyched" to work even harder?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 15

Did you get on your parents' nerves often when you were growing up?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 16

How often did you obey rules and regulations that were established by your parents?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (always)

Question 17

Growing up, did you ever act in ways that your parents thought were objectionable?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 18

Do you often do well at different things that you try?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 19

Not being careful enough has gotten me into trouble at times.

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 20

When it comes to achieving things that are important to me, I find that I don't perform as well as I ideally would like to do.

- 1 (never true)
- 2
- 3 (sometimes true)
- 4
- 5 (very often true)

Question 21

I feel like I have made progress toward being successful in my life.

- 1 (certainly false)
- 2
- 3
- 4
- 5 (certainly true)

Question 22

I have found very few hobbies or activities in my life that capture my interest or motivate me to put effort into them.

- 1 (certainly false)
- 2
- 3
- 4
- 5 (certainly true)

APPENDIX F. Demographic and Clinical Characteristics of Respondents and Non-Responders

	Respondents (n=191) n (%, IQR)	Non-Responders (n=49) n (%, IQR)	p-Value
Age			
Median	60 (7)	59 (7)	0.98
Women	132 (69%)	39 (80%)	0.15
Race			
White	174 (91%)	46 (94%)	0.98
American Indian/Alaska Native	2 (1.0%)	1 (2.0%)	
Asian	2 (1.0%)	0 (0.0%)	
Native Hawaiian/Pacific Islander	0 (0.0%)	0 (0.0%)	
Black	8 (4.2%)	1 (2.0%)	
Other	6 (3.1%)	0 (0.0%)	
Hispanic	3 (1.6%)	1 (2.0%)	0.82
Highest education			
Less than high school	4 (2.1%)	1 (2.0%)	0.82
High school graduate/GED	26 (14%)	11 (22%)	
Post-high school training, excluding college	46 (24%)	11 (22%)	
Associate's degree or some college	65 (34%)	17 (35%)	
Bachelor's degree	36 (18%)	7 (14.3%)	
Graduate school	14 (7.3%)	2 (4.1%)	

BMI			
Median	27 (7)	26 (9)	0.46
Current Smoker	114 (60%)	34 (69%)	0.28
Pack-years			
Median	44 (13)	40 (12)	0.57
Years Quit*			
Median	6 (8)	4 (4)	0.12
Prior malignancy (excluding BCC or SCC)	8 (4.2%)	0 (0.0%)	0.31
Chronic pulmonary disease			
Chronic bronchitis/emphysema	41 (22%)	3 (6%)	0.02
Pulmonary fibrosis	2 (1.0%)	0 (0.0%)	1.00
Exposures			
Silica	6 (3.1%)	1 (2.0%)	1.00
Asbestos	31 (16%)	10 (20%)	0.63
Family history of lung cancer	47 (25%)	14 (29%)	0.70
Insurance			
Employer-based commercial	68 (36%)	15 (31%)	0.35
Non-employer-based commercial	22 (12%)	7 (14%)	
Medicare	42 (22%)	12 (25%)	
Medicaid/other state program	27 (14%)	1 (2.0%)	

TRICARE/VA/Military	12 (6.3%)	3 (6.1%)	
Alaska Native/Indian/Tribal Health Services	0 (0.0%)	0 (0.0%)	
Other	1 (0.5%)	1 (2.0%)	
None	17 (8.9%)	10 (20%)	
Income (%)			
<$25,000	61 (32%)	8 (16%)	0.12
$25,000-$49,999	52 (27%)	23 (47%)	
$50,000-$74,999	37 (19%)	14 (29%)	
$75,000-$99,999	22 (12%)	3 (6.1%)	
$100,000-$149,999	13 (6.8%)	0 (0.0%)	
$150,000-$199,999	1 (0.5%)	1 (2.0%)	
≥$200,000	0 (0.0%)	0 (0.0%)	
Decline to answer	5 (2.6%)	0 (0.0%)	

*Calculated among former smokers
Mechanical Turk (MTurk)
Body-mass index (BMI)
General Education Development (GED)
Basal cell carcinoma (BCC)
Squamous cell carcinoma (SCC)
Veterans' Affairs (VA)

APPENDIX G: Study Questions

Age screening question:

Question 1

In what year were you born?

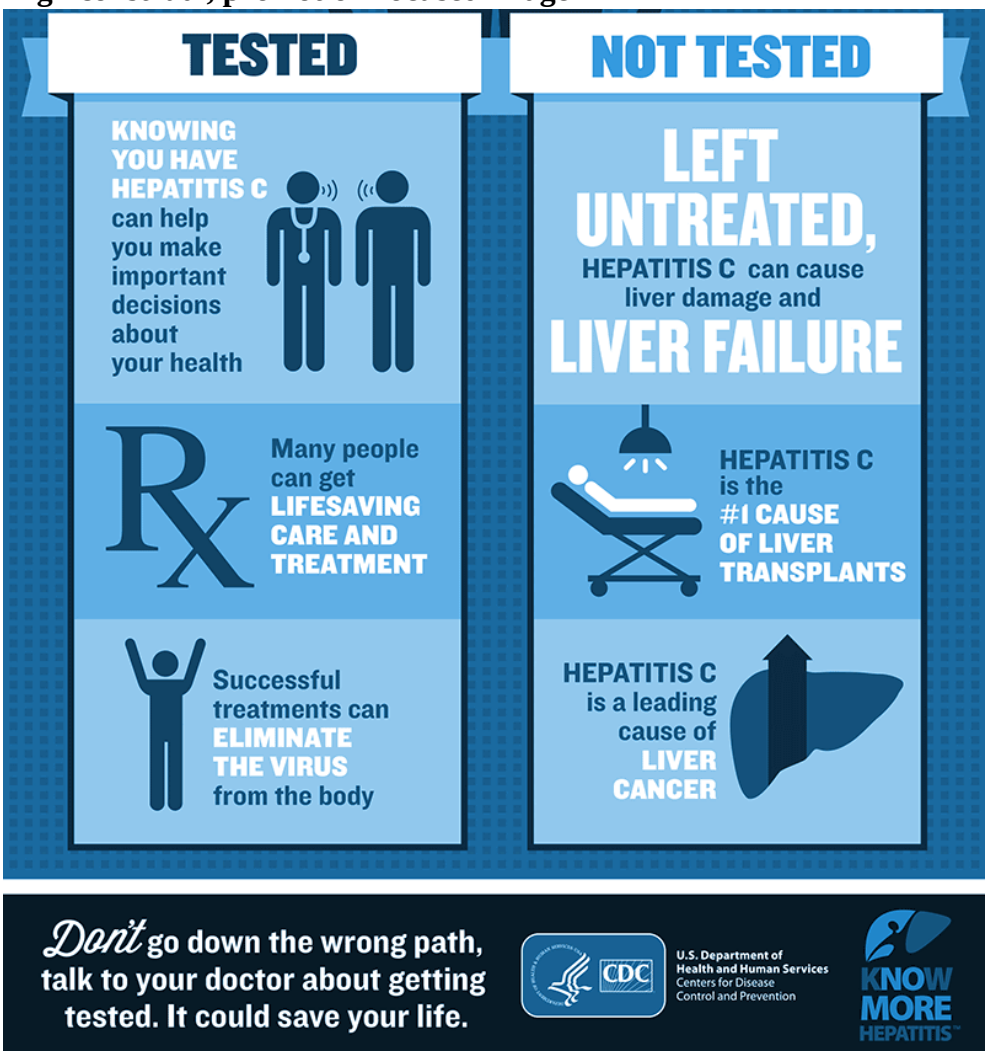
- Year: _____

Part 1

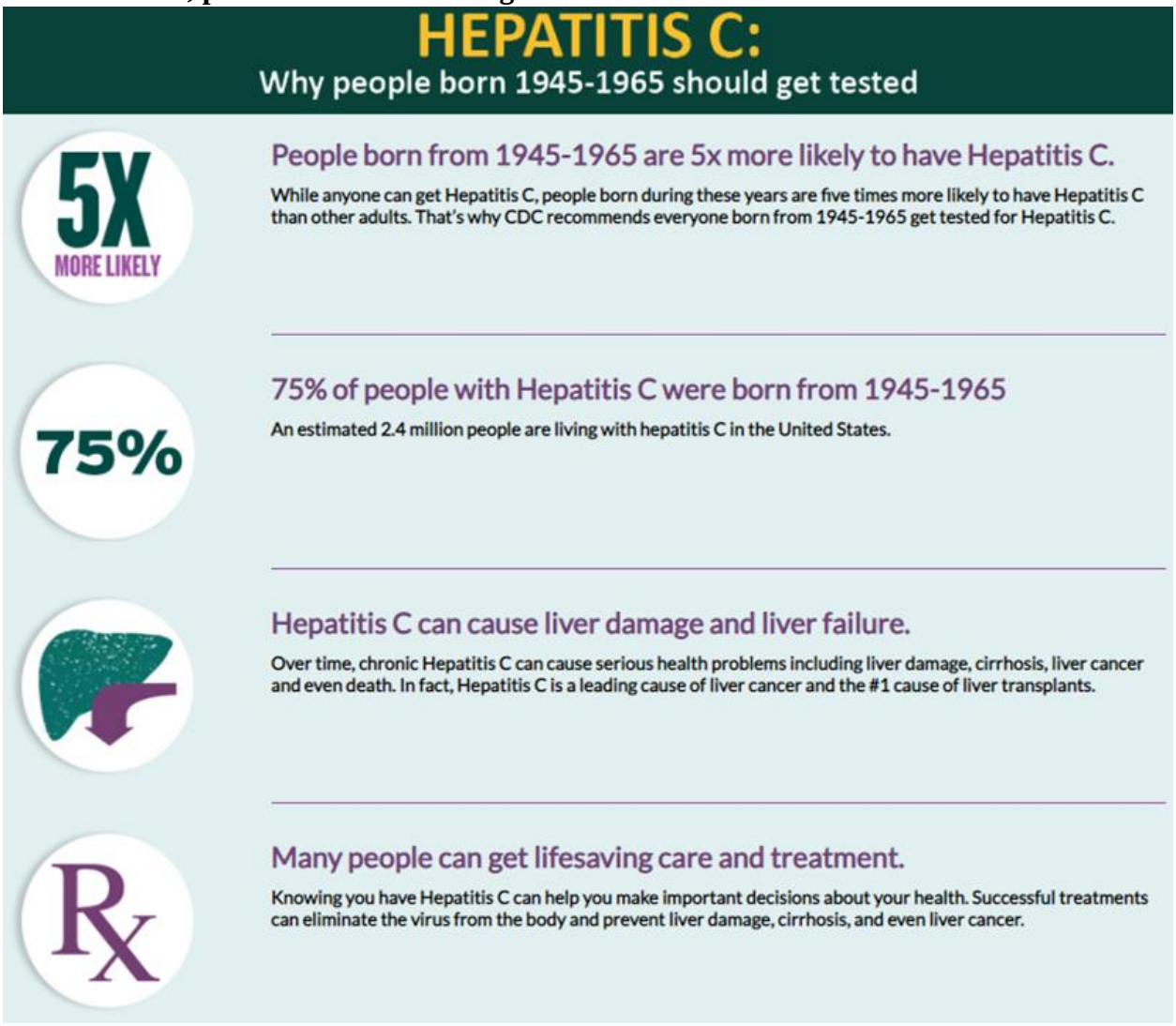
The following image is an advertisement for a blood test that looks for the Hepatitis C virus (HCV)

(Participants randomized to see one of the following four images)

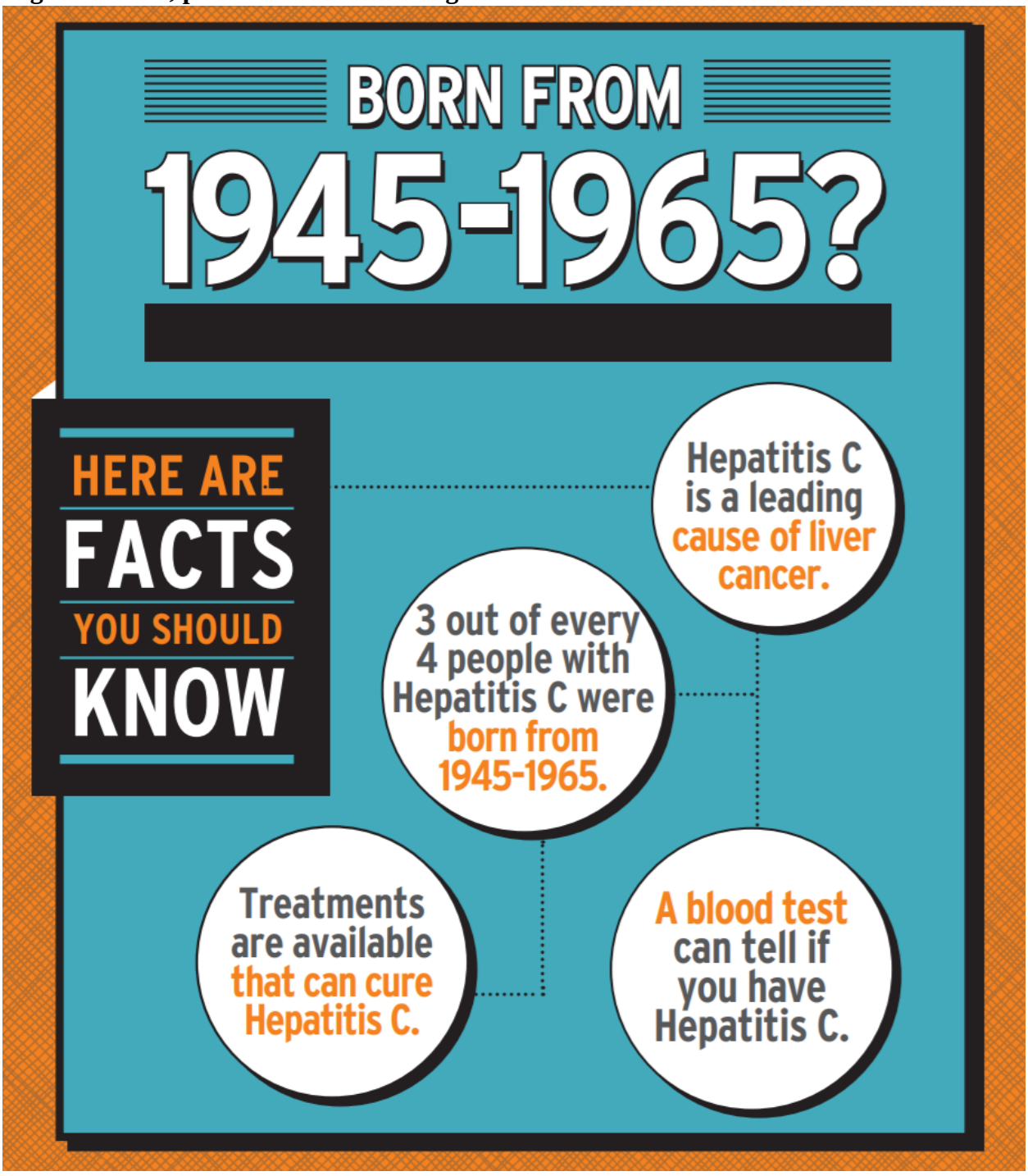
High construal, promotion-focused image



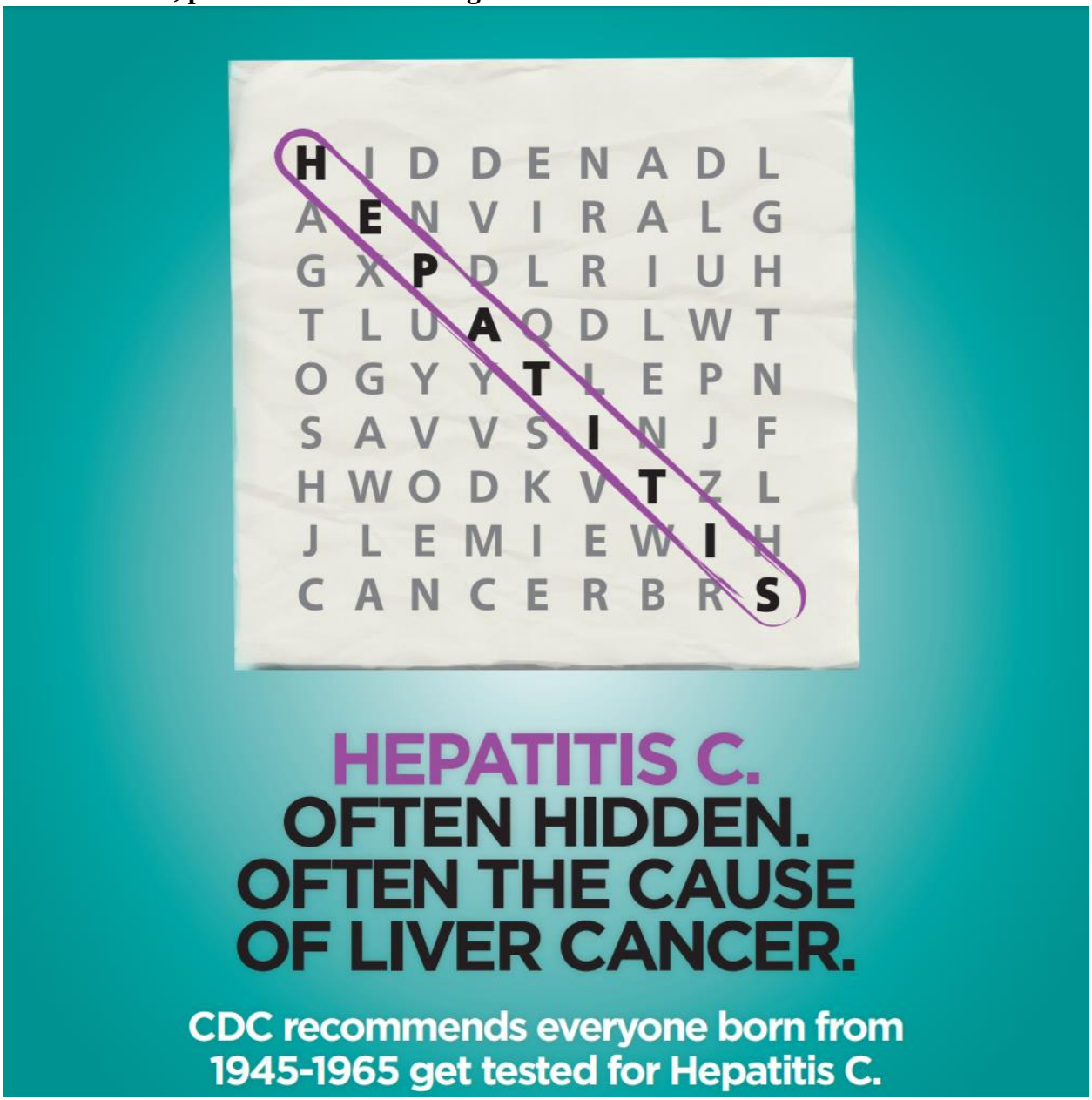
Low construal, promotion-focused image



High construal, prevention-focused image



Low construal, prevention-focused image



Question 1

After viewing this image, how likely are you to get tested for Hepatitis C?

- Very likely
- Likely
- Not sure
- Unlikely
- Very unlikely

Part 2

Any behavior can be described in many ways. For example, one person might describe a behavior as "writing a paper," while another person might describe the same behavior as "pushing keys on the keyboard." Yet another person might describe it as "expressing thoughts." This form focuses on your personal preferences for how a number of different behaviors should be described. Below you will find several behaviors listed. After each behavior will be two different ways in which the behavior might be identified.

Here is an example:

2. Attending class
    - sitting in a chair
    - looking at a teacher

Your task is to choose the identification, a or b, that best describes the behavior for you. Of course, there are no right or wrong answers. People simply differ in their preferences for the different behavior descriptions, and we are interested in your personal preferences. Remember, choose the description that you personally believe is more appropriate in each pair.

Question 2

Picking an apple

- Getting something to eat
- Pulling an apple off a branch

Question 3

Painting a room

- Applying brush strokes
- Making the room look fresh

Question 4

Locking a door

- Putting a key in the lock
- Securing the house

Question 5

Voting

- Influencing the election
- Marking a ballot

Question 6

Filling out a personality test

- Answering questions
- Revealing what you're like

Question 7

Taking a test

- Answering questions
- Showing one's knowledge

Question 8

Greeting someone

- Saying hello
- Showing friendliness

Question 9

Resisting temptation

- Saying "no"
- Showing moral courage

Question 10

Traveling by car

- Following a map
- Seeing countryside

Question 11

Talking to a child

- Teaching a child something
- Using simple words

This set of questions asks you **HOW FREQUENTLY** specific events actually occur or have occurred in your life. Please answer each question on a scale of (1) “never or seldom” to (5) “very often”

Question 12

Compared to most people, are you typically unable to get what you want out of life?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 13

Growing up, would you ever “cross the line” by doing things that your parents would not tolerate?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 14

How often have you accomplished things that got you "psyched" to work even harder?

- 1 (never or seldom)

- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 15

Did you get on your parents' nerves often when you were growing up?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 16

How often did you obey rules and regulations that were established by your parents?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (always)

Question 17

Growing up, did you ever act in ways that your parents thought were objectionable?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 18

Do you often do well at different things that you try?

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 19

Not being careful enough has gotten me into trouble at times.

- 1 (never or seldom)
- 2
- 3 (sometimes)
- 4
- 5 (very often)

Question 20

When it comes to achieving things that are important to me, I find that I don't perform as well as I ideally would like to do.

- 1 (never true)
- 2
- 3 (sometimes true)
- 4
- 5 (very often true)

Question 21

I feel like I have made progress toward being successful in my life.

- 1 (certainly false)
- 2
- 3
- 4

- 5 (certainly true)

Question 22

I have found very few hobbies or activities in my life that capture my interest or motivate me to put effort into them.

- 1 (certainly false)
- 2
- 3
- 4
- 5 (certainly true)

The following questions will focus on various parts of your health

Question 23

Do you regularly floss your teeth?

- Yes
- No

Question 24

Sigmoidoscopy, colonoscopy and fecal occult blood testing are all exams to look for signs of cancer or other health problems in the colon. Have you ever had any of these exams?

- Yes
- No
- I don’t know

If answer is “yes” to Question 24

Question 25

What was the main reason you decided to get a colon cancer test? Check all that apply.

- My doctor/healthcare provider recommended it
- A relative/friend recommended it

- I heard about the test on television
- I read about the test in a newsletter/magazine
- I was worried I might have colon cancer
- It was easy to schedule the test
- Other: _____

Question 26

What is your sex?

- Male
- Female

Question 27

Do you identify your gender as being the same as your sex?

- Yes
- No, please specify: _____

Question 28 (shown to female participants only)

A mammogram is an x-ray of each breast to look for breast cancer. Have you ever had a mammogram?

- Yes
- No
- I don't know

If answer is "yes" to Question 28

Question 29

What was the main reason you decided to get a mammogram? Check all that apply.

- My doctor/healthcare provider recommended it
- A relative/friend recommended it
- I heard about the test on television
- I read about the test in a newsletter/magazine

- I was worried I might have breast cancer
- It was easy to schedule the mammogram
- Other: _____

Question 30

When did you last receive an influenza (flu) vaccine?

- Within the past year
- With the past 1 to 2 years
- Within the past 2 to 5 years
- More than 5 years ago
- Not sure
- Never

Question 31

If answer is "yes" to Question 30

What was the main reason you decided to get an influenza (flu) vaccine? Check all that apply.

- My doctor/healthcare provider recommended it
- A relative/friend recommended it
- I heard about the test on television
- I read about the test in a newsletter/magazine
- I was worried I might have breast cancer
- It was easy to schedule the mammogram
- Other: _____

The following are general questions about you

Question 32

Are you of Hispanic, Latino, or Spanish origin?

- Yes
- No

Question 33

What is your race or origin? Please check all that apply

- American Indian or Alaska Native
- Black or African American
- Asian
- Native Hawaiian or Other Pacific Islander
- White
- Some other race: _____

Question 34

What is your current employment status?

- Employed, full time
- Employed, part-time
- Employed, but on sick leave or maternity leave
- Unemployed, looking for work
- Unemployed, NOT looking for work
- Disabled, due to medical condition, permanently or temporarily
- Disabled, for other reasons
- Student
- Retired
- Other: _____
- Prefer not to answer

Question 35

What is the highest education level that you have attained?

- Less than High School
- High school graduate or GED
- Some college, no degree
- Occupational/technical/vocational program
- Associate degree: academic program

- Bachelor's degree
- Master's degree (e.g., M.A., M.S., M.Eng., M.Ed., M.B.A.)
- Professional school degree (e.g., M.D., D.D.S., D.V.M., J.D.)
- Doctoral degree (e.g., Ph.D., Ed.D.)
- Prefer not to answer

Question 36

How many people are currently living in your household, including yourself?

- Number of people: _____
- Of these people, how many are children (individuals under 18 years of age)? _____
- Of these people, how many are adults? _____
- Of the adults, how many bring income into the household? _____

Question 37

Which of these categories best describes your total combined family income for the past 12 months?

- Less than $5,000
- $5,000 through $11,999
- $12,000 through $15,999
- $16,000 through $24,999
- $25,000 through $34,999
- $35,000 through $49,999
- $50,000 through $74,999
- $75,000 through $99,999
- $100,000 through $149,999
- $150,000 through $199,999
- $200,000 and greater
- Prefer not to answer

Question 38

What is the primary source of your health care coverage?

- A plan purchased through an employer or union (includes plan purchased through another person's employer)
- A plan that you or another family member buys on your own (includes Affordable Care Act or Obamacare coverage)
- Medicare
- Medicaid or other state program
- TRICARE (formally CHAMPUS), VA, or Military
- Alaska Native, Indian Health Service, Tribal Health Services
- Some other source
- None (no coverage)

APPENDIX H. Health Maintenance Behaviors by Character Trait

	High construal, Promotion focus (n=122) % (95% CI)	Low construal, Promotion focus (n=50) % (95% CI)	High construal, Prevention focus (n=85) % (95% CI)	Low construal, Prevention focus (n=50) % (95% CI)	p-Value
Screen for colon cancer	68 (59-76)	86 (73-94)	75 (65-84)	70 (55-82)	0.10
Screen for breast cancer*	58 (49-67)	72 (58-84)	65 (54-75)	66 (51-79)	0.60
Annual influenza vaccination	55 (46-64)	56 (41-70)	57 (45-67)	60 (45-74)	0.95
Regularly floss teeth	58 (49-67)	64 (49-77)	53 (42-64)	58 (43-72)	0.66

Hepatitis C virus (HCV)
*Among women