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Individual differences in aversion to ambiguity regarding medical tests and treatments: association with cancer screening cognitions

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Abstract

Background—Aversion to “ambiguity”—uncertainty about the reliability, credibility, or adequacy of information—regarding medical tests and treatments is an important psychological response that varies among individuals, but little is known about its nature and extent. The purpose of this study was to examine how individual-level ambiguity aversion relates to important health cognitions related to different cancer screening tests.

Methods—A survey of 1074 adults, aged 40–70, was conducted in four integrated US healthcare systems. The Ambiguity Aversion in Medicine (AA-Med) scale, a measure of individual differences in aversion to ambiguity (AA) about medical tests and treatments, was administered along with measures of several cancer screening-related cognitions: perceived benefits and harms of colonoscopy, mammography, and prostate-specific antigen (PSA) screening, and ambivalence and future intentions regarding these tests. Multivariable analyses were conducted to assess the associations between AA-Med scores and cancer screening cognitions.

Results—Individual-level AA as assessed by the AA-Med scale was significantly associated ($p < .05$) with lower perceived benefits, greater perceived harms, and greater ambivalence regarding all three screening tests, and lower intentions for colonoscopy but not mammography or PSA screening.

Conclusion—Individual-level AA is broadly and simultaneously associated with various pessimistic cognitive appraisals of multiple cancer screening tests. The breadth of these associations suggests the influence of individual-level AA is insensitive to the degree and non-specific with respect to the causes of ambiguity.

Impact—Individual-level AA constitutes a measurable, wide-ranging cognitive bias against medical intervention, and more research is needed to elucidate its mechanisms and effects.

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Keywords

Ambiguity; Ambiguity Aversion; Cancer Screening

Introduction

Uncertainty in health care is a problem that originates from several sources [1]. One major source is what decision theorists since Ellsberg have termed “ambiguity”—uncertainty arising from limitations in the reliability, credibility, or adequacy of available information [2, 3]. Ambiguity is a problem of growing significance in health care due to several recent trends: the increasingly rapid emergence and diffusion of new technologies such as genomic testing; heightened awareness—stimulated by the evidence-based medicine movement—of limitations in medical knowledge; expanded efforts to help patients make informed medical decisions based on an understanding of the benefits, harms, and uncertainties associated with medical tests and treatments; widespread mass media coverage of medical controversies.

Ambiguity is also a significant problem in health care because it can cause people to appraise choice options pessimistically and to avoid decision making. This cognitive bias, known as “ambiguity aversion” (AA), has been demonstrated in numerous decision-making domains. It has cognitive, affective, and behavioral manifestations [4], and is distinguishable from other related but more general constructs including “pessimism” (a cognitive tendency towards negative expectations about future outcomes) [5], lack of “trust” in physicians and medical institutions (a multidimensional construct signifying the optimistic acceptance of a vulnerable situation in which the truster believes a trustee will care for the truster’s interests) [6], and “preference for self-treatment” (a general propensity to avoid seeing physicians and using prescription drugs) [7]. These other constructs point to phenomena that may result in similar outcomes (e.g., avoidance of decision making), but are non-specific in terms of their causes and are not produced by ambiguity *per se*.

In the domain of health care, AA poses potentially significant problems, to the extent that it may impede decision making and lead people to forego potentially beneficial interventions in an unreflective, non-deliberative manner. Yet much remains unknown about the causes and effects of AA in health care. In non-health decision-making domains, for example, a substantial minority of people have been shown to be indifferent to ambiguity [3], suggesting the existence of individual differences in AA. This finding motivated development of the Ambiguity Aversion in Medicine (AA-Med) scale, a brief measure of individual differences in aversion to ambiguity regarding medical tests and treatments [4]. As assessed by the AA-Med scale, greater individual-level AA (propensity towards aversion to ambiguity regarding medical tests and treatments) was found to be associated with lower interest in an ambiguous hypothetical cancer screening intervention. These findings corroborate the existence of individual differences in aversion to ambiguity regarding medical tests and treatments.

However, several important questions remain. The effects of individual differences in AA and the mechanisms of these effects have yet to be elucidated. The phenomenon of

ambiguity aversion is characterized by pessimistic cognitive appraisals—e.g., higher perceived risks, lower perceived benefits—of ambiguous choice options [8–10]. In theory, individual-level AA should moderate this phenomenon; people with higher individual-level AA should demonstrate more pessimistic appraisals of ambiguous choice options than people with lower individual-level AA. Furthermore, these pessimistic appraisals should be specific to ambiguous as opposed to non-ambiguous interventions. However, we currently lack empirical evidence on the nature and specificity of the effects of individual-level aversion to ambiguity about medical tests and treatments.

The overall objective of the current study was to address these knowledge gaps. Its specific aim was to determine how individual differences in aversion to ambiguity regarding medical tests and treatments relate to cognitive appraisals of medical tests that vary in associated ambiguity. The current study focused on cancer screening tests and the relationships between individual-level AA (measured by the AA-Med scale) and key health cognitions consistent with the phenomenon of ambiguity aversion [3, 10]: pessimistic perceptions of the benefits and harms of screening, ambivalence about screening, and (lower) intentions to be screened. By examining these relationships, we sought to generate new insights about both the nature and specificity of the effects of individual-level ambiguity aversion on cognitive appraisals of medical interventions.

Materials and Methods

Data source and study population

This study was conducted as part of a larger National Cancer Institute-supported project, Cancer Research Network Across Health Care Systems (Grant Number U19 CA079689), conducted within the HMO Cancer Research Network (CRN), a consortium of research organizations affiliated with 14 non-profit integrated healthcare delivery systems with nearly 11 million enrollees across the U.S.. The current study was part of a project to develop new measures to assess comprehension of spoken health messages related to cancer prevention and screening [11, 12]. Four CRN sites participated in recruiting participants for the study: Kaiser Permanente Georgia, Kaiser Permanente Hawaii, Kaiser Permanente Colorado, and Fallon Community Health Plan in Massachusetts. The study protocol was approved by the institutional review boards at each site.

Eligible participants were adults aged 40 to 70 years at the time of recruitment, who had been enrolled with one of the participating health plans for at least 5 years, were able to speak and understand English, and had no physical or psychological limitations that would interfere with participating in data collection efforts including interviews and surveys. To recruit a diverse study population, sampling at three sites (Fallon Community Health Plan, Kaiser Permanente Georgia, and Kaiser Permanente Hawaii) was stratified by U.S. Census-based estimates of educational level. At Kaiser Permanente Georgia, sampling was further stratified to ensure that African American and White members were invited in equal numbers within educational strata. At Kaiser Permanente Colorado, only Hispanic adults were recruited; potential participants were identified using health care system data on race/ethnicity and language preference to identify members who self-identified as Latino and had English as their preferred language. Recruitment methods included direct mailings,

telephone follow-up, and offering multiple study session locations. Participants provided written informed consent and received \$50 incentives for participation. Across the four sites, a total of 1,074 individuals participated and are included in the present study. Further details on participant recruitment and data collection procedures are reported elsewhere [11–13].

Data Collection and Measures

The study measures were part of a broad-ranging survey assessing numerous health cognitions and behaviors. Trained research assistants at each site administered all study measures in-person and orally during an approximately 2-hour session.

Ambiguity aversion was assessed using the AA-Med scale (Table 1), a 6-item measure assessing cognitive, affective, and behavioral manifestations of aversion to ambiguity regarding medical tests and treatments [4]. Ambiguity aversion as assessed by the AA-Med scale has been shown to be associated with diminished interest in a hypothetical ambiguous cancer screening test [4]. For the current study, wording of the original scale was adapted to make the items specific to cancer screening. AA-Med scores were calculated by averaging scores of individual scale items (range 1–4); participants with 2 missing items (n=16) were dropped from analysis, leaving 1,057 participants in the analytic sample.

Cancer screening cognitions assessed in the current study pertained to three different screening tests that vary in their associated ambiguity: colonoscopy for colon cancer screening, mammography for breast cancer screening, and prostate-specific antigen (PSA) testing for prostate cancer screening. The comparative level of ambiguity—judged with respect to the strength of existing evidence and the degree of consensus among clinical practice guidelines—is greatest for PSA testing, least for colonoscopy, and intermediate for mammography (given the lack of definitive evidence about its mortality benefit in women aged 40–49) [14]. *Perceived benefit of screening* was assessed using two items. The first assessed the perceived mortality reduction associated with screening: “Having a [colonoscopy/mammogram/PSA test] will reduce my chances of dying from [colon cancer/breast cancer/prostate cancer].” The second assessed the perceived reassurance from undergoing screening: “Having a normal [colonoscopy/mammogram/PSA test] would reassure me that I don’t have [colon cancer/breast cancer/prostate cancer].” *Perceived harm of screening* was also assessed using two items. The first assessed perceived discomfort associated with screening: “Having a [colonoscopy/ mammogram/PSA test] is unpleasant.” The second assessed fear of screening: “Thinking about having a [colonoscopy/ mammogram/PSA test] would make me nervous about what they might find.” *Ambivalence about screening* was assessed with a single item: “I have mixed feelings about having a [colonoscopy/mammogram/PSA test].” All items used a 4-point response scale ranging from “Strongly Disagree” to “Strongly Agree.” *Intentions for future screening* were assessed with a single item with a “Yes/No” response option: “Do you plan on having a [colonoscopy/ mammogram/PSA test]?” Both women and men completed questions about colonoscopy, while only women completed questions about mammography and only men completed questions about PSA testing.

Sociodemographic characteristics included age, sex, race (Black/African American, Asian/Pacific Islander, White, Hispanic, Other), and education (High school or less, Some college, Bachelor's degree, Graduate degree).

Data analyses

Simple descriptive statistics were computed for all study variables. ANOVA was used to test univariate associations between both health cognitions and sociodemographic factors (independent variables) and AA-Med scores (dependent variable), and ANCOVA using general linear models was used to test multivariate associations adjusting for sociodemographic factors. We also conducted sensitivity analyses limited to the subpopulation of participants ≥ 50 years old, given that for adults aged 40–49, existing clinical practice guidelines do not recommend colonoscopy or PSA screening, and vary in their recommendations for mammography.

Results

Among the total sample (N=1067), 453 (42.5%) had a colonoscopy within the previous five years (earlier colonoscopy utilization data were unavailable), while among all females (N=630) 485 (77.0%) had a mammogram within the previous one year, and among all males (N=437) 211 (48.3%) had a PSA test within the previous year. Other characteristics of the study population are listed in Table 2. The sample had substantial sociodemographic diversity; 51.6% were non-White and 26.5% had an educational level of high school or less. The AA-Med scale demonstrated acceptable internal consistency reliability ($\alpha=.77$).

Table 2 also shows the associations between sociodemographic characteristics and individual-level AA, as assessed by the AA-Med scale. Higher AA was associated with lower education but not with other sociodemographic characteristics. Table 3 shows the adjusted associations between individual-level AA and different cancer screening cognitions. The pattern of associations was broad and non-specific; higher individual-level AA was significantly associated ($p<.05$) with nearly all cognitions examined, including lower perceived benefits (mortality reduction, reassurance), greater perceived harms (unpleasantness, fear of screening), and greater ambivalence about screening. Notably, the associations between individual-level AA and these multiple screening-related cognitions were also broadly consistent across all three cancer screening tests (colonoscopy, mammography, PSA testing). The exceptions were perceived reassurance from PSA screening and perceived unpleasantness of mammography, which were not associated with individual-level AA, and future intentions for cancer screening. Higher individual-level AA was associated with lower intentions for only colonoscopy (the least ambiguous of the three tests), and not for mammography or PSA testing (the most ambiguous of the tests). Sensitivity analyses (not shown) restricting the analytic sample to participants ≥ 50 years old showed no significant differences in either the direction or the magnitude of the observed associations.

Discussion

This study sheds new light on the nature and mechanisms of individual differences in aversion to ambiguity regarding medical tests and treatments. Individual-level AA was broadly and simultaneously associated with multiple pessimistic appraisals—including perceived benefits and harms and greater ambivalence—pertaining to multiple cancer screening tests (colonoscopy, mammography, PSA testing). These associations have several implications regarding the mechanisms by which individual-level AA influences behavior.

First, the overall directions of the observed associations are consistent with the phenomenon of AA, and thus provide indirect support for the hypothesis that individual-level ambiguity aversion promotes more pessimistic appraisals of ambiguous choice options. This conclusion is preliminary, since definitive evidence for a moderating role of individual-level AA can only be obtained by directly assessing how people with different levels of this attribute respond to ambiguous information. Our study, however, provides initial supportive evidence that individual-level AA moderates people's responses to ambiguous medical interventions, and raises the need for further research to confirm these findings.

The more significant implications of our findings relate to the breadth of the potential effects of individual-level AA. Overall, our findings suggest that these effects are insensitive to the degree of ambiguity associated with medical interventions. Patients with higher AA-Med scores perceived lower perceived benefits and greater perceived harms and reported greater ambivalence regarding all three cancer screening tests, including not only PSA testing (a clearly ambiguous intervention) but mammography and colonoscopy—both of which are well-supported by existing scientific evidence and clinical practice guidelines, and hence less ambiguous.

In addition, our findings suggest that the potential effects of individual-level AA are non-specific with respect to the ultimate cause of ambiguity surrounding cancer screening tests. From a normative perspective, any existing ambiguity surrounding the three cancer screening tests (colonoscopy, mammography, PSA testing) pertains primarily to the mortality benefit of the test. Yet patients with higher individual-level AA demonstrated more pessimistic appraisals not only of the tests' mortality benefit but their reassurance value and associated harms (perceived discomfort, aversive findings). Both the non-specific and ambiguity-insensitive pattern of these associations suggests that the negative cognitive appraisals associated with individual-level AA result from heuristic rather than systematic reasoning processes. Individual-level AA as measured by the AA-Med scale may ultimately constitute a non-deliberative cognitive bias against medical interventions in general.

At the same time, our findings also suggest that the effects of this anti-interventionist bias on decision making are not straightforward. Among all of the health cognitions measured in our study, future cancer screening intentions were the most direct proxy for actual behavior and indicator of AA. Yet contrary to predictions, higher AA-Med scores were negatively associated with lower cancer screening intentions only for colonoscopy (the least ambiguous of the three tests examined) and not for PSA screening (the most ambiguous) or mammography. These findings suggest that the effects of individual differences in AA on

screening intentions (and ultimately behaviors) are moderated and/or mediated by other, unmeasured factors. In the case of PSA screening, for example, prevailing standards of care and the attitudes of physicians and patients may increase screening intentions despite the ambiguity surrounding the net benefits of this intervention. Notably, data collection for this study occurred before release of the 2012 revised US Preventive Services Task Force recommendation against PSA screening, and the highly-publicized controversy about this recommendation. Nevertheless, the ambiguity-insensitive nature of the associations between individual-level AA and future cancer screening intentions is counterintuitive, and raises the need for more research to understand the factors that modify the effects of individual-level AA.

More research is also needed to address other study limitations and alternative explanations for our findings. The current study was part of a larger study in which participants were exposed to other spoken health messages related to cancer prevention and screening; this exposure may thus have influenced participants' perceptions of the three screening tests. We do not believe any such influence was significant, however, given that the AA measure was administered *before* participants were exposed to cancer prevention and screening messages. One might also argue that all of the cancer screening tests examined in our study are ambiguous to at least some degree, and that firm inferences thus cannot be drawn about how individual-level AA affects patients' responses to unambiguous interventions. Mammography for breast cancer screening in women aged 40–49 has been a matter of controversy, for example, as has the question of the optimal screening test for colon cancer. We believe there are still meaningful differences in the degree of ambiguity associated with these tests; however, more research—examining a greater number of medical tests and treatments of varying ambiguity—is required to establish how individual-level AA affects health cognitions and behaviors. Furthermore, the degree of ambiguity that patients themselves perceive—regardless of whatever ambiguity exists from the perspective of experts—remains an open question and the ultimate determinant of patients' judgments and decisions. We did not assess these or related perceptions, such as patients' familiarity with the three screening tests or any associated controversies. Assessing these perceptions is an important focus for future research.

One might also argue that the observed associations between individual-level AA and at least some of the cognitions examined in this study—e.g., ambivalence and lower intentions regarding breast, colon, and prostate cancer screening—are simply a measurement artifact attributable to the fact that the AA-Med scale ascertains closely related cognitions. We believe this explanation is unlikely, however, given that the AA-Med scale assesses attitudes towards an unspecified “medical test that checks for cancer”—not colonoscopy, mammography, PSA testing, or any other specific cancer screening test (Table 1). Furthermore, the AA-Med scale focuses not on any test whatsoever but specifically on *ambiguous* tests for which there are conflicting expert opinions; it neither mentions breast, colon, or prostate cancer screening tests, nor attributes conflicting expert opinions to these tests. Nevertheless, more research—measuring individual-level AA in different ways and with differing levels of domain-specificity—is needed to understand the extent to which this attribute affects health cognitions and behaviors.

Other study limitations include the sample population, which was sociodemographically diverse but limited to members of large, mature, integrated health care delivery systems that provide a high level of access to health information and services. Although the consistency of our findings with past theory and empirical evidence on AA supports their validity, more research is needed to determine the generalizability of our findings to other patient populations. Corroborating this need, the current study diverged from the original AA-Med scale development study in demonstrating significant associations between AA-Med scores and education level only, and not age, sex, or race [4]. At least some of these negative findings are arguably unexpected; for example, one might expect sex-based differences in AA given that females are often more engaged in decision making than males [14] [15]. Notably, the former study notably utilized a national sample with a substantial proportion of patients aged less than 40 (39%) and greater than 70 (10%), as well as smaller proportions of minorities (31%) and college graduates (31%) than the current study. The influence of sociodemographic factors on ambiguity aversion is thus an important focus for future research, particularly since the observed influence of factors such as education level raises the interesting question of whether individual-level AA might be alterable through educational interventions. Finally, our study also assessed behavioral intentions rather than actual cancer screening behaviors. Behavioral intentions predict behaviors and are a central element in health behavior theories such as the Theory of Planned Behavior; however, multiple factors influence their effects [16]. Further research examining actual screening behaviors is needed to definitively establish the predictive validity of the AA-Med scale and the relationship between individual differences and actual manifestations of AA.

Despite these limitations, the current study provides important preliminary evidence that individual-level aversion to ambiguity regarding medical tests and treatments constitutes a broad cognitive bias against medical intervention, characterized by pessimistic cognitive appraisals that are both insensitive to the degree and non-specific with respect to the causes of ambiguity. The study thus sheds new light on an old problem. Nearly four decades ago Sackett and Holland famously characterized people who oppose screening interventions in the absence of definitive scientific evidence as “snails,” in contrast to “evangelists” who advocate interventions in spite of uncertainty [17]. The individual differences separating snails and evangelists have since remained poorly understood, but the current work furnishes seminal evidence that AA constitutes a measurable, wide-ranging cognitive bias that contributes to these differences. It remains for further research to elucidate the causes and mechanisms of this bias, and the ways in which clinicians might help patients make better decisions under conditions of ambiguity.

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Table 1

Ambiguity Aversion in Medicine (AA-Med) Scale.

Please imagine that you are considering having a medical test that checks for cancer. Experts have conflicting opinions about this medical test. Tell me if you would strongly agree, agree, disagree, or strongly disagree with the following statements.

1. I would still be willing to have the test.
 2. The conflicting opinions would make me upset.
 3. The conflicting opinions would lower my trust in the experts.
 4. I would be afraid of trying the test.
 5. I would avoid making a decision about the test.
 6. I would not have confidence in the test.
-

All items rated on 4-point Likert scale ranging from Strongly Disagree-Strongly Agree; Item 1 reverse-coded

Table 2

Sociodemographic characteristics and their association with individual-level ambiguity aversion as assessed by the Ambiguity Aversion in Medicine (AA-Med) scale.

		N	%	Ambiguity Aversion (AA-Med Score) ^a	p
Age				Mean (SD)	
	40–49	191	18.1	2.31 (0.44)	0.12
	50–59	394	37.3	2.24 (0.39)	
	60–69	448	42.4	2.23 (0.38)	
	70–74	24	2.3	2.18 (0.41)	
Sex	Female	624	59.0	2.26 (0.39)	0.31
	Male	433	41.0	2.23 (0.40)	
Education					
	High School or less	279	26.5	2.30 (0.40)	0.03
	Some college	289	27.4	2.23 (0.39)	
	Bachelor's degree	258	24.5	2.24 (0.42)	
	Graduate degree	229	21.7	2.21 (0.37)	
Race					
	Black/African American	145	13.7	2.25 (0.42)	0.13
	Asian/Pacific Islander	141	13.3	2.27 (0.40)	
	White	512	48.4	2.25 (0.40)	
	Hispanic	196	18.5	2.27 (0.37)	
	Other/Unknown	63	6.0	2.12 (0.44)	

^a Mean scores on Ambiguity Aversion in Medicine (AA-Med) measure (range 1–4); higher scores indicate greater ambiguity aversion

Table 3

Associations between cancer screening cognitions and individual-level ambiguity aversion as assessed by the Ambiguity Aversion in Medicine (AA-Med) scale.

	N	%	Ambiguity Aversion (AA-Med score) ^a	
			Mean (95% CI)	p
Perceived benefit: Mortality reduction				
Colonoscopy	238	23.3	2.14 (2.08, 2.21)	0.007
Strongly agree	614	60.1	2.22(2.17, 2.28)	
Disagree	138	13.5	2.24 (2.16, 2.31)	
Strongly disagree	31	3.0	2.36 (2.22, 2.51)	
Mammography	125	20.1	2.08 (1.98, 2.17)	0.002
Strongly agree	380	61.2	2.22 (2.14, 2.29)	
Disagree	96	15.5	2.25 (2.14, 2.35)	
Strongly disagree	20	3.2	2.29 (2.11, 2.48)	
PSA	39	15.2	1.99 (1.86, 2.13)	<0.001
Strongly agree	164	63.8	2.24 (2.15, 2.33)	
Disagree ^b	54	21.0	2.24 (2.12, 2.36)	
Perceived benefit: Reassurance				
Colonoscopy	214	21.0	2.13 (2.06, 2.19)	<0.001
Strongly agree	749	73.4	2.24 (2.18, 2.29)	
Disagree ^b	58	5.7	2.29 (2.18, 2.40)	
Mammography	100	16.1	2.05 (1.95, 2.15)	<0.001
Strongly agree				

	N	%	Ambiguity Aversion (AA-Med score) ^a	p
Agree	447	71.8	2.23 (2.15, 2.30)	
Disagree ^b	76	12.2	2.22 (2.11, 2.34)	
PSA				0.07
Strongly agree	25	9.7	2.05 (1.89, 2.21)	
Agree	188	73.2	2.23 (2.14, 2.33)	
Disagree ^b	44	17.1	2.20 (2.07, 2.33)	
Perceived harm: Unpleasant				
Colonoscopy	190	18.7	2.21 (2.14, 2.28)	<0.001
Strongly agree	513	50.6	2.25 (2.19, 2.30)	
Agree	276	27.2	2.20 (2.14, 2.27)	
Disagree	35	3.5	1.90 (1.77, 2.03)	
Strongly disagree				
Mammography	123	19.7	2.18 (2.08, 2.28)	0.91
Strongly agree	341	54.7	2.21 (2.13, 2.29)	
Agree	149	23.9	2.19 (2.10, 2.28)	
Disagree	10	1.6	2.19 (1.93, 2.44)	
Strongly disagree				
PSA	33	13.8	2.38 (2.24, 2.52)	<0.001
Agree ^c	156	65.3	2.20 (2.12, 2.29)	
Disagree	50	20.9	1.99 (1.86, 2.11)	
Strongly disagree				
Perceived harm: Fear				
Colonoscopy	39	3.8	2.30 (2.17, 2.42)	<0.001
Strongly agree	380	37.2	2.32 (2.26, 2.37)	
Agree				

	N	%	Ambiguity Aversion (AA-Med score) ^a	p
Disagree	503	49.3	2.18 (2.13, 2.23)	
Strongly disagree	99	9.7	1.88 (1.79, 1.96)	
Mammography				<0.001
Strongly agree	12	1.9	2.26 (2.03, 2.49)	
Agree	176	28.3	2.28 (2.20, 2.37)	
Disagree	352	56.5	2.22 (2.14, 2.29)	
Strongly disagree	83	13.3	1.98 (1.88, 2.09)	
PSA				<0.001
Agree ^c	62	24.1	2.37 (2.26, 2.48)	
Disagree	152	59.1	2.20 (2.11, 2.29)	
Strongly disagree	43	16.7	1.93 (1.80, 2.05)	
Future screening intentions				
Colonoscopy				0.004
Yes	891	87.5	2.19 (2.14, 2.24)	
No	127	12.5	2.30 (2.22, 2.37)	
Mammography				0.15
Yes	609	98.4	2.19 (2.12, 2.27)	
No	10	1.6	2.37 (2.12, 2.62)	
PSA				0.87
Yes	211	87.9	2.19 (2.10, 2.28)	
No	29	12.1	2.18 (2.02, 2.34)	
Ambivalence about screening				
Colonoscopy				<0.001
Strongly agree	40	3.9	2.37 (2.24, 2.49)	
Agree	268	26.3	2.30 (2.24, 2.36)	

	N	%	Ambiguity Aversion (AA-Med score) ^a		p
			Mean	(95% CI)	
Disagree	573	56.1	2.21	(2.15, 2.26)	
Strongly disagree	140	13.7	1.94	(1.87, 2.02)	
Mammography					<0.001
Strongly agree	9	1.4	2.71	(2.46, 2.96)	
Agree	79	12.7	2.40	(2.30, 2.50)	
Disagree	421	67.6	2.22	(2.15, 2.29)	
Strongly disagree	114	18.3	1.95	(1.85, 2.04)	
PSA					<0.001
Agree ^c	40	15.6	2.37	(2.24, 2.50)	
Disagree	167	65.0	2.24	(2.15, 2.33)	
Strongly disagree	50	19.4	1.96	(1.84, 2.08)	

^aMean scores on Ambiguity Aversion in Medicine (AA-Med) measure (range 1–4) from multivariate ANCOVA models adjusted for age, sex, race, and education; higher scores indicate greater ambiguity aversion; mammography and PSA analyses limited to females and males, respectively and not adjusted for sex.

^bWhen N = 5 for "strongly disagree", collapsed and included in "disagree".

^cWhen N = 5 for "strongly agree", collapsed and included in "agree".