TESTING THE EFFECTIVENESS OF COMMUNICATION-BASED STRATEGIES TO SUPPORT SOUTH KOREAN WOMEN'S INFORMED DECISION-MAKING ABOUT LOW-VALUE CANCER SCREENING

by

SOELA KIM

(Under the Direction of Jennifer L. Monahan)

ABSTRACT

Overuse of low-value cancer screening may result in overdiagnosis and overtreatment of low-risk cancers that can harm patients' well-being and the healthcare system. This dissertation developed theoretical frameworks explicating the processes underlying cancer screening intention by extending the multicomponent theory of planned behavior to include risk perceptions and anticipated regret. The developed frameworks were applied to the design of communication-based strategies to curb low-value screening: (1) removing the word cancer from the disease label to reduce risk perceptions, (2) highlighting negative affective consequences of cancer screening to reduce attitudes, and (3) providing information about diagnostic uncertainty to reduce anticipated regret.

612 South Korean women aged 20 to 59 participated in an online survey-based experiment employing a 2 (disease label: thyroid cancer vs. a borderline thyroid neoplasm) × 2 (a message about affective consequences: absent vs. present) × 2 (diagnostic uncertainty information: absent vs. present) full-factorial between-subject design with a control condition.

Participants read a scenario in which they had a regular health checkup scheduled and then received an information booklet about an optional screening test for thyroid disease.

Attitudes and injunctive norms increased screening intention directly and indirectly (via anticipated regret). Perceived susceptibility increased screening intention only indirectly (via anticipated regret). The interaction effect between perceived severity and susceptibility on screening intention was significant, such that when perceived severity was low, perceived susceptibility directly increased intention. When perceived severity was high, perceived susceptibility directly reduced intention. Capability directly increased screening intention, but unexpectedly autonomy reduced it.

The alternative disease label reduced perceived severity not susceptibility; and that reduction led to a decrease in anticipated regret, which then reduced screening intention. The affective message reduced screening intention through two pathways: (1) lower positive attitudes and (2) lower positive attitude to less anticipated regret. Although the diagnostic uncertainty information reduced anticipated regret, its effect disappeared when included in a model with other predictors of anticipated regret. Of the three strategies, only the alternative label increased intention *not* to undergo screening, but the effect was not explained by the developed theoretical framework. Implications of these findings are discussed along with directions for future research.

INDEX WORDS: overuse, low-value cancer screening, theory of planned behavior, risk perception, anticipated regret, disease label, affective message, diagnostic uncertainty

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CHAPTER 1

INTRODUCTION TO THE PROBLEM

Chapter 1 first provides an overview of the problem of the overuse of low-value cancer screening. Chapter 1 also demonstrates how the problem has unfolded in South Korea, which is the context of this dissertation. Third, it discusses limitations and implications of existing approaches to curb the overuse of low-value screening that focus on simple provision of evidence-based, balanced information about uncertain health-related benefits and potential health-related harms of low-value screening. At the end, the three primary objectives of this dissertations are introduced.

Overview of the Problem: Overuse of Low-value Care, Overdiagnosis, and Overtreatment

In medical care, there is a popular deep-seated belief that 'more is better' (Fisher, 2003). The culture that has long embraced the 'more is better' mantra has been identified as one driver of excessive utilization of low-value care (Levinson et al., 2015; Pathirana et al., 2017). Low-value care is broadly defined as healthcare services (i.e., medical procedures, tests, and treatments) that do not provide clear benefits to patients, have a potential for harms that exceed possible benefits, or are not cost effective (Elshaug et al., 2017). Given the total amount of medical resources is limited, the use of low-value care for one patient may restrict healthcare access for another person who may genuinely need care. Thus, the use of low-value care can amount to social injustice in a sense that it diverts finite healthcare resources away from other pressing medical needs (Black, 2000; Cassel & Guest, 2012; Kale & Korenstein, 2018). This

dissertation focuses on a demand-side intervention aimed at reducing the overuse of low-value thyroid cancer screening.

Screening for thyroid cancer in asymptomatic individuals is increasingly considered as low-value care. The goals of cancer screening are to look for early signs of cancers before there are any symptoms to enable early treatment and to prevent death from cancer. However, thyroid cancer screening has not been shown to reduce the mortality rate for thyroid cancer and is known to be associated with potential harms such as false positives, overdiagnosis, and overtreatment (Ahn et al., 2014; Vaccarella et al., 2016). Overdiagnosis in the context of cancer screening refers to identifying abnormalities that corresponds to the pathological definition of cancer, but would not have gone on to cause symptoms or harm individuals in their lifetime without cancer screening (Black, 2000). Overdiagnosis is problematic because it often leads to unnecessary diagnostic procedures (e.g., biopsies) and overtreatment. Overtreatment basically refers to low-value treatments (e.g., surgery, chemotherapy, radiation, or medication) that provide patients no benefits, but only adverse effects such as complications derived from the treatment of tumors that would never have clinically manifested (Wegwarth & Gigerenzer, 2013).

Overdiagnosis also can create a self-affirming, positive cycle. If a lot of people with over-diagnosed cancers are included in survival statistics, the survival rate will be inflated. This is known as lead time bias, a misleading consequence of overdiagnosis. The apparent improvement in the survival statistics, in turn, would encourage more testing of others and more overdiagnosis (Ebell & Herzstein, 2015). Given overdiagnosis can be both a cause and a result of the use of low-value care, there is a pressing need to break the self-affirming cycle by reducing low-value care to reduce unnecessary suffering of patients and enable the effective use of medical resources.

The Epidemic of Thyroid Cancer in South Korea

Overdiagnosis of thyroid cancer is a global issue, but particularly prominent in South Korea. Thus, South Korea provides an important context to study the issues related to the overuse of low-value cancer screening, overdiagnosis, and overtreatment. Concerns about overdiagnosis of thyroid cancer in South Korea have begun to be raised as the thyroid cancer incidence has increased significantly over the past two decades. In South Korea, the incidence increased slowly during the 1990s, then rapidly after 2000. In 2011, the incidence was 15 times higher than in 1993, making South Korea the country with the highest incidence of thyroid cancer in the world (Ahn et al., 2014). According to the most recent nationwide statistics, thyroid cancer is the most commonly diagnosed cancer among women in South Korea (Hong et al., 2020). This "epidemic" of thyroid cancer represents a classic example of cancer overdiagnosis. It is now well-known in international scientific community that the rapid and unprecedented increase in the incidence of thyroid cancer over a short time span was mainly driven by the increased incidental detection of papillary thyroid carcinoma—small (1 cm or less in diameter) low-risk lesions that will not develop aggressively—through screening with ultrasonography that sensitively detects smaller nodules/lumps that are difficult to be detected by palpation test (Ahn et al., 2014; Ahn & Welch, 2015; Park et al., 2016; Udelsman & Zhang, 2014).

Despite the fact that most thyroid cancers found incidentally by ultrasonography (i.e., papillary thyroid carcinoma) have a generally slow clinical course, thyroid cancer diagnosis is typically followed by unnecessary treatments. Virtually all individuals who received a diagnosis of thyroid cancer underwent thyroidectomy (i.e., the surgical removal of part or all of thyroid gland) which has risks of complications, including vocal cord paralysis and could necessitate life-long thyroid hormone replacement (Ahn et al., 2014; B. Y. Cho et al., 2013; Vaccarella et

al., 2016). Unfortunately, in spite of the medical resources poured into screening for and treatment of thyroid cancer, during the same period, thyroid cancer mortality remained almost unchanged over that time period (Ahn et al., 2014; Ahn & Welch, 2015). Figure 1 demonstrates the large gap between trends in thyroid cancer incidence and mortality from 1993 to 2011. The patterns of incidence and mortality indicate that more thyroid cancer screening does not meaningfully lower the number of women who die from thyroid cancer.

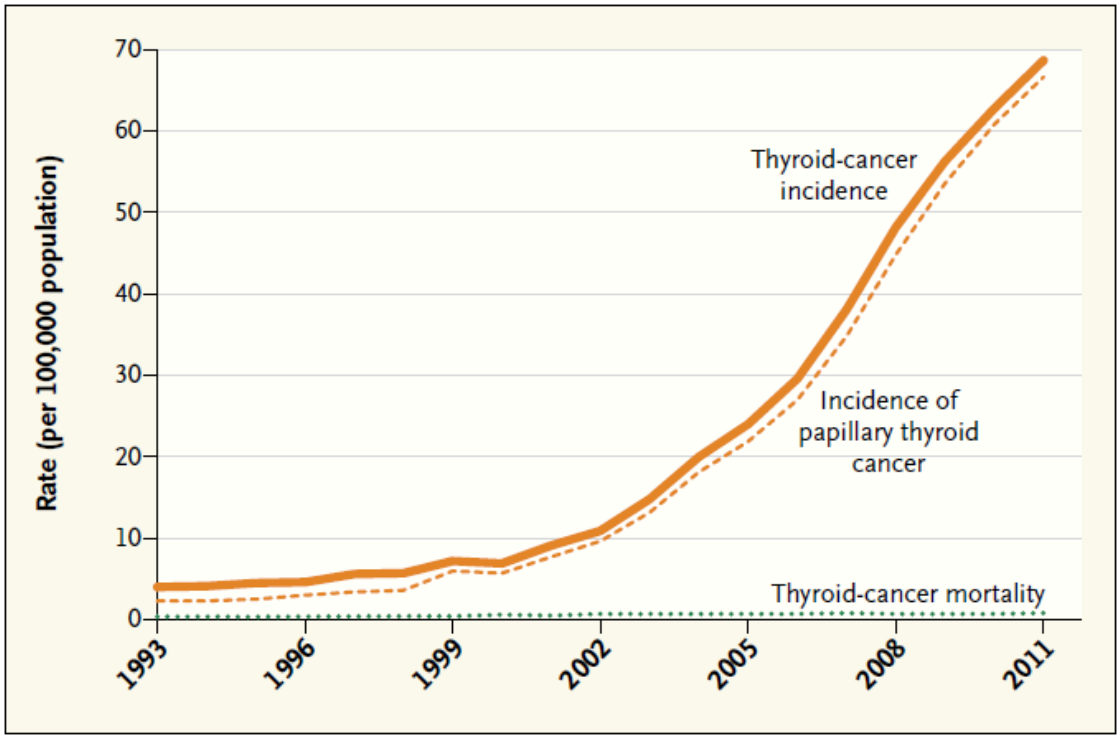

Figure 1 *Thyroid cancer incidence and mortality in South Korea (Ahn, Kim, & Welch, 2014)*

Why is the problem of overdiagnosis of thyroid cancer more pronounced in Korea compared to countries with similar healthcare systems? Accessibility and affordability of thyroid cancer screening with ultrasonography may provide one key answer. Thyroid ultrasonography has become affordable and highly accessible in South Korea since the healthcare reform in 2000.

The government-funded national cancer screening and health checkup program launched in 1999 provides screening for some common cancers and diseases free of charge or with a minimum copayment. Although thyroid cancer screening is not part of the national screening program, most healthcare providers offer thyroid cancer screening with ultrasonography as a low-priced (about $40 on average) add-on. Furthermore, many hospitals and general practitioners now sell routine health check-up programs that include thyroid ultrasonography for revenue generation purposes (Ahn et al. 2014). Experts generally have concurred in their view that cancer overdiagnosis and overtreatment are largely attributable to the healthcare provider-induced demand coupled with the public's general beliefs that early detection of cancer is the best way to stop developing or dying from cancer (Pathirana et al., 2017; Schwartz et al., 2004; Waller et al., 2015).

In response to calls for urgent action from the government and medical community to stop overdiagnosis (Y. J. Kim, 2014; Lee & Shin, 2014), in 2015, a task force led by the South Korean government issued the Korean guideline for thyroid cancer screening with ultrasonography, stating that "thyroid ultrasonography is not routinely recommended for healthy subjects because the gain or harm is not clearly defined at the current evidence level" (Yi et al., 2015, p. 302). In addition, the guideline also states that if asymptomatic individuals request thyroid ultrasonography, ultrasonography can be offered on the condition that they are provided with information about the potential benefits and harms of thyroid cancer screening (p. 310). Thus, the guideline recommends that a decision regarding whether to undergo thyroid ultrasound screening should be based not only on what is best from a medical point of view, but also on how individuals value the potential benefits and harms of thyroid ultrasound screening. The Korean guideline contrasts with US Preventive Services Task Force (USPSTF)'s guideline that explicitly

recommends against screening for thyroid cancer in asymptomatic adults (Bibbins-Domingo et al., 2017). The difference could be due to that the Korean guideline was developed mainly based on opinions of interest groups such as thyroid specialists, especially surgeons, whereas the USPSTF guideline was developed by an independent panel of nonfederal experts in prevention and evidence-based medicine. Leaving the difference aside, according to the Korean guideline, the following two decisions could be considered adequate or appropriate: (1) a decision not to undergo thyroid ultrasound screening, and (2) a decision that is based on decision-relevant knowledge and that represents the values of the decision maker (Dierks et al., 2019; Marteau et al., 2001).

Given the Korean guidelines, whether to undergo thyroid ultrasound screening qualifies as a *preference-sensitive decision* which is defined as a decision for which no one option is particularly better (Elwyn et al., 2009). In preference-sensitive healthcare decisions, the value of healthcare is ideally determined by fully informed individuals who are able to evaluate and weigh the benefits and risks of each decision option in the context of their preferences (Colla et al., 2017; Sox, 2013). Thus, the appropriate or adequate decision for such preference-sensitive decision depends primarily upon individuals' preferences. However, it should be acknowledged that the process in which individuals evaluate and weigh the risks and benefits of cancer screening is not completely free from social and cultural influences that highly value cancer screening. In fact, since the issue of overdiagnosis received media coverage and the following establishment of the Korean guideline in 2015, there has been a marked decrease in thyroid cancer incidence and surgical operations. The decrease could be attributed to an increased awareness about overdiagnosis among physicians and the general public (Ahn & Welch, 2015). However, according to a study published in 2016, the public awareness of overdiagnosis is still

low, such that only 27.8% of South Korean women who participated in that study reported that they were aware of overdiagnosis (Lee et al., 2016). Moreover, the majority of the participants intended to undergo thyroid cancer screening before and even after receiving information on overdiagnosis (87% and 74%, respectively). This result suggests that lay individuals' preferences may be biased in favor of undergoing thyroid cancer screening. In this situation, concerted efforts are needed to demote the use of low-value care by reducing the gap between what is best from a medical point of view and what lay individuals value and prefer.

Providing Balanced, Factual Information is Necessary, but Not Sufficient

As aforementioned, the cultural enthusiasm for cancer screening and the increased accessibility and affordability of thyroid cancer screening together might have created an environment ripe for the overuse of thyroid cancer screening in South Korea. Thus, both health provider-side and demand-side interventions may be equally necessary. I focus on demand-side interventions aimed at reducing the overuse of low-value thyroid cancer screening.

The natural first approach to tackling the overuse of low-value cancer screening at the individual level has been to provide individuals with evidence-based, balanced information about potential health-related harms (e.g., overdiagnosis and overtreatment) as well as uncertain health-related benefits of cancer screening (e.g., limited efficacy in reducing mortality) through awareness campaigns (e.g., Choosing Wisely®, Cassel & Guest, 2012) and patient education using various communication tools (McDowell et al., 2019; Pathirana et al., 2017; Shaffer & Scherer, 2018; Sheridan et al., 2016). Communicating the health-related harms and benefits involved in cancer screening is a necessary first step toward increasing the quality of preference-sensitive decisions and addressing the overuse of low-value screening. However, a growing body of evidence suggests that factual information giving is not sufficient to curb the desire for cancer

screening of questionable value. For example, after receiving information about lack of benefits and presence of harms in prostate-specific antigen (PSA) screening, 58.8% of U.S. male participants still wanted screening (Scherer et al., 2018). In another experimental study (Scherer et al., 2019), 43.6% of U.S. adults wanted to be screened for cancer using a test that is explicitly stated to have no life-saving benefits, while accurately recalling the benefits and risks profile of the cancer screening. Similar null effects of factual information provision was found in tests of different information formats (e.g., words, numbers, narrative, message framing, and visual aids) on changes in intention to undergo low-value screening (McDowell et al., 2019; Sheridan et al., 2016). Another common finding across studies was that although individuals' knowledge about the health benefits and harms of cancer screening varied by information formats, their intention for screening of low-value or willingness to participate in potentially low-value screening did not vary based on the information format.

The studies briefly reviewed have two important implications. First, lay individuals' desire for low-value cancer screening may not be simply attributed to the lack of knowledge about the harms of cancer screening or misconceptions about life-saving benefits of cancer screening. That is, factors other than the knowledge inadequacy may also significantly contribute to the use of low-value cancer screening. Second, to support decision-making about low-value cancer screening, intervention strategies need to be developed based on the understanding of the mind of lay individuals, moving beyond provision of evidence-based, balanced information to affect screening intentions.

Overview of The Dissertation

The present dissertation is motivated by the need for a better understanding of motivations to undergo screening that is considered by experts to be low-value and the need for

practical suggestions for communication-based strategies to promote lay individuals' informed decision-making about taking low-value screening tests without falling into unwarranted enthusiasm for cancer screening. This dissertation has three specific primary objectives. The first objective is to develop theoretical frameworks that explicate the processes that are hypothesized to determine cancer screening intention, and thus screening behavior. The second objective is to use the developed frameworks to propose communication-based strategies that could help reduce intention to undergo low-value screening. The third objective is to empirically examine the effectiveness of the strategies among women living in South Korea. Each objective is elaborated briefly below.

Goal 1: Theoretical framework. The fact that the non-negligible number of lay individuals intended to undergo cancer screening of questionable value (i.e., with uncertain benefits and possible harms) calls for scholarly efforts to understand underlying reasons for cancer screening. Thus, this dissertation proposes and tests a theoretical framework (and its alternative theoretical framework) that explain and predict screening intention by integrating social-cognitive and affective factors that have been found to be associated with detection behaviors, particularly cancer screening behavior. Specifically, I use a multicomponent model of the theory of planned behavior (Conner & Sparks, 2015; Fishbein & Ajzen, 2010) as a groundwork on which to construct a new theoretical framework. The TPB predicts behavioral intentions using three predictors: Attitudes, subjective norms and perceived behavioral control (PBC). The multicomponent TPB breaks these 3 key components into two subcomponents. Attitude is split into affective and cognitive/instrument attitudes; subjective norms is split into injunctive and descriptive norms; and perceived behavioral control is split into capability and autonomy. I first examine how these components may predict intentions to get screened for

thyroid cancer in asymptomatic women. Then, in the light of results of empirical applications of the TPB and other theories of health behaviors (i.e., protection motivation theory, Rogers, 1975; Rogers, 1983) and decision making (i.e., decision justification theory, Connolly & Zeelenberg, 2002), two additional variables were integrated into the multicomponent the TPB: Risk perception (i.e., perceived severity and susceptibility) and anticipated regret.

Two theoretical frameworks were developed to explicate the processes that were hypothesized to determine cancer screening intention. A *parallel model* proposes that attitudes (i.e., affective, cognitive/instrumental), subjective norms (i.e., descriptive and injunctive), and perceived behavioral control (i.e., capability and autonomy), risk perception (i.e., perceived severity, perceived susceptibility) and anticipated regret with respect to screening non-uptake serve to positively predict cancer screening intention in parallel. A *serial model*, the model alternative to the parallel model, proposes that anticipated regret mediates the effects of attitudes, subjective norms, and risk perceptions on cancer screening intention. Identical to the parallel model, perceived behavioral control in the serial model was proposed to directly predict screening intention. The proposed models may help identify factors that can be targeted by an intervention with the aim of changing screening intention, and thus behavior.

Goal 2: Communication strategies. A second goal is to examine specific communication strategies aimed at reducing screening intentions among asymptomatic individuals. Towards that goal, this dissertation developed decision support material (i.e., patient information booklet) that aims to promote an informed decision-making about low-value thyroid ultrasound screening. The developed theoretical framework was applied to the design of communication-based strategies used in the decision support material. The three strategies and factors targeted are: (1) removing the word cancer from the disease label to reduce risk

perceptions; (2) highlighting negative affective consequences of thyroid ultrasound screening to reduce positive attitudes; and (3) providing information about diagnostic uncertainty to reduce anticipated regret with respect to screening non-uptake.

Goal 3: Empirical test. The third goal of this dissertation was to examine the effectiveness of the three communication-based strategies in a survey-based experiment. The strategies were tested among 612 South Korean women—a population in which the prevalence of thyroid cancer is 4.7 times higher (and therefore are assumed to be more susceptible to overdiagnosis and overtreatment) than men (Hong et al., 2020). Furthermore, I tested if the effects of the communication-based strategies influence screening intention through the constructs in the developed theoretical frameworks. Given the problem of overdiagnosis of some common cancers (e.g., breast cancer and prostate cancer) is increasing rapidly worldwide including less affluent regions (Li et al., 2020), results obtained in this population could serve as cautionary tales or exemplary or exemplary cases for the rest of the world.

Chapter 2 provides the theoretical rational for the developed parallel and serial models. In addition, arguments for the three communication strategies and hypotheses regarding how the communication strategies affect components of the theorized models are explicated. Chapter 3 describes the survey-based experiment used to test the proposed models and hypotheses while Chapter 4 provides the results from this experiment. Finally, Chapter 5 provides a discussion of the results, suggestions for future research and describes limitations of this study.

CHAPTER 2

THEORETICAL RATIONALE AND HYPOTHESES

Chapter two provides the theoretical foundation for the hypotheses and proposed models tested in this dissertation. This chapter has three major sections. In the first and largest section, I review the theory of planned behavior (TPB; Ajzen, 1991) and a multicomponent model of the TPB, and propose to further extend the multicomponent TPB's utility for cancer screening by incorporating anticipated regret and risk perceptions into the model. I also consider an alternative variable ordering within the further extended version of the multicomponent TPB. In the second major section, I propose three communication-based strategies to encourage the reduction in motivation to use low-value screening. In the third and final section, given the preference-sensitive nature of thyroid cancer screening decision, I discuss additional indicators of the effectiveness of the communication-based strategies, namely decisional conflict (i.e., perceived difficulty in making a decision), informed decision (i.e., whether a decision is based on relevant knowledge and consistent with one's value), and intention not to undergo screening. I also consider one possible unintended negative effect of the communication strategies, medical skepticism. Chapter 2 begins with an overview of the TPB.

Overview of the TPB

Original formation of the TPB. Understanding the factors influencing cancer screening decisions is important given it forms the basis for successful interventions promoting informed decision making for cancer screening. The TPB (Ajzen, 1991) serves as an initial platform for understanding individuals' decision making about cancer screening. Being one of the most

broadly applied and empirically validated theories in the behavioral sciences, the TPB provides a parsimonious summary of the determinants of a wide range of behaviors, or the factors that need to be in place for behavior changes to occur. The TPB is found to be nearly as good at predicting health behaviors as it is at predicting other behaviors. According to a meta-analysis of prospective studies using the TPB to predict health behaviors (McEachan et al., 2011), the TPB accounted for about 44% of the variance in intention and 19% of the variance in actual behavior.

Central to the TPB is the assumption that the most important direct determinant of a human behavior is behavioral intention which is individuals' self-instruction or decision to perform the behavior. Forming a behavioral intention signals the end of the contemplation on what individuals may do and indicates how much effort they are willing to exert to perform a behavior of interest. In that sense, intention is considered to summarize one's motivation to perform a particular behavior (Ajzen, 1991). Intention itself is conceptualized as being determined by the three belief-based constructs: Attitude, subjective norms, and perceived behavioral control (PBC). Attitude taps an overall evaluation of performing a target behavior, whether it is positive or negative. Subject norms refer to the perceived social pressure to perform the behavior (i.e., whether others think one should perform the behavior). The last predictor, PBC, is the perceived ease or difficulty of performing the behavior. In summary, according to the TPB, individuals will have strong intentions to perform a particular behavior, when they evaluate the behavior positively, think that important others would want them to perform the behavior, and think that it is easy to perform the behavior (Ajzen, 1991; Fishbein & Ajzen, 2010).

All the three determinants of behavioral intentions are constructs based on beliefs concerning health behaviors. The TPB relies on an expectancy-value formulation to delineate the way in which various beliefs influence attitude, subjective norms, and PBC. Specifically, attitude

is posited to be a function of easily accessible beliefs about the likely outcomes of the behavior, termed behavioral beliefs. Behavioral beliefs are based on two perceptions: The subjective likelihood that performing a target behavior leads to a certain outcome (or is associated with a certain experience), and the evaluation of that the outcome (or the experience). In their aggregate, behavioral beliefs are theorized to contribute to a production of a positive or negative attitude toward the behavior. Consider, for example, the formation of attitudes toward the uptake of cancer screening. Individuals may think that cancer can be detected and treated earlier through screening and/or that cancer screening gives peace of mind about cancer. Because they already have positive evaluations of the outcome of and the experience associated with screening uptake, the beliefs will produce a positive attitude toward the behavior. Subjective norms are beliefs about whether others believe one should or should not perform the behavior. Subjective norms are quantified as individuals' subjective likelihood that specific referent groups (e.g., significant others) will think they should perform the behavior under consideration, multiplied by the individuals' motivation to conform the specific wishes and expectation of the referents. PBC is a function of beliefs about whether one has access to internal control factors (e.g., personal deficiencies, information, specialized skills, and abilities) and external control factors (e.g., time, opportunities, cooperation of others), weighted by the perceived facilitating or inhibiting power of each control factor. These behavioral, normative and control beliefs are sometimes referred to as indirect measures of attitude, subjective norms, and PBC (Ajzen, 1991; Fishbein & Ajzen, 2010).

Figure 2 shows a visual representation of the TPB. As illustrated in Figure 2, the TPB assumes that the effects of any other influences on behavior (i.e. demographic variables, personality traits, perceived risk, past behavior, and intervention) on behavior are mediated by

components contained within the TPB (sufficiency assumption; Azjen, 1991). Thus, some view the TPB as a theory of proximal determinants of behavior (Conner & Armitage, 1998). In addition, although not illustrated in Figure 2, the TPB allows for a feedback loop from behavior. The feedback loop assumes that unexpected outcomes, others' reactions, challenges, or facilitating factors that individuals experience when performing a behavior alter behavioral, normative or control beliefs, thereby affecting their future intentions and behaviors (Fishbein & Ajzen, 2010).

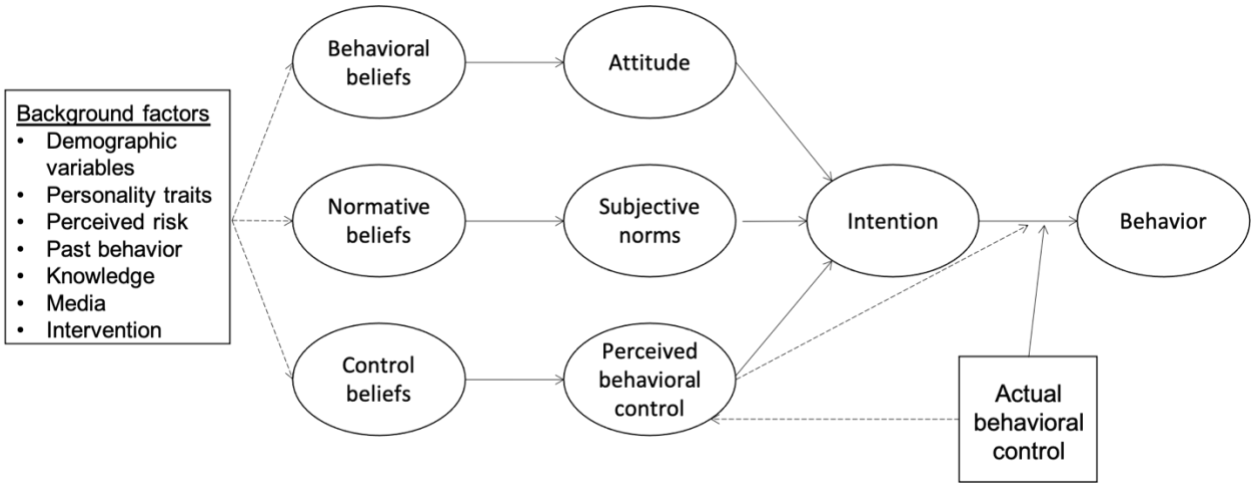

Figure 2 *The theory of planned behavior (Adapted from Fishbein and Ajzen, 2010)*

Multiple-component model of the TPB. The question of whether the constructs and relationships included in the TPB are sufficient for explaining a behavior has been repeatedly raised. In recent years, researchers have sought to extend the TPB with additions of a number of constructs (Conner, 2014; Conner & Armitage, 1998; Conner & Sparks, 2015; Fishbein & Ajzen, 2010; Sheeran & Orbell, 1999). One newly revised version of the TPB is the multicomponent model of the TPB (Conner & Sparks, 2015; Fishbein & Ajzen, 2010). The multicomponent TPB

breaks the three major concepts of attitude, subjective norms, and PBC into two subcomponents. Attitude is split into affective attitude (e.g., pleasant–unpleasant, interesting–boring) and cognitive/instrument attitude (e.g., beneficial–harmful, valuable–worthless). Subjective norms are split into injunctive norms (i.e., perceptions of which behaviors are typically approved or disapproved) and descriptive norms (i.e., perceptions of which behaviors are typically performed). Finally, PBC is split into capability (i.e., the perceived degree of confidence in performing a behavior) and autonomy (i.e., the perceived degree of control over performing the behavior). Figure 3 shows a visual representation of the multicomponent model of the TPB.

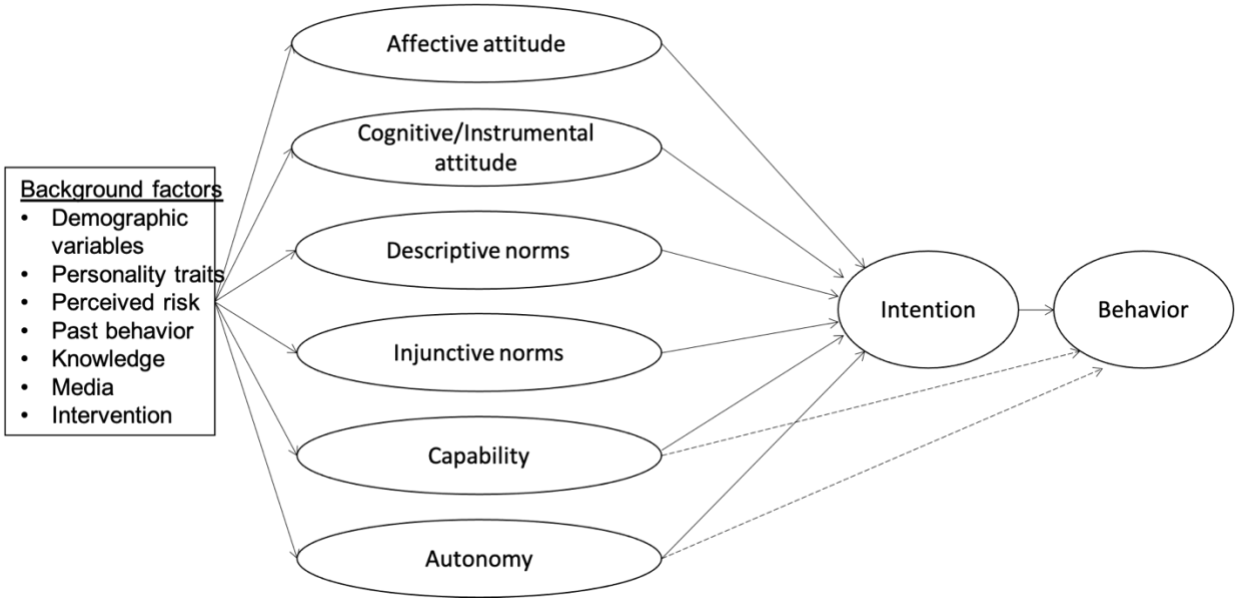

Figure 3 *The multicomponent model of the TPB (Adapted from Conner and Sparks, 2015)*

Ajzen (2002) and Ajzen and Fishbein (2005) suggested to employ a second-order factor where the subcomponents reflect the more general constructs (e.g., affective and cognitive/instrumental attitudes reflect overall attitude toward a given behavior) and use the more general constructs of attitude, social norm, and PBC as predictors of intention. Although

using the 3 general constructs is advantageous from a parsimony perspective, it is disadvantageous in that it requires further theorization of the relationship between a more general TPB construct and its subcomponents—that is, which causes which (Ajzen, 2002; Hagger & Chatzisarantis, 2005; Rhodes & Courneya, 2003). An alternative approach has been to consider each of the subcomponents as separate, independent predictors of intention. This approach is less parsimonious but has the advantage of allowing examination of which subcomponent is the more important predictor and also testing novel pathways (e.g., direct path from affective attitude to behavior) (McEachan et al., 2016). In the interest of proposing and testing more detailed but constrained hypotheses, I utilize a multi-component version of the TPB (Conner & Sparks, 2015; Fishbein & Ajzen, 2010) as a groundwork on which to build a new theoretical framework to explain and predict cancer screening behavior.

The growing number of studies utilizing the multicomponent TPB has prompted several meta-analyses and point to the discriminant validity of the subcomponents (Conner et al., 2017; Conner et al., 2015b; Manning, 2009; McEachan et al., 2016; Rodgers et al., 2008). A meta-analysis by McEachan et al. (2016) demonstrated that the full multicomponent TPB explained a higher percentage of variance than reported in the previous meta-analyses of the original TPB applied to health behaviors (McEachan et al., 2011). The six subcomponents explained 58.7% of the variance in intentions, with all except autonomy serving as significant predictors. Affective attitude and capability were the strongest predictors of intention. The six determinants of intention plus intention explained 32.3% of the variance in behavior with affective attitudes, descriptive norms, capacity and intention being significant.

The limited predictive validity of the TPB for predicting detection behaviors. Several meta-analyses have been reported for the TPB focusing on health behaviors (e.g., Godin

& Kok, 1996; McEachan et al., 2011; McEachan et al., 2016; Sheeran & Taylor, 1999). Those meta-analyses not only summarize findings across independent studies, but also provide valuable insights into research gaps in the literature and suggest directions for next steps. One research gap relevant to this dissertation that I identified by reviewing the meta-analyses was that the predictive ability of the TPB tends to be weaker in detection behaviors.

In their meta-analysis of the original the TPB studies, McEachan et al. (2011) divided health promoting behaviors into three categories: detection, curative behaviors, and preventive (which again subdivided into four categories of abstinence, physical activity, dietary and safer sex behaviors). They noted that the pattern of the results obtained in their meta-analysis was slightly different for detection behaviors. TPB only explained 30.4% variance of intentions for detection behaviors, while it explained 50.3% and 51.3% variances of intentions for dietary and safer sex behaviors. In addition, attitudes were the strongest predictor of intentions for all health promoting behaviors except detection behaviors (where PBC most strongly predicts). Furthermore, the TPB was relatively worse at predicting detection behaviors (14.5% variance explained), compared to physical activity and dietary behaviors (23.9% and 21.2% variation explained, respectively). McEachan et al.'s categorization of health behaviors might not be optimal in that some categories contain single behavioral types while the others are more general categories. Still, the results of their meta-analysis suggest that the TPB is less successful in predicting detection behaviors than in other types of health promoting behaviors.

McEachan et al.'s (2016) meta-analysis of the full multicomponent TPB also reported that the attitude variables and descriptive norms significantly better predicted health risk behaviors (e.g., drinking alcohol, exceeding the posted speed limit, and using drug) than health protection behaviors (e.g., exercise, diet, condoms or sunscreen use, and safe driving).

Unfortunately, McEachan et al.'s meta-analysis in 2016 included only four empirical studies applying the multicomponent TPB to detection behaviors. As a result, detection behaviors were classified into 'other behaviors' category and was not included in the moderator analysis of behavior type. Nonetheless, the results of the meta-analysis suggest that the predictive validity of the TPB-based framework for health behaviors depends on the type of behavior; and that when the multicomponent TPB is used to explain and predict detection behaviors, it may not be as predictive as when it is used in health risk behavior or other type of health promotion behaviors.

The TPB's relatively poorer predictive validity in detection behaviors indicates that there is room for challenging the TPB's assumption that attitude, subjective norms, and PBC are sufficient to explain intention to undergo cancer screening. As a first step to address the research gap, I seek to identify variables that are known as particularly relevant for cancer-related decision and incorporate them into the multicomponent TPB to create a model that will better explain and predict screening intention. Towards that goal, I focus on anticipated regret and risk perception that prior research suggests may be salient in cancer-related decisions.

Anticipated Regret

Despite its widespread application and empirical validation, the TPB has been subject of debate in the literature (Conner, 2014; Ogden, 2015; Sniehotta et al., 2014). One major criticism is that the TPB is firmly grounded in the cognitive tradition and emphasizes cognitive influences while not adequately explaining the role of affective influences on intention and behavior (Conner & Armitage, 1998; Conner et al., 2013; Conner & Sparks, 2015; Manstead & Parker, 1995; Williams & Evans, 2014). Thus, a growing number of the TPB studies have started to focus on *anticipated affects* (beliefs regarding how performing or not performing a certain behavior would make oneself feel) as a unique predictor of health behaviors (Fishbein & Ajzen,

2010). Anticipated negative affects, anticipated regret in particular, have been the focus of a majority of empirical studies (for reviews see Conner et al., 2013; Rivis et al., 2009; Sandberg & Conner, 2008).

Regret is a prototypical decision-related emotion that individuals experience when realizing or imagining that the current situation could have been better had they decided differently (Zeelenberg & Pieters, 2008). Regret is an emotion that is particularly relevant to preference-sensitive decisions that do not have clear, clinically preferable option (Brehaut et al., 2003) such as a decision whether to undergo screening whose potential benefits do not clearly offset harms it may cause. Since a decision has to be made on the basis of preferences and values, individuals may consider the potential for decisional regret as part of comparing the available options (Connolly & Reb, 2005; Feldman-Stewart & Siemens, 2015). Although researchers have used different definitions of regret (Bell, 1985; Janis & Mann, 1977; Kahneman & Tversky, 1982; Landman, 1996; Sandberg & Conner, 2008; Zeelenberg & Pieters, 2007), there are some common ground between the different definitions. Most definitions acknowledge that regret is an aversive emotion that (1) signals an unfavorable evaluation of a decision and its outcome; (2) is accompanied by a wish that things were otherwise and counterfactual thoughts (i.e., comparing what actually did or will happen with better alternatives); (3) involves strong wishes to undo a bad decision; and therefore (4) is distinct from other negative emotions (e.g., anger, fear, and sadness) and also from general negative affective states (Connolly & Reb, 2005).

Unlike experienced or retrospective regret, *anticipated regret* is an expectation of whether a feeling of regret will follow from performance or non-performance of a given behavior and entails a mental simulation of the consequences of different decision options. Thus, one may say anticipated regret is primarily cognitive rather than affective in nature. However, as thinking

about unpleasant events in the future can generate emotions in the present, anticipated regret also has an affective element (Brewer et al., 2016). Furthermore, individuals can anticipate regret that may arise from their decisions beforehand, and then choose to avoid unfavorable outcomes and regret altogether in the future. In this sense, anticipated regret can be functional like experienced regret that motivates individuals to correct their bad decisions and change in subsequent behavior (Zeelenberg, 1999b; Zeelenberg & Pieters, 2007). For example, Richard et al. (1998) manipulated anticipated regret by explicitly priming college students to think about the regret they would feel after having engaged in unsafe sex. They then found that priming anticipated regret made the students more likely to engage in safe sexual behavior that would shield them from the possible regret.

The importance of anticipated regret in motivating health behavior has been supported by meta-analytic evidence. Brewer et al. (2016) provide the most comprehensive review of the impact of anticipated regret on health behaviors in correlational studies. Across the 81 studies reviewed, anticipated regret about not performing the behavior was strongly associated with higher intentions and moderately associated with higher engagement in behaviors. In contrast, anticipated regret about performing behaviors of interest was strongly associated with lower intentions and moderately associated with lower engagement in behaviors.

The role of anticipated regret has also been studied within the TPB framework. Sandberg and Conner (2008) conducted a meta-analysis of cross-sectional TPB studies to evaluate anticipated regret as an additional component to the TPB. The results their meta-analysis indicated a strong effect of anticipated regret on intention and a small to medium effect on behavior. Regressions of the meta-analytic correlations demonstrated that anticipated regret increased the variance explained in intentions by a further 7%, after the TPB components had

been taken into account, while it added a further 1% to the variance in behaviors explained by the TPB. Furthermore, anticipated regret was the stronger predictor of intention than any of the TPB components. Rivis et al.'s (2009) meta-analysis reported similar findings. Overall, these correlational findings suggest that anticipated regret's effect on health behavior is small to medium, and that it could be partially mediated by intention (Conner, 2018).

Ajzen and colleagues argue that the interpretation of these meta-analytic results should be done with caution. Fishbein and Ajzen (2010) and Ajzen and Sheikh (2013) both noted that when evaluating the role of anticipated regret within the TPB framework, the TPB components are measured with respect to performing one behavior (e.g., performing a target behavior) while anticipated regret is usually measured in relation to the opposite (e.g., not performing the behavior). For example, Abraham and Sheeran (2003) asked participants to rate their attitudes, subjective norms, PBC, and intention related to exercising regularly, but also asked to indicate how much the participants would regret it if they did not exercise regularly. From the perspective of the TPB, the frequently used measures of anticipated regret can be viewed as actually assessing individuals' behavioral beliefs about possible affective outcomes of not performing a behavior of interest which are technically determinants of attitudes toward the non-performance. Then, one might argue that most of the previous studies that investigated the role of anticipated regret within the TPB framework actually included attitudes toward both performing and not performing a target behavior as two different predictors of behavioral intention (Ajzen & Sheikh, 2013; Fishbein & Ajzen, 2010). It is not surprising that predicting the intention to engage in a certain behavior is improved by factoring in the attitude toward not engaging in the behavior as well as the attitude toward engaging in the behavior (Davidson & Morrison, 1983; Gardner & Abraham, 2010; Jaccard, 1981; Letirand & Delhomme, 2005). In this line of logic, the

originators of TPB (Fishbein & Ajzen, 2010) argued that that previous TPB studies with anticipated regret increased the proportion of variance explained in behavioral intentions, mainly because they actually captured attitudes toward not performing the behavior as well, not because they captured the affective influences that the TPB had been criticized for ignoring.

I view the TPB originators' interpretation as unsatisfactory mainly because they neglect the motivational or functional property of anticipated regret. As discussed earlier, anticipated regret is a conscious emotional state that drives individuals to behave in a way to avoid regret in the future (Zeelenberg, 1999b; Zeelenberg & Pieters, 2007). For example, anticipated regret with regard to screening non-uptake could immediately motivate individuals to take screening tests without necessarily affecting a formation of their attitude toward screening non-uptake. From this point of view, I contend that not all aspects of anticipated regret related to screening non-uptake can be simply reduced to behavioral beliefs about the consequences of not taking screening tests.

Nonetheless, the originators' argument leaves open the question of how anticipated affect is distinct from affective attitude. As Conner at al. (2013) have summarized, affective attitude and anticipated affect can be conceptually distinguished at least in two ways. First, measures of anticipated affect typically focus on self-conscious emotions (i.e., emotions elicited by how we see ourselves and how we think others perceive us) such as regret and guilt (Giner-Sorolla, 2001), whereas measures of affective attitudes typically focus on emotions with hedonic aspect (i.e., emotions triggered by intrinsically motivated behaviors) such as enjoyment and excitement. Second, research on anticipated affect focuses on emotions expected to follow after a performance or a nonperformance of a behavior under consideration, while research on affective attitudes focuses on emotions expected to occur while the behavior is being performed. For

example, a woman considering whether to undergo thyroid cancer screening may have affective attitudes toward an ultrasound exam. She may feel worried and anxious that an ultrasound exam will detect cancer. She may also think that although the procedure may be temporarily uncomfortable, it would not be painful and ultimately reduce cancer-related worry and anxiety if she is screened and cancer-free. These affective attitudes differ from her anticipated regret, or expectation of regret she may feel if she does not get screened and finds cancer at a later stage. Supporting these conceptual differences, Conner et al. (2013) demonstrated that affective attitude toward blood donation, which was tapped by how "unpleasant-pleasant" and "tired-revitalizing" the behavior might be, was distinct from anticipation of positive affect (i.e., proud, happiness, and satisfaction) and negative affect (i.e., regret, bother, disappointment) as a result of blood donation. Moreover, Sandberg et al. (2016) found that both anticipated regret about performing three different behaviors (i.e., regular exercise, healthy eating, and being organized for work) and anticipated regret about not performing those behaviors were significant independent predictors of behavioral intentions, even when controlling for the TPB components including affective attitudes toward performing the behaviors (i.e., unpleasant–pleasant). What was also found was that although both types of anticipate regret was significant predictor of intentions, anticipated regret about not performing the behaviors was consistently the stronger predictor of intention. These findings suggest that the effects of anticipated regret observed in the previous studies may not be merely due to the fact that they failed to match questions on the target behavior.

As interest in the role of anticipated regret within the TPB increases, the evidence base is growing. However, much of the available evidence is limited to correlational findings (Sandberg et al., 2016). In that regard, I attempt to establish better causal evidence for the effect of anticipated regret on screening intention by conducting a prospective study in which the presence

of a message designed to modify the level of anticipated regret is experimentally manipulated. (The message manipulation is described in the second major component of Chapter 2 starting on page 64). Although both anticipated regrets with respect to screening uptake and non-uptake could be independent predictors of intention, I exclusively focus on anticipated regret with respect to screening non-uptake (hereafter called anticipated regret for brevity) due to its stronger power to predict intention (Sandberg et al., 2016) and salience in cancer-related decisions (Connolly & Reb, 2005).

Risk Perception

I propose to include risk perception as another important predictor of screening intention. Risk perception is central to many theories designed to predict an engagement in health behaviors, such as the protection motivation theory (Rogers, 1975; Rogers, 1983), the health belief model (Rosenstock et al., 1988), the extended parallel process model , and the risk perception attitude framework (Rimal & Real, 2003). These theories conceptualize risk perception as a key factor that motivates self-protective behaviors. Another common thread is that these theories postulate that individuals perceive a risk in a health threat in terms of its severity (i.e., the seriousness of potential negative consequences of the threat) and their susceptibility to it (i.e., the likelihood of experiencing the potential negative consequences of the threat).

The TPB does acknowledge risk perception, specifically perceived susceptibility, as one of many background factors that can influence behavior indirectly via attitudes, subjective norms, and PBC (Fishbein & Ajzen, 2010). However, the specific mechanism whereby the TPB constructs mediate the effect of risk perception on motivation to perform health-related behaviors remains rather ambiguous. Weinstein (1993) put an interesting spin on how risk perception

comes into play within the TPB framework. In the process of discussing commonalities among commonly used health behavior change theories including the TRA, which is the basis of the TPB, and protection motivation theory, Weinstein interpreted that perceived severity and susceptibility may be indirectly tapped by the evaluation component of behavioral beliefs and the strength of the beliefs in the TPB, respectively. Taking cancer screening as an example, behavioral beliefs may focus on the evaluation of a negative outcome that might result from not getting cancer screening (i.e., perceived severity of cancer diagnosed at a later stage) and the perceived likelihood that the negative health outcome will occur (i.e., perceived susceptibility). The difference between risk perception conditional on screening and risk perception conditional on not screening would determine the expected benefits of screening, which in turn contributes to the formation of an attitude toward screening behavior. In short, from the perspective of the TPB, risk perceptions may form beliefs about other possible negative consequences of not engaging in the target behavior; and their effects on intention and behavior could be conceived as being mediated by attitudes toward the behavior which is a more proximal determinant of intention and behavior (Fishbein & Ajzen, 2010; Stasson & Fishbein, 1990).

Contrary to the TPB's view, in this dissertation, I bring risk perception from the background to the foreground. I propose that risk perception could act as a proximal independent determinant of cancer screening intention and in turn behavior. This decision was made based on three considerations. First, uncertainty is inherent in medicine and can present significant challenges in making healthcare decisions (Han et al., 2011). Thus, it may be unrealistic to assume that individuals always rely on the cognitive computation of likely outcomes (i.e., costs and benefits) of cancer screening in order to achieve the highest satisfaction from their screening decision even under conditions of uncertainty. Second, Brewer et al. (2007) argue, and I agree,

that risk perception plays a more central role in the formation of motivation to engage in behaviors that are intended to reduce a specific health threat (e.g., sunscreen use), compared to behaviors that have a wide range of health-related and non-health-related consequences (e.g., physical activity and dietary behavior). Since cancer screening is intended specifically to reduce the severity of a health threat, risk perception is arguably more important for cancer screening intention and behavior that for other types of health behaviors. This proposition is supported by meta-analytic evidence showing that perceived risks of breast cancer is directly associated with participation in breast cancer screening (Katapodi et al., 2004; McCaul et al., 1996). Third, although behavioral beliefs about and attitude toward a target behavior (e.g., screening uptake) could be influenced by beliefs about the object at which the behavior is directed at (e.g., cancer risk perception), consistent with other theories of health behaviors mentioned earlier, it may be more advantageous to separate them out and examine their effects on behavioral intention separately.

In summary, a review of the literature indicates that the TPB does not predict detection behaviors as well as it does other health promoting behaviors. I argue that the limited predictive validity of the TPB for detection behaviors possibly relates to its strict focus on conscious behavior-specific cognitions as proximal determinants of behaviors and failure to sufficiently acknowledge other factors that exert further motivational influences on cancer screening behavior. As a remedy to this limitation, I propose to further extend the multicomponent TPB by including anticipated regret and risk perception as additional predictors of cancer screening intention.

The Parallel Model: Additive Effects of Anticipated Regret and Risk Perception in Predicting Screening Intention

The next thing to consider is how the two additional variables of anticipated regret and risk perception should be combined with the existing components in the TPB to predict screening intention. Based on previous studies that demonstrated anticipated regret adds to the prediction of intentions above and beyond that obtained by the TPB components for a wide range of behavior (Conner et al., 2013; Richard et al., 1996; Rivis et al., 2009; Sandberg & Conner, 2008), I first posit that anticipated regret may have a simple additive effect on screening intention. However, there is no evidence that shows whether a combination of risk perception and the TPB components have a simple additive effect on screening intention or whether the combination can result in any synergistic effect. Thus, I draw upon the protection motivation theory (PMT; Roger, 1975, 1983) to posit that risk perception would also have an additive effect in predicting screening intention rather than interacting with other predictors of screening intention.

The PMT is useful for theoretically understanding how risk perception could be a valuable addition to the TPB-based framework. Protection motivation refers to intention to perform a certain health-protective behavior or to avoid a health-risk behavior, and thus is similar to behavioral intention in the TPB. The PMT posits that protection motivation is determined by two independent cognitive processes, threat appraisal and appraisals. Threat appraisal is the process by which individuals assess the likelihood that a threat will occur or will result in adverse consequences and the severity of the consequences. Threat appraisal and risk perception have the same underlying meaning (i.e., perceived severity and susceptibility) and are often assessed with questions that are essentially interchangeable (Ferrer & Klein, 2015).

Although a later revision of the PMT (Rogers, 1983) included the rewards of not adopting a health protective behavior as an additional threat appraisal component, most applications of the PMT rarely examine rewards (Milne et al., 2000).

Coping appraisal involves the process of assessing a behavior option that might remediate a threat. Coping appraisal can include three components: response efficacy, self-efficacy, and response costs. Response efficacy refers to individuals' beliefs about the effectiveness of a certain health protective behavior in reducing or eliminating a health threat. Self-efficacy refers to individuals' self-assessed capability to successfully perform the health protective behavior. Response costs concern beliefs about how costly performing a health protective behavior will be to individuals.

Although the original version of the PMT points to a potential interaction between the two cognitive appraisal processes in eliciting protection motivation, Rogers' (1983) revision of PMT proposes a simpler additive model. According to the revised PMT, protection motivation is a positive linear function of perceptions of severity, susceptibility, response efficacy, and self-efficacy, and a negative linear function of response costs of adopting a health protective behavior and the rewards of not adopting the behavior. Thus, most empirical studies based on the PMT consider the simple additive effects of the PMT variables on protection motivation (Norman et al., 2015).

PMT and the TPB appear to have some conceptual overlap in their underlying constructs. Fishbein and Ajzen (2010) views PBC, particularly the capability component, in the TPB as conceptually identical to self-efficacy (Ajzen, 2020). To the best my knowledge, no connection has been made between response efficacy in the PMT and existing constructs of the TPB. However, response efficacy is arguably akin to attitude in the TPB. More specifically, response

efficacy could be the essential element incorporated in the process of forming attitude, particularly cognitive/instrumental attitude, toward a target health behavior. Thus, in this dissertation, I suggest that attitudes and PBC in the TPB may map fairly directly to the contents of coping appraisal in the PMT. Moreover, and consistent with the PMT, I argue that risk perception would have the additive effect on screening intention within the TPB-based framework.

Given the theoretical overlap between the TPB and the PMT, it is plausible to suggest that risk perceptions (akin to threat appraisal), attitudes (akin to response efficacy), PBC (akin to self-efficacy) will have additive, not interactive, effects in predicting screening intention. Note that the PMT does not have components comparable to subjective norms and anticipated regret. However, at the same time, there is no theoretical ground to expect that risk perception would interact with subjective norms and anticipated regret to predict screening intention.

In the interest of model parsimony, I propose that cancer screening intention is a positive linear function of (a) cognitions about screening behavior (i.e., the multicomponent TPB variables), (b) an expectation of regret that will follow from non-screening behavior (i.e., anticipated regret), and (c) cognitions about a disease, the source of a threat at which the behavior is directed at (i.e., risk perception). Based on the foregoing discussion, the following set of hypotheses are posed. The hypotheses are incorporated into a conceptual structure, named as the parallel model, as shown in Figure 4.

H1: Higher perceived severity (a) and perceived susceptibility (b) will increase intention to take screening tests.

H2: Higher anticipated regret with respect to screening non-uptake will increase intention to take screening tests.

H3: Higher affective attitude (a) and cognitive/instrumental attitude (b) toward screening uptake will increase intention to take screening tests.

H4: Higher descriptive norms (a) and injunctive norms (b) regarding screening uptake will increase intention to take screening tests.

H5: Higher capability (a) and autonomy (b) will increase intention to take screening tests.

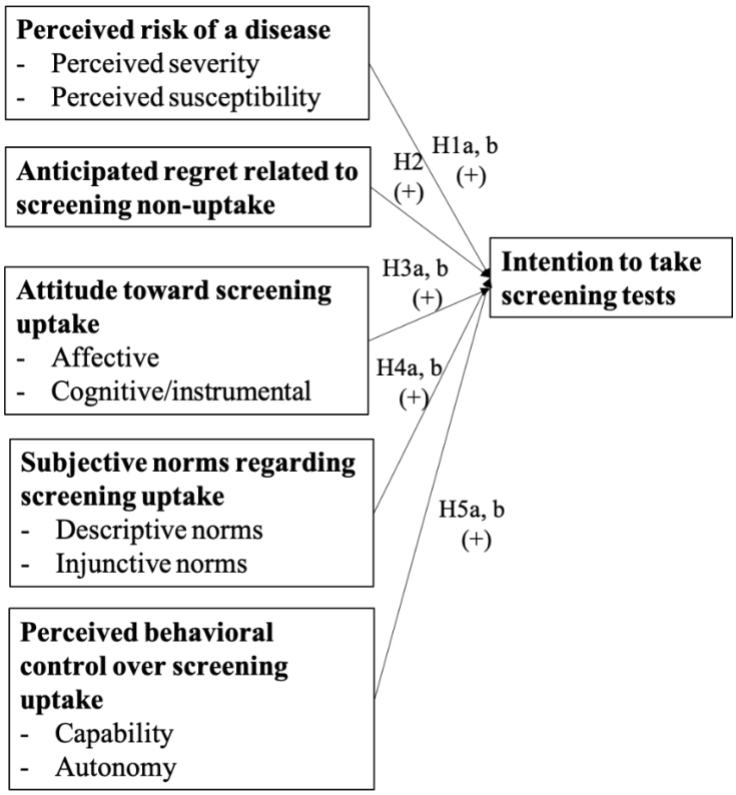

Figure 4 *The proposed parallel model with each hypothesis specified*

Potential interaction effect between perceived severity and susceptibility. In meta-analytic reviews of the relationships between risk perception and screening behavior, the effect sizes for risk perception were found to be small and inconsistent; and the empirical literature does not provide much information as to whether higher perceived severity leads to increased

screening intention. For example, Janz and Becker (1984) reviewed five empirical studies based on the health belief model and found significant relationships of perceived susceptibility to screening behaviors. However, in the five studies reviewed, perceived severity negatively predicted screening behavior. In another meta-analysis of studies guided by the health belief model (Harrison et al., 1992), an effect size of perceived susceptibility as a predictor of screening behavior was small ($r = .13$, $p < .01$) and the relationship of perceived severity to screening behavior was non-significant ($r = .03$). In their meta-analytic review of studies about breast cancer screening behaviors, McCaul et al. (1996) also reported a small effect size for relationships between perceived susceptibility of breast cancer and screening behavior ($r = .13$, $p < .001$). Lastly, in a relatively recent systematic review and meta-analysis of 57 studies on colorectal cancer screening, Atkinson et al. (2015) reported a small pooled effect size ($z = .13$; 95 % CI [.10, .16]) for the relationship between perceived susceptibility to colorectal cancer and screening behavior. Interestingly, the meta-analyzed effect sizes that Atkinson et al. (2015) reported were quite heterogeneous with a range of -0.28 to 0.93.

Overall, the meta-analytic evidence demonstrates that the magnitude of the relationships of perceived susceptibility with screening behavior are significant but consistently small. Furthermore, Atkinson et al.'s (2015) meta-analysis indicates that the effects of perceived susceptibility on screening behavior is somewhat inconsistent. This meta-analytic evidence coincides with individual studies concerning other health protective behaviors that found the association between perceived susceptibility and health behavioral to be a mix of positive, negative, and non-significant results (Brewer et al., 2007; Floyd et al., 2000; Milne et al., 2000; Sheeran et al., 2014). The small and inconsistent patterns of relationships observed call for

further investigation of potential moderators of the effects of perceived susceptibility on screening intention and behavior.

I argue that perceived severity could moderate the effect of perceived susceptibility on screening behavior. Popova (2012) argues that no matter how susceptible individuals perceive themselves to be to a given health threat, if they perceive the threat as not serious, the effects of perceived susceptibility may be inconsequential. This idea has an intuitive appeal, but it has not been subject to empirical testing as many studies did not include perceived severity as a predictor of screening behavior. At least two explanations exist for the exclusion of perceived severity. One, perceived susceptibility may be indeed a better predictor than perceived severity (Janz & Becker, 1984). Two, high severity is already implied in the cancer context because the threat whose likelihood is being assessed is a disease that is commonly associated with morbidity and mortality. That is, few people perceive outcomes of a disease detected via cancer screening as anything other than severe, which leads to restricted variance in perceived severity. The small variance in perceived severity could have lowered its power as a predictor of behavior and result in researchers dropping the variable entirely (e.g., Champion, 1999; Harrison et al., 1992). While understanding why there has been insufficient variance in perceived severity in the cancer context, I argue that it is theoretically unjustifiable to exclude perceived severity just because of the possibility of insufficient variance. When the goal of a message is to explain that not all cancers progress uniformly to metastasis and death, it becomes infeasible to assume that the severity is already implied in the context. Rather, in such a case, perceived severity should be treated as a variable of even higher relevance. As noted above, I agree with Popova (2012) that we should examine how severity and susceptibility might interact to affect intentions, and therefore propose the following research question:

RQ1. How may perceived severity and perceived susceptibility interact each other to influence screening intention?

The Serial Model: An Alternative Model

While the additive model has support from both the TPB and PMT perspectives, I take a step further to consider an alternative ordering of the predictors of intention to generate a serial model. Variable ordering is an important issue, especially to those who are interested in explaining communication processes (Jones et al., 2015; Slater & Gleason, 2012). By considering and testing an alternative order of the predictors of screening intention, I seek to advance the TPB-based framework as an explanatory model for communication research. Figure 5 displays the visual representation of the serial model with each hypothesis specified.

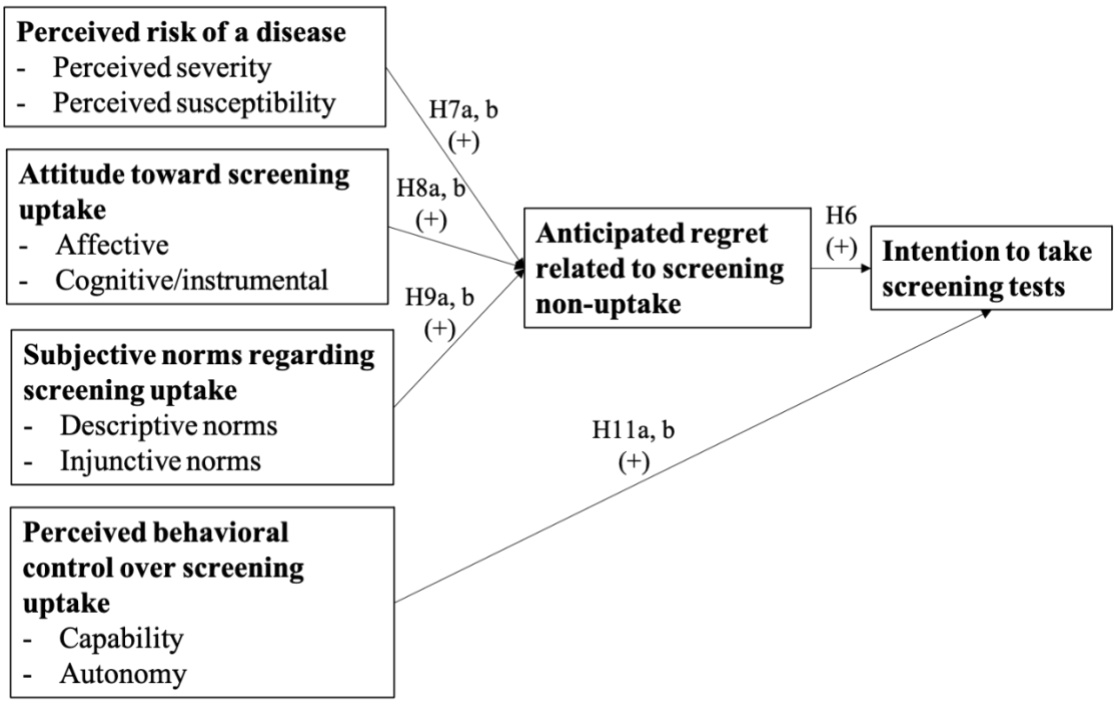

Figure 5 *The serial model with each hypothesis specified*

An assumption underlying the parallel model appears to be that risk perception, anticipated regret, attitude, subjective norms, and PBC may be activated simultaneously from the start of the decision-making process and simultaneously influence screening intention. However, there are theoretical reasons to consider the possibility that some of the proposed predictors of screening intention form causal chains. Specifically, based on the knowledge of antecedents of regret, I argue that anticipated regret will be the most immediate determinant of screening intention and that risk perceptions, attitudes, and subjective norms would serve as determinants of anticipated regret. The argument for the causal chains is formulated below.

Early regret theories in economics derived from the expected utility framework (Bell, 1982; Janis & Mann, 1977; Loomes & Sugden, 1982; Savage, 1951) posit that regret results only from comparing a decision outcome against a better one that would have resulted if one had made a different decision. These economic theories of regret assume that anticipated regret plays an important role in determining what we choose by modifying the expected utilities of potential outcomes (e.g., Janis & Mann, 1977; Loomes & Sugden, 1982). That is, regret anticipated from not performing a particular behavior reduces the utility that individuals could gain, thereby making them choose behavior alternative (e.g., performing the behavior). The originators of the TPB, Fishbein and Ajzen's (2010) view on anticipated regret and its antecedents and consequences is not distantly different from the early economic theories' view (see also Pligt and De Vries, 1998). However, despite the intuitive appeal of this view, empirical support has been lacking. Several initial studies (e.g., Loomes & Sugden, 1987a, 1987b; Simonson, 1992) provided some empirical support regarding the antecedents of anticipated regret, but they were later claimed to be flawed by methodological limitations (Humphrey, 1995; Starmer & Sugden, 1993). Thus, research in line with the early economic regret theories seems mainly to have

stopped. Nonetheless, good evidence still exists that anticipated regret directly affects decisions (Connolly & Zeelenberg, 2002).

Continued research over the last two decades has produced several theories that allow a more complex and comprehensive understanding of regret in a decision-making process. Decision-justification theory (DJT; Connolly & Zeelenberg, 2002) is one such contemporary theory of regret. The DJT identifies two components that are key for a regret generation: (a) the comparative evaluation of a decision outcome, and (b) the sense of self-blame for having made a decision that is not justified. Similar to the earlier regret theories, the DJT posits that regret arises when individuals perceive that the obtained decision outcome is poorer than some standard which is often the foregone decision outcome. What is unique in the DJT is the role of decision justifiability which refers to the perception that individuals have appropriate reasons, relevant evidence, rationales, or arguments to support the decision they have made or will be making (Reb & Connolly, 2010). The DJT proposes that the intensity of regret felt varies according to the degree to which the decision is perceived as justifiable. That is, in the event of a poor decision outcome, individuals tend to ask themselves if their decision was justified. If the decision was deemed unjustifiable partially or entirely, individuals feel regret, and the intensity of regret is increased by the severity of the outcome. In contrast, the decision that resulted in a poor outcome may cause less regret if the decision was, in retrospect, still justifiable.

Connolly and Zeelenberg (2002) have shown that perception of decision justifiability can explain inconsistent earlier findings regarding the key determinant(s) of experienced and/or anticipated regret (e.g., Crawford, McConnell, Lewis, & Sherman, 2002; Simonson, 1992; Zeelenberg, van den Bos, van Dijk, & Pieters, 2002). For example, in a study by Zeelenberg et al. (2002), participants were asked how much regret a soccer coach would feel if his team lost

after he either changed or did not change the team. If the team had been winning, participants reported more regret for the coach who changed the team. If the team had been losing, on the other hand, participants expected more regret for the coach who did not changed the team. In the DJT' terms, the team's prior experience (i.e., having a winning vs. losing record) appears to have unjustified the winning coach's decision to make changes and the losing coach's decision not to make changes, subsequently leading to more anticipated regret.

As Connolly and Zeelenberg (2002) note, little is known regarding what makes a decision justifiable. In fact, justifiability is likely to depend on the contexts, and to vary from an individual to an individual (Connolly & Reb, 2003). For some people and contexts, performing a certain behavior may be seen as less justified, and thus more regrettable, than not performing. However, the reverse may also be true for other people and other contexts. Given the context-dependency of justifiability, the social normality of a decision could be one factor that makes good justifications. Reb and Connolly (2010, Study 1 and 3) examined how perceived social normality of vaccination decision affect parents' anticipated regret for poor vaccination outcomes. One important finding in their study was that in contexts where vaccination is socially normal, participants perceived a decision to vaccinate children as more appropriate and justifiable, which in turn, made them consider the decision less regrettable in the event of an unfavorable outcome of the decision (i.e., a child suffering from side-effects of vaccine). The role of social normality is also consistent with what Janis and Mann (1977) proposed more than four decades ago. Janis and Mann conceptualized four conditions that give rise to anticipated regret for a decision not to act, one being that significant others in the decision maker's social network view the decisional outcome as important and will expect him or her to act.

According to the DJT, it is possible that the perceived risk of cancer and some of the TPB components regarding cancer screening uptake, specifically attitudes and subjective norms, contribute to perceived justifiability of cancer screening uptake which can make the non-uptake of cancer screening expected to be more regrettable. First, perceived risks of cancer may affect how well-justifiable the decision to undergo screening would be perceived to be. The potential risks of not undergoing cancer screening include getting cancer diagnosed at a later stage, missing early cancer treatment opportunity, and even dying from cancer. Although undergoing cancer screening can result in negative consequences such as unnecessary worry, distress, overdiagnosis, and overtreatment, considering the low public awareness of those issue, these risks of undergoing cancer screening may not be salient to lay individuals. More importantly, the negative consequences of undergoing cancer screening are likely be considered less important and less severe than the consequences of not undergoing cancer screening. The relative severity and importance of the consequences of not undergoing cancer screening can make cancer screening uptake seem more desirable, defensible, and justifiable than cancer screening non-uptake. Since cancer screening non-uptake is perceived as less justifiable, individuals would anticipate experiencing more self-blame and regret in the event of the negative outcomes of their decision not to undergo cancer screening. In fact, there exists evidence suggesting the relative severity of decision outcome can influence the intensity of anticipated regret. That is, the worse the anticipated outcome of a chosen behavioral option compared to an unchosen one, the greater the anticipated regret (Loomes & Sugden, 1982; Mellers et al., 1999). Thus, it is possible that perceived risk of cancer positively predicts anticipated regret with respect to cancer screening non-uptake.

It would be reasonable to expect that a positively evaluated behavior may lead to lower anticipated regret because it is perceived as more justifiable than a negatively evaluated behavior. Consider a person who thinks undergoing cancer screening is instrumentally positive (e.g., beneficial and worthwhile) and affectively rewarding (e.g., pleasant and anxiety-reducing). It would be easier for the person to justify undergoing cancer screening than not undergoing cancer screening. According to the justifiability account, since the decision *not* to undergo cancer screening is perceived to be less justifiable, the person would expect to have more regret over the decision if he or she experiences negative decision outcomes in the future (e.g., getting cancer diagnosed at a later stage). Additionally, since the decision to undergo cancer screening is perceived to be more justifiable, the person would expect to have less regret over the decision even in the event of experiencing unfortunate outcomes of screening (e.g., unnecessary worry and distress, overdiagnosis, and overtreatment).

The effects of subjective norms on perceived decision justifiability were discussed earlier. If a decision to undergo cancer screening reflects the consensus decision of significant others, it would be more difficult to justify a decision not to undergo cancer screening than a decision to undergo cancer screening. Since the decision not to undergo cancer screening is less or not justifiable, individuals will think that if the outcome of not undergoing cancer screening is bad, they are more likely to blame themselves for and regret making the decision, to a greater extent. Getting cancer diagnosed at a later stage and missing an early cancer treatment opportunity are regrettable in itself. However, individuals are likely to expect the regret to be exacerbated if they think the bad outcomes result from their own decision that goes against social norms. The foregoing discussion is summarized in the following formal testable hypotheses. First, I argue that the most proximal predictor of screening intentions is anticipated regret:

H6: Higher anticipated regret with respect to screening non-uptake will increase intentions to take screening tests.

Second, as noted above, risk perceptions and TPB constructs should predict anticipated regret:

H7: Higher perceived severity (a) and perceived susceptibility (b) will increase anticipated regret with respect to screening non-uptake.

H8: Higher affective attitude (a) and cognitive/instrumental attitude (b) toward screening uptake will increase anticipated regret with respect to screening non-uptake.

H9: Higher descriptive norms (a) and injunctive norms (b) regarding screening uptake will increase anticipated regret with respect to screening non-uptake.

With the central argument of the serial model (i.e., H6) combined, these predictions result in mediation hypotheses in which higher risk perceptions, attitudes, and subjective norms increase screening intention through heightened anticipated regret.

H10a: Higher perceived severity will increase intention to take screening tests by increasing anticipated regret with respect to screening non-uptake.

H10b: Higher perceived susceptibility will increase intention to take screening tests by increasing anticipated regret with respect to screening non-uptake.

H10c: Higher affective attitude toward screening uptake will increase intention to take screening tests by increasing anticipated regret with respect to screening non-uptake.

H10d: Higher cognitive/instrumental attitude toward screening uptake will increase intention to take screening tests by increasing anticipated regret with respect to screening non-uptake.

H10e: Higher descriptive norms will increase intention to take screening tests by increasing anticipated regret with respect to screening non-uptake.

H10f: Higher injunctive norms will increase intention to take screening tests by increasing anticipated regret with respect to screening non-uptake.

In summary, this alternative serial model posits that risk perceptions, attitudes, subjective norms act in combination to give a rise to anticipated regret, which in turn increases screening intention. As in the parallel model, in the serial model, the capability, and autonomy are expected to exert direct effects on screening intention bypassing anticipated regret. That is mainly because unlike for attitude and subjective norms, there is no theoretical nor empirical justification to argue that the effect of PBC is mediated by anticipated regret.

H11: Higher capability (a) and autonomy (b) will increase intention to take screening tests.

Proposing Communication-Based Strategies to Reduce the Use of Low-Value Screening

The proposed parallel and serial models provide a basis for understanding the determinants of screening intention. These determinants of screening intentions present important targets for interventions aiming to reduce motivation to take low-value screening tests. In this second major theoretical section, I propose three communication-based strategies that target three components in the models. The three strategies and targeted components are: (1) removing the word cancer from the disease label to reduce risk perceptions; (2) highlighting negative affective consequences of thyroid ultrasound screening to reduce positive attitudes; and (3) providing information about diagnostic uncertainty to reduce anticipated regret.

Subjective norms and PBC are not targeted for two reasons. First, as reviewed in Chapter 1, in the context of South Korean healthcare system thyroid cancer screening is both affordable and highly accessible. Second, thyroid ultrasound screening is a painless non-invasive test. In that regard, it was assumed that the uptake of thyroid cancer screening is more under volitional

control than that of other screening tests that are more expensive and/or inconvenient (e.g., colorectal cancer screening, Jones et al., 2010) and for people living in South Korea than for those living in other countries. If the assumption holds, I argue PBC will be less of an important determinant in this context.

Furthermore, a communication or educational intervention aimed to reduce individuals' capability and autonomy might not be plausible. To achieve a goal of reducing PBC regarding the uptake of thyroid cancer screening in the South Korean context, interventions other than patient education and communication, such as increasing out-of-pocket costs, might be more relevant and effective (see Colla et al., 2017). Additionally, targeting subjective norms was deemed ethically not justifiable because it does not accord with the ideal of evidence-informed decision-making. In addition, a meta-analytic review regarding the efficacy of the TPB to predict cancer screening behaviors reported a statistically weaker correlation between subjective norms and intention to screen, compared to the other TPB components (Cooke & French, 2008; Griva et al., 2009), indicating subjective norms might be less important to target. For these reasons, I selectively focus on developing communication-based strategies aimed to change risk perception, attitudes (i.e., cognitive/instrumental, affective) and anticipated regret, to which I turn next.

Strategy 1: Removing the word cancer from the disease label to reduce risk perceptions. Both the parallel model and the serial model propose that risk perceptions directly and indirectly (via anticipated regret) increase screening intention. Hence, modifying risk perceptions could be one way to reduce screening intentions. In the health communication literature, the typical challenge is that perceived risk is lower than actual risk (Leventhal et al., 1999). Accordingly, interventions have focused on increasing risk perceptions as a means for

promoting health protective behaviors and demoting health risk behaviors (Sheeran et al., 2014). However, this dissertation concerns the opposite case where the perceived risk is higher than the actual risk. As discussed in Chapter 1, despite not all cancers progress uniformly to metastasis and death, few people perceive cancer as anything other than a disease with serious consequences. The invariantly inflated perception of cancer risk can be problematic, particularly in the case of low-risk cancers like thyroid cancer because it can increase both concern about illness and desire for more testing and invasive treatment (Nickel et al., 2018).

There would be no disagreement about the importance of bringing risk perceptions in correspondence with actual risk to encourage individuals to initiate and maintain health promoting/preventive behaviors at a level that is appropriate to their actual risk and its source. The natural first approach to resolve the discordance between perceived and actual risks has been the provision of factual information to counter pervasive beliefs about cancer, such as explaining that thyroid cancers exist on a severity spectrum, and that the actual clinical severity of the most common type of thyroid cancer is not that high. However, previous informational interventions demonstrated that while factual information giving was necessary, it was insufficient to curb lay individuals' intention to undergo cancer screening that is considered by experts to be low value, such as prostate specific antigen screening and thyroid cancer screening (Lee et al., 2016; Scherer et al., 2019; Shaffer & Scherer, 2018). The limited effectiveness of the provision of factual information calls for a different approach to curbing the utilization of low-value screening tests.

In recent years, researchers (Kale & Korenstein, 2018; Nickel, Barratt, et al., 2017; Nickel, Brito, et al., 2017; Shaffer & Scherer, 2018) have become increasingly aware of the importance of *disease labels* in driving the utilization of low-value care. More specifically, the

term “cancer” has the potential to generate screening and treatment decision that are disproportionate to the objective risk. Historically, cancer has been regarded as synonymous with a painful death; and thus, the word cancer can immediately trigger a visceral response of fear in people who hear it (Berman & Wandersman, 1990; J. Cho et al., 2013; Robb et al., 2014; Sontag & Broun, 1977). The belief that being diagnosed with cancer is synonymous with a death sentence could lead to a fear-driven, rather than evidence-based, approach to cancer screening and management (Nickel et al., 2017). In other words, cancer fears could make individuals want to detect small malignancies before they grow large enough to cause symptoms and treat the detected small malignancies as fully developed cancer even when they are unlikely to cause harm even if left untreated. With a recognition of the impact that the cancer label has on cancer screening and management behaviors, several expert groups recommended changing the terminology used to describe low-risk cancers (Esserman et al., 2014; Esserman & Varma, 2019; McCaffery et al., 2016; Nikiforov et al., 2016). For example, in 2016, twenty-four pathologists suggested renaming a slow-growing, non-life-threatening thyroid cancer ‘noninvasive follicular thyroid neoplasms with papillary-like nuclear features,’ or NIFTP to reduce psychological and clinical consequences associated with the early diagnosis of thyroid cancer through screening (e.g., the stigma of a cancer diagnosis, overdiagnosis, and overtreatment) (Nikiforov et al., 2016). In 2017, the World Health Organization (WHO) Classification of Endocrine Organ Tumors adopted NIFTP.

Evidence is accumulating for the effect of taking the word ‘cancer’ out of the disease label on medical decision making. Phillips et al. (2016) examined how young women’s responses to information about overdiagnosis in cancer vs. non-cancer screening differ. The information given to study participants was identical across groups except for the names of

disease (i.e., cervical cancer vs. aneurysm). The results of their experiment show that information about overdiagnosis in non-cancer screening reduced the perception of the risk of the disease, whereas the same information in cancer screening did not. Furthermore, participants who received information about overdiagnosis in cancer screening were more likely to choose extreme responses (i.e., *definitely will or definitely will not*) when asked about their screening intention. Taken together, it could be argued that heighten cancer risk perception and fear may lead some individuals to seek, demand, or expect cancer screening with questionable value as a measure of self-protection. Omer et al. (2013) compared the commonly used cancer term for ductal carcinoma in situ (DCIS, non-invasive cancer, or Stage 0 breast cancer) with non-cancer terms (i.e., breast lesion, abnormal cells). Results showed when DCIS was labeled as the term noninvasive cancer, 47% preferred surgical treatment to nonsurgical options (i.e., medication and active surveillance), whereas 34% selected nonsurgical options when the term was breast lesion and 32% selected nonsurgical options when the term was abnormal cells (Omer et al., 2013). Another study that compared papillary thyroid cancer with non-cancer terms (i.e., papillary lesion, abnormal cells) reported similar findings for treatment decision for low-risk thyroid cancer (Nickel et al., 2018) .

Renaming low-risk thyroid cancers appears to have a potential to reduce lay individuals' desire for thyroid cancer screening by making the level of perceived risk of thyroid cancer consistent with its actual risk. However, there is variation in the views of the public, health professionals, and also cancer societies concerning whether renaming low-risk cancer is an adequate strategy to help reduce overdiagnosis and overtreatment; thus, it still remains as a controversial issue that requires social and professional consensus (Codacci-Pisanelli, 2019; Esserman & Varma, 2019; Kohn & Malik, 2019; Nickel, Barratt, et al., 2017; Nickel, Brito, et

al., 2017). To provide some preliminary evidence that may inform future policy and clinical practice guidelines, it is necessary to empirically examine the effect of the removal of the cancer label has on South Korean women's intention to undergo thyroid cancer screening.

For two reasons, however, it was decided not to use the term NIFTP as an alternative disease label. First, in 2017, the rate of NIFTP in South Korea was estimated to be around 2% (Cho et al., 2017). This means that the most common type of low-risk thyroid cancer in South Korean population does not have the same clinicopathologic and molecular features as NIFTP. Second, from a communication perspective, I concluded that the term NIFTP may not be intuitive to the general public and has the potential to impose unnecessary cognitive burdens on them. Taken together, using the term of NIFTP in the present study was deemed scientifically incorrect and communicatively inappropriate. After consulting a pathologist, a radiologist, and an epidemiologist, an alternative disease label, a *borderline thyroid neoplasm*, was created for this dissertation. The alternative disease label was created so that the disease label served the purpose of this dissertation (i.e., to explore if removing the word cancer from the disease label reduces risk perceptions), but still sounded like a legitimate disease. Based on the foregoing discussion, the following hypothesis is derived:

> H12: When a disease is associated with a non-cancer label, it will result in lower levels of (a) perceived severity and (b) perceived susceptibility, compared to when it is associated with a cancer label.

Strategy 2: Highlighting negative affective consequences of cancer screening to reduce positive attitudes. The parallel model postulates that affective and cognitive/instrumental attitudes directly increase screening intention, whereas the serial model posits they indirectly (through anticipated regret) increases screening intention. Thus, attitudes

could be another promising target of an intervention. According to the two models, screening intention could be lowered by reducing positive attitudes.

The first step needed to explore communication-based strategies that could reduce a favorable attitude would be to understand the behavioral beliefs underlying preexisting favorable attitudes toward the uptake of thyroid cancer screening. Identifying the salient behavioral beliefs about the outcomes of cancer screening and identifying the attributes with which individuals strongly associate cancer screening would help understand what drives screening behaviors, and eventually provide a focus for messaging. Among beliefs about the positive outcomes of cancer screening uptake, probably the most salient and pervasive is that cancer screening reduces cancer mortality, or saves lives, by finding and treating cancer early (Lee et al., 2016). To counter the pervasive belief that cancer screening saves lives, previous studies (Howard et al., 2013; Moynihan et al., 2015; Scherer, Kullgren, et al., 2018; Scherer, Shaffer, et al., 2018; Smith et al., 2020) and clinical practice guidelines, such as USPSTF recommendations (Bibbins-Domingo et al., 2017), put heavy emphasis on providing neutral and evidence-based information on the potential health-related harms (e.g., overdiagnosis and overtreatment) and the uncertain health-related benefits of cancer screening (e.g., limited mortality-reducing benefits).

However, if an intervention is limited to providing information that targets behavioral beliefs about the health-related harms and benefits of screening, there is a danger of missing out another important lever of change. Scherer and her colleagues' (2019) two experimental studies shed light on another behavioral belief that is strongly associated with cancer screening intention, and therefore should also be targeted. In Study 1 of Scherer et al. (2019), 43.6% of participants still preferred to participate in cancer screening even when they believed that cancer screening would not reduce the risk of cancer death nor extend the length of their life. Moreover, in their

Study 2, 36.9% of participants still preferred to undergo cancer screening even when they assumed screening has no life-saving benefit. The authors' exploratory analyses indicated that cancer worry and anticipated emotional reassurance about their health explained variance in preference for cancer screening that would not provide a life-saving benefit. The findings of Scherer et al. (2019) can be interpreted to suggest that individuals are willing to experience risks of potential health-related harms of cancer screening (e.g., overdiagnosis and overtreatment) to obtain potential benefits; and that the benefits not only include health or life-saving benefits, but also emotional benefits (e.g., reducing anxiety and achieving reassurance).

The results of Scherer et al.'s study suggest that when making decisions about cancer screening, some people consider the importance of screening in terms of reducing their own anxiety and worry over cancer as well as reducing the severity of cancer diagnosed. Thus, targeting the beliefs about emotional benefits of thyroid cancer screening could be as important and much needed as targeting the beliefs about life-saving benefits. Information about potential health-related harms of thyroid cancer screening—the common approach to intervening the utilization of low-value care—could contribute to reduce the favorable cognitive/instrumental attitude towards screening uptake by modifying the beliefs about its health benefits. In addition, by highlighting potential negative affective consequences of thyroid cancer screening (e.g., anxiety due to false-positive and regret unfortunate outcomes of thyroid ultrasound screening), it may be possible to counter the previously held beliefs about emotional benefits of cancer screening, and consequently reduce the favorable affective attitude towards screening uptake. Evidence, although indirect, exists providing some support for this idea. Scherer et al. (2019) reported that the percentage of participants preferred to undergo cancer screening dropped from 43.6% to 23.8% when a detailed list of possible physical, psychological, and financial harms

from screening was provided. From the perspective of this dissertation, the decrease in preference for cancer screening observed by Scherer et al. may be due to a decrease in favorable attitudes towards cancer screening after reading the information about the various types of harms. The foregoing discussion leads to the following hypothesis:

> H13: When negative affective consequences of cancer screening are highlighted, it will result in lower levels of (a) positive affective attitude and (b) positive cognitive/ instrumental attitude, compared to when the affective consequences are not highlighted.

Strategy 3: Providing information about diagnostic uncertainty to reduce anticipated regret. The parallel model and the serial models are distinguished by how they theorize the role of anticipated regret. The parallel model proposes that along with risk perceptions, attitudes, and subjective norms, anticipated regret increases screening intention. By contrast, the core idea of the serial model is that anticipated regret mediates the effects that risk perception, attitudes, and subjective norms have on screening intention. As anticipated regret in both of the models is hypothesized to increase screening intention, anticipated regret could also be a promising intervention target. That is, an intervention could demote screening intention by aiming to lower the level of anticipated regret. Furthermore, if the serial model is supported and thus anticipated regret indeed is the most proximate determinant of screening intention, directly targeting it is likely to be more effective than targeting the more distal determinants of intention (i.e., risk perception and attitudes).

An intervention may influence the level of anticipated regret by modifying antecedent conditions under which individuals anticipate regret. As reviewed earlier, according to the DJT (Connolly & Zeelenberg, 2002), the key two components for a regret generation are the perception that the obtained decision outcome is poorer than the foregone decision outcome, and

the sense of self-blame for making a decision that is not justified. The first component, the comparative evaluation, suggests that an intervention could lower the level of anticipated regret with respect to screening non-uptake by providing information that shows predicted outcomes of screening non-uptake may not necessarily be poorer than those of screening uptake. However, as discussed earlier, the standard approach that provides didactic information about health-related benefits and harms (e.g., overdiagnosis and overtreatment) has been limited in its ability to curb individuals' seeking of unnecessary medical services (e.g., Scherer et al., 2018; Schaffer & Scherer, 2018).

Another approach that complements the standard approach may be to emphasize the limited diagnostic accuracy of screening tests by quantifying the uncertainty involved in test results. Consider the following example:

> In South Korea, women have a 0.1 % chance of having thyroid cancer (the disease prevalence). If a woman has thyroid cancer, the probability that she tests positive is 94% (the sensitivity of a test). When a woman does not have thyroid cancer, the probability that she nonetheless tests positive is 34% (the false-positive rate). Consider South Korean woman who received a positive test result from her routine thyroid cancer screening. She wants to know whether she has thyroid cancer for sure. What would the probability be that she actually has thyroid cancer?

The question at the end asks the positive predictive value (PPV) of thyroid cancer screening. PPV is one measure of diagnostic accuracy to be considered when evaluating the performance of screening tests, which refers to the probability that a person with a positive screening test truly have a disease (Gigerenzer et al., 2007; Sedgwick, 2014). The correct answer to the question is 2.6%, meaning that of 100 women who have positive test results, only about 2

to 3 actually have thyroid cancer. This example illustrates that the predictive value of thyroid cancer screening is surprisingly low, and therefore, undergoing cancer screening may not efficiently determine the absence or presence of thyroid cancer.

I propose that information about diagnostic uncertainty could reduce anticipated regret in three ways. First, by illustrating that cancer screening could result in false alarms with high probability, the information could facilitate a mental simulation of negative outcomes, other than health-related ones, that might result from screening uptake. The uncertainty that is expected to follow after the uptake of screening tests could possibly encourage the generation of counterfactual thoughts about the negative outcome of screening uptake in individuals' mind, which in turn could make anticipated regret with respect to screening non-uptake relatively less salient to individuals at the time they make the screening decision (Zeelenberg, 1999). In such a case, individuals may recognize that screening uptake is not the only option to avoid or minimize future regret.

Second, according to Zeelenberg (1999a), individuals' expectation of a post-decisional feedback on the outcome of a foregone option influences their anticipation of regret. Take a cancer screening decision as an example. In the process of deciding whether to take screening tests, individuals can easily imagine a future situation where they experience negative outcomes of not taking screening tests (e.g., finding cancer at later stages) and realize the outcome of screening uptake would have been better. By contrast, it would be relatively more difficult for them to imagine a future situation where they face negative outcomes of taking tests (e.g., overdiagnosis) and realize screening non-uptake would have been better. That is mainly because overdiagnosis is counterfactual in its nature and imperceptible at the individual level. To put it differently, not undergoing screening carries the risks of learning that a foregone outcome turns

out to be better and therefore experiencing regret in the future, whereas undergoing screening does not carry such risks. The possibility of post-decisional regret could drive individuals to take screening tests even when they know its benefits do not outweigh its harms. Considering that, I suggest highlighting inherent diagnostic uncertainty could make the outcomes of screening uptake seem as uncertain (or risky) as those of screening non-uptake, eventually making individuals to think that screening uptake is not necessarily the only regret-avoiding or minimizing option.

Lastly, but perhaps more importantly, information about diagnostic uncertainty may provide a justification for not taking screening tests. The fact that having the positive or negative test results does not necessarily guarantee the presence or absence of a disease can make the decision not to undergo screening more defensible and justifiable. Furthermore, individuals may think that even if the negative consequences ensue from their decision not to undergo screening, they could manage to take the blame off of themselves for the consequences and redirect the blame toward the inevitable scientific uncertainty instead. Based on these considerations, I hypothesize that

H14: When information about diagnostic uncertainty is provided, it will result in a lower level of anticipated regret, compared to when the information is not provided.

The Parallel Multiple Mediation and Serial Multiple Mediation Models

The parallel model and the serial model provide frameworks for tracing how the three communication strategies proposed influence screening intention. Figure 6 is the parallel model with message variables included and will be referred to as the *parallel multiple mediation model* hereafter. The red boxes in the figure represent the message components that are hypothesized to affect risk perceptions, attitudes toward screening uptake, and anticipated regret related to

screening non-uptake. The parallel multiple mediation model proposes the indirect effect of the three message variables on screening intention through perceived severity, perceived susceptibility, affective attitude, cognitive/instrumental attitude, and anticipated regret. Hypotheses regarding the indirect effects in the parallel multiple mediation model are as follow:

H15a: Changing a disease label will reduce screening intention by reducing perceived severity.

H15b: Changing a disease label will reduce screening intention by reducing perceived susceptibility.

H15c: Highlighting negative consequences of screening uptake will reduce screening intention by reducing affective attitude toward screening uptake.

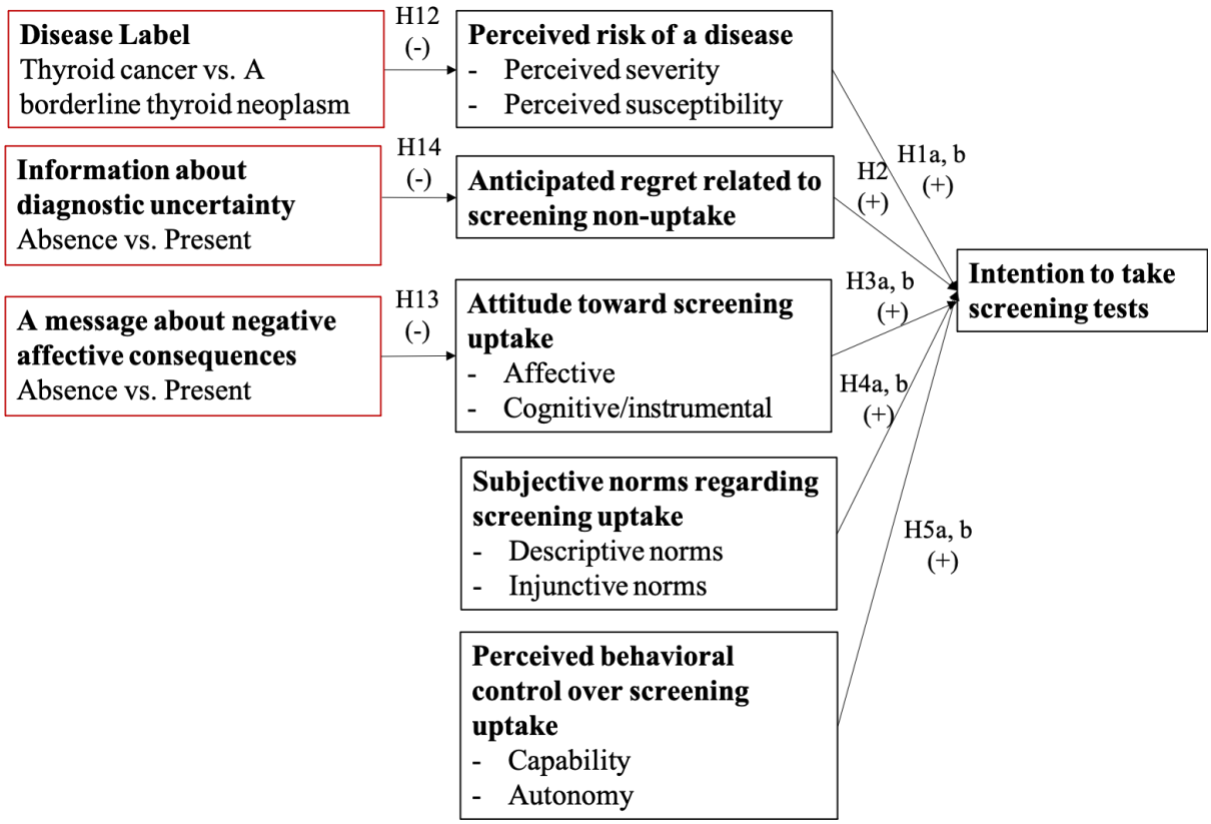

Figure 6 *The parallel mediation model with each hypothesis specified*

H15d: Highlighting negative consequences of screening uptake will reduce screening intention by reducing cognitive/instrumental attitude toward screening uptake.

H15e: Providing information about diagnostic uncertainty will reduce screening intention by reducing anticipated regret with respect to screening non-uptake.

Figure 7 depicts the serial model with the message variables included and will be referred to as the *serial multiple mediation model* hereafter. In the serial multiple mediation model, the message effects run via six separate pathways to screening intention. Hypotheses regarding the indirect pathways from the message variables to screening intention are as follow:

H16a: Changing a disease label will reduce screening intention by reducing perceived severity which in turn reduces anticipated regret with respect to screening non-uptake.

H16b: Changing a disease label will reduce screening intention by reducing perceived susceptibility which in turn reduces anticipated regret with respect to screening non-uptake.

H16c: Highlighting negative consequences of screening uptake will reduce screening intention by reducing affective attitude toward screening uptake which in turn reduces anticipated regret with respect to screening non-uptake.

H16d: Highlighting negative consequences of screening uptake will reduce screening intention by reducing cognitive/instrumental attitude toward screening uptake which in turn reduces anticipated regret with respect to screening non-uptake.

H16e: Providing information about diagnostic uncertainty will reduce screening intention by reducing anticipated regret with respect to screening non-uptake.

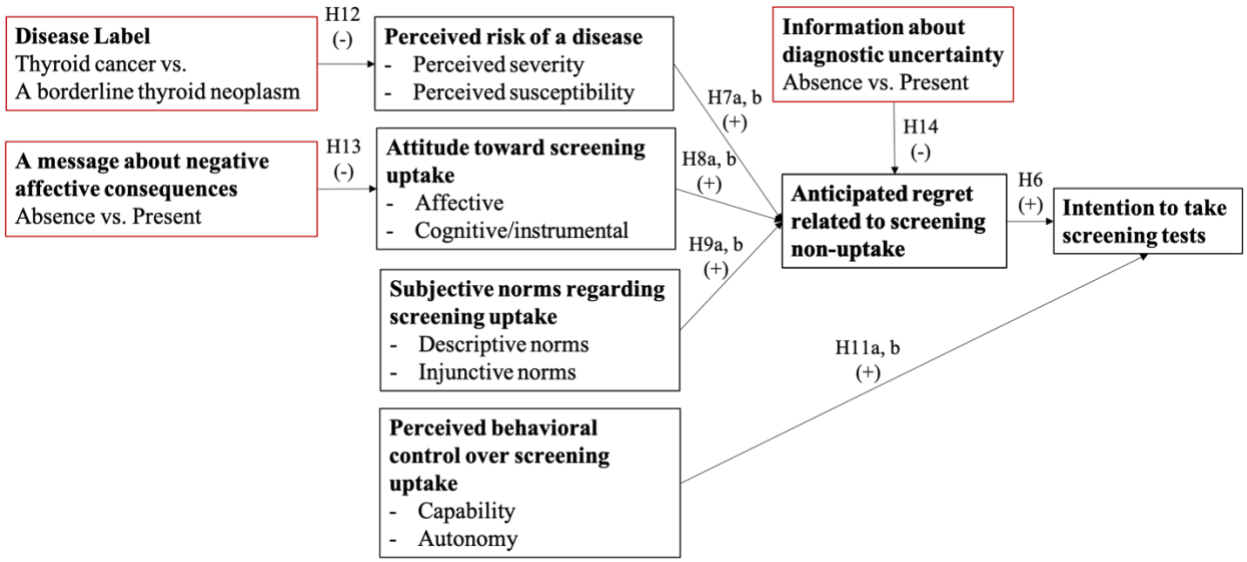

Figure 7 *The serial mediation model with each hypothesis specified*

Effects on Decisional Conflict, Informed Decision Making, Intention Not to Undergo Screening, and Medical Skepticism

The primary outcome of this dissertation is intention to undergo thyroid ultrasound screening; and the three communication strategies proposed in this dissertation aim to reduce the intention to undergo screening. However, the ultimate goal of decision support materials communicating the benefits and harms of cancer screening is to help individuals make appropriate or adequate decisions about their participation in cancer screening. In that regard, I also consider other decision-related outcomes that could serve as indicators of the effectiveness of the three communication strategies employed in decision support materials in improving decision quality.

It should be noted again that although the Korean guideline does not recommend thyroid ultrasound as a routine screening test for individuals without any symptoms of thyroid cancer, in the South Korean context, a decision to and not to undergo thyroid ultrasound screening is also

considered as preference-sensitive due to uncertainty about its benefit versus harm ratio (Yi et al., 2015). Thus, thyroid cancer screening decision could be relatively less straightforward, compared to a decision in situations where there is one option that is clearly better than the alternative based on sufficient scientific evidence (e.g., getting a flu vaccine). Furthermore, for such preference-sensitive decisions, a decision that individuals make cannot be simply judged as right or wrong only from a medical point of view. In consideration of the preference-sensitive nature of thyroid cancer screening, I consider decisional conflict, informed decision, and intention not to undergo screening as additional indicators of the effectiveness the three communication strategies rather than relying only on intention to undergo screening.

Decisional conflict refers to perceived uncertainty or confusion about which course of action to take when making choices among competing options that involves uncertain outcomes (O'Connor, 1995). Decisional conflict is an important decision outcome in and of itself that has been demonstrated to be reduced by the use of decision aids for individuals facing screening decisions (Stacey et al., 2014). Decision support materials explaining potential health-related risks (i.e., overdiagnosis and overtreatment) as well as non-health-related risks (i.e., anxiety and regret) of thyroid ultrasound screening and diagnostic uncertainty can reduce decisional conflict. However, the opposite effect could be also expected. Communicating about overdiagnosis and overtreatment (and associated affective outcomes) requires acknowledging uncertainty inherent in medicine (McCaffery et al., 2016), which can lead to individuals' confusion (Han, 2013). In addition, the degree of decisional conflict could be increased by provision of information about diagnostic uncertainty that adds another complexity in decision-making. Lastly, the use of the alternative disease label also has a potential to increase decisional conflict because individuals

may not be able to draw on prior knowledge or experience to facilitate their decision-making about screening for a novel health problem. Thus, the following research question is posed:

> RQ2: To what extent will (a) changing a disease label, (b) highlighting negative consequences of screening uptake, and (c) providing information about diagnostic uncertainty reduce decisional conflict?

For preference-sensitive decisions, an informed decision is often defined as a decision that is both based on relevant evidence and congruent with what matters to decision makers (e.g., values and goals) (Elwyn et al., 2009; Marteau et al., 2001). This means, the same decision could be considered adequate to one person, but not to the others. For example, consider an asymptomatic woman who decides to undergo thyroid ultrasound screening. We cannot simply say her decision is wrong if she is fully aware of the uncertain benefits and potential harms of thyroid ultrasound screening and she values the reassurance that could result from normal screening results despite the risk of overdiagnosis. Next, consider another asymptomatic woman who is also well informed of the uncertain benefits and potential harms of thyroid ultrasound screening, and thus has had unfavorable attitudes toward unnecessary medical screening. If she accepts the offer of thyroid ultrasound screening mainly because it is an inexpensive add-on option to her biannual health checkup, her decision could not be deemed adequate because it does not reflect her preference well.

The quality of preference-sensitive decisions could be improved by increasing individuals' decision relevant knowledge and the congruence between individuals' preferences and their decisions (Sepucha et al., 2006). Provision of additional information about uncertainties related to the benefits and harms of medical interventions could increase decision relevant knowledge, thereby empowering individuals to make an informed decision. However,

information that can help individuals to make informed decisions can also be an obstacle to the same informed decision (Hibbard & Peters, 2003). Previous studies have shown that full disclosure of uncertainties about the effects of cancer treatments exceeds some patients' capacity to process and make use of the information effectively (Mazur & Merz, 1996). Thus, it may be that provision of the additional relevant information could make informed decision-making easier or they may serve to overload individuals and complicate matters, making informed decisions more challenging.

A message about affective consequences of screening could be an effective way to mitigate the negative unintended effect of communicating medical uncertainty. Research on affect heuristics suggests that affects can act as information that guides cancer screening and treatment decisions (Peters, Lipkus, et al., 2006; Peters, Västfjäll, et al., 2006). For example, Alhakami and Slovic (1994) demonstrated that individuals' general affective evaluation of a particular behavior guide their judgments about risks and benefits of the behavior. That is, if feelings toward a behavior are positive, individuals tend to judge its risks to be low and its benefits to be high. By contrast, if their feelings are not favorable, they are inclined to judge its risks to be high and its benefits to be low. Building upon affect heuristic research, I expect that a message highlighting negative affective consequences of screening could help individuals assess potential harms and uncertain benefits of screening in ways that are consistent with the negative affect associated with screening (i.e., high risks and low benefits), which in turn could increase the match between their preferences and screening decisions. However, it is also possible that a message highlighting affective consequences distract individuals from making an informed decision particularly if the message motivates individuals to attend to the emotional message at the expense of other equally important information that could inform decisions (Peters, Lipkus,

et al., 2006). Based on the preceding discussion, another research question is posed to explore how the three communication strategies might facilitate informed decisions:

> RQ3: To what extent will (a) changing a disease label, (b) highlighting negative consequences of screening uptake, and (c) providing information about diagnostic uncertainty increase the degree to which individuals make an informed decision?

As an exploratory purpose, I also aim to assess to what extent the three strategies contribute to an increase in intention *not* to undergo screening which is also another adequate decision about thyroid ultrasound screening. One may think a weak intention of undergoing thyroid ultrasound screening is the same as a strong intention of not undergoing thyroid ultrasound screening. However, Richetin et al. (2011) demonstrated that intention to perform a certain behavior was not simply the opposite of intention not to perform the behavior, and that both types of intentions independently predicted behaviors. Richetin et al. speculated that was because performance and non-performance of a certain behavior are likely associated with two different, rather than opposite, sets of goals and reasons. Take, for instance, the decision-making process underlying screening uptake and non-uptake. Typical goals that individuals seek by not undergoing cancer screening may be to avoid risks of overdiagnosis and overtreatment and to avoid unnecessary healthcare spending. However, typical goals that individuals pursue by undergoing cancer screening may be to reduce uncertainty about the presence or absence of cancer and to detect/treat a cancer early, rather than to experience overdiagnosis and overtreatment and to increase unnecessary healthcare spending. Although the two sets of goals could partly clash at times, this does not mean that they are opposite to each other, or they cannot coexist.

The discussion thus far suggests that since screening uptake and screening non-uptake

could be a means to two separate goals, a weak intention of undergoing thyroid ultrasound screening may not necessarily be the same as a strong intention of not undergoing thyroid ultrasound screening. Thus, it would be worthy to explore the extent to which the communication strategies increase intention not to undergo thyroid ultrasound screening as another way to look at the effectiveness of the strategies.

RQ4: To what extent will (a) changing a disease label, (b) highlighting negative consequences of screening uptake, and (c) providing information about diagnostic uncertainty increase intention not to undergo screening?

As the communication-based strategies proposed are not conventional ones, it is also necessary to evaluate whether they engender any negative unintended outcomes. A concern about explaining uncertain benefits of screening and providing information about diagnostic uncertainty is that they may unintentionally lead to individuals to have greater skepticism toward medical care and health care utilization. Extant studies show that while it is important to communicate scientific uncertainties so that lay individuals can make informed decisions without being misled, communication about scientific uncertainty can invite adverse effects such as increased distrust in the information at hand and reduced source credibility perceptions (Gustafson & Rice, 2020; Jensen et al., 2011; Johnson & Slovic, 1995; Longman et al., 2012). Building upon these studies, I aim to explore if providing information about diagnostic uncertainty and highlighting anxiety and worry related to diagnostic uncertainty may have similar outcomes with respect to individuals' medical skepticism. Scientific uncertainties surrounding thyroid ultrasound screening may not only decrease individuals' intention to take thyroid screening tests, but also make them discredit even well-established medical recommendations (Fiscella et al., 1998). Thus, the last research question is posed:

RQ5: Will (a) changing a disease label, (b) highlighting negative consequences of screening uptake, and (c) providing information about diagnostic uncertainty fuel medical skepticism?

CHAPTER 3

METHOD

Study Design and Sample

Data collection took place in the form of an online survey-based experiment. The experiment employed a 2 (disease label: thyroid cancer vs. a borderline thyroid neoplasm) × 2 (a message about affective consequences of screening: absent vs. present) × 2 (information about diagnostic uncertainty: absent vs. present) full-factorial between subject design with a control condition. Participants were randomly assigned to one of the eight experimental conditions resulting from the 3-factor 2-level full-factorial design or to the control condition for the entire experiment.

There were three eligibility criteria for participants: (a) being 19 or older, (b) being a biological female, and (c) having no prior cancer diagnosis. South Korean adult women are surveyed in this experiment as in South Korea, the prevalence of thyroid cancer among women is 4.7 times higher than that of among men (Hong et al., 2020). Thus, this dissertation focused on women as they are more susceptible to experiencing overdiagnosis and overtreatment. The reason for excluding individuals with a prior cancer diagnosis was that their personal cancer history could potentially confound the results of the experiment.

From December 16th to December 23rd, 2020, a convenient sample of South Korean adult women without any prior cancer diagnosis were recruited via a sampling service provided by *Hankook Research Inc.,* a professional polling company in South Korea. No stratification was carried out by age, education, or other variables. An invitation to an online survey entitled “A

Survey on Korean Women's Knowledge, Perceptions of, and Demand for Health Screening" was sent to panelists registered to *Hankook Research Inc*. The panel consisted of individuals from the South Korean general public who voluntarily participate in online surveys. A total of 612 South Korean adult women without any prior cancer diagnosis completed the online survey (M_{age} = 38.70, SD_{age} = 10.06, $Median_{age}$ = 39). Of note, this is the final number of participants after the polling company removed participants that did not meet the eligibility criteria or did not finish their participation. With a sample of 612 and a two-tailed alpha of .05, the power to detect differences between the two levels of each experimental factor and the control condition for the entire experiment was also .60 for small effects (f = .10), and in excess of .99 for medium effects (f = .25) and large effects (f = .40). With a sample of 492 (the number of participants after dropping 120 in the control condition) and a two-tailed alpha of .05, the power to detect main effects and interactions of the three experimental factors was .60 for small effects (f = .10), and in excess of .99 for medium effects (f = .25) and large effects (f = .40). Participant characteristics are further described in Chapter 4 (Results).

Procedure

The online survey was administered via the website of *Hankook Research Inc*. and consisted of a consent form, eligibility questions, a baseline questionnaire, exposure to stimulus materials (i.e., scenario and booklet), and a post-exposure questionnaire. The first page of the online survey was the consent form. Interested panelists self-selected to participate by reviewing the eligibility criteria listed in the consent form. Then, consented panelists completed eligibility questions that were placed at the beginning of a baseline questionnaire. Those who reported being 18 years old or younger, a biological female, and/or having had a prior cancer diagnosis were redirected to the end of the survey.

Eligible participants continued to complete the rest of the baseline questionnaire. The baseline questionnaire included items regarding participants' experience with cancer. Upon the completion of the baseline questionnaire, participants were randomly assigned to either one of the eight experimental conditions resulting from the 2 × 2 × 2 between-subject design or the control condition. The size of control condition was preset to be half of the size of each level of experimental factors. The rationale for this decision was twofold. It would be difficult to detect the effect of any experimental factor, if the control condition is very different from experimental conditions in size. In fact, it would be statistically most efficient to match the number of control participants to the number of participants expected to be assigned to each level of experimental factors. However, after weighing the opportunity costs associated with not exposing a substantial number of participants to experimental treatments against the statistical efficiency of an even split between conditions, I concluded to preset the number of control condition participants to be at least half of the number of participants in each level of experimental factors. As a result, 60 to 63 participants were assigned to each of the eight experimental conditions (243 to 248 were assigned to each level of the experimental factor), 120 participants were assigned to the control condition. See Appendix A for the number of participants assigned to each study condition.

Then, participants read a scenario and an information booklet relevant to the condition to which they were assigned (a detailed description of the stimulus materials is presented in the next section) and then completed the post-exposure questionnaire specific to the scenario and booklet they had read. Of note, participants were asked to complete the post-exposure questionnaire, imagining that it was not during Covid-19 pandemic, and that they were in a situation with a week left before one's regular health checkup. The post-exposure questionnaire included items assessing the primary outcome variables (i.e., the TPB components, risk

perceptions, anticipated regret). To rule out the possibility that simply asking participants about their anticipated regret unintentionally increases the salience of anticipated regret for all conditions and subsequently affect screening intention (Abraham & Sheeran, 2003, 2004; Sandberg & Conner, 2009), the anticipated regret questions were presented after the questions measuring other primary outcome variables. At the end of the post-exposure questionnaire, there were also items about participants' income, education levels, and whether they worked in the health field.

The post-exposure questionnaire was matched on experimental conditions. In the questionnaires that participants in the alternative disease label conditions completed, the label *thyroid cancer* had been replaced with *a borderline thyroid neoplasm*. All other information in the post-exposure questionnaires were identical in all nine conditions. On average, participants took about 25 minutes to complete the entire study. Participants were debriefed after the completion of the post-exposure questionnaire and received 3,000 KRW, which is equivalent to around 2.5 USD, for their participation. Institutional Review Boards of University of Georgia and Seoul National University Hospital reviewed and approved the procedures.

Stimulus Materials

All participants read a scenario in which they were asked to imagine themselves having a regular health checkup scheduled in a week (imagining that it was not during Covid-19 pandemic) and then were presented with a booklet describing an optional thyroid ultrasound screening they could get for an additional fee. The booklet was developed based on previous research on communication of health statistics and already existing patient decision aids for cancer screening (e.g., Gigerenzer et al. 2007; Hersch et al., 2015) and revised with inputs from a radiologist and an epidemiologist. The booklet contained written and visual information about

the following topics: 1) thyroid cancer (e.g., its prevalence, symptoms, indolent nature); 2) thyroid ultrasound screening, 3) a clinical practice guideline for thyroid cancer screening that does not recommend screening asymptomatic adults for thyroid cancer, and 4) uncertain benefits and potential harms of thyroid cancer screening. The last part of the booklet where it explained uncertain benefits and potential harms of thyroid ultrasound screening was varied according to the experimental design. The variations are explained in more detail below.

For all experimental conditions (but not the control condition), the booklet explained the issues of overdiagnosis and overtreatment thoroughly using visual aids (e.g., a line graph) and also emphasized that screening for thyroid cancer in asymptomatic persons might not meaningfully reduce thyroid cancer mortality. The other portion of information was varied according to the two experimental factors: information about diagnostic uncertainty (absent vs. present) and a message about negative affective consequences of thyroid ultrasound screening (absent vs. present). Appendix A provides an overview of how the nine booklets were structured.

Diagnostic uncertainty. In the conditions where information about diagnostic uncertainty was presented, using a tree structure, the booklet illustrated that the positive predictive values of thyroid ultrasound screening (i.e., the probability of a disease given a positive test) could be as low as 2.6%. The tree structure is often recommended to use when communicating statistics to lay individuals; it translates abstract and complex probabilistic information (e.g., the disease prevalence, measures of screening test performance) into a more intuitive and transparent natural frequency representation, facilitating understanding of the statistical information (Gigerenzer, 2011) (see Figure 8).

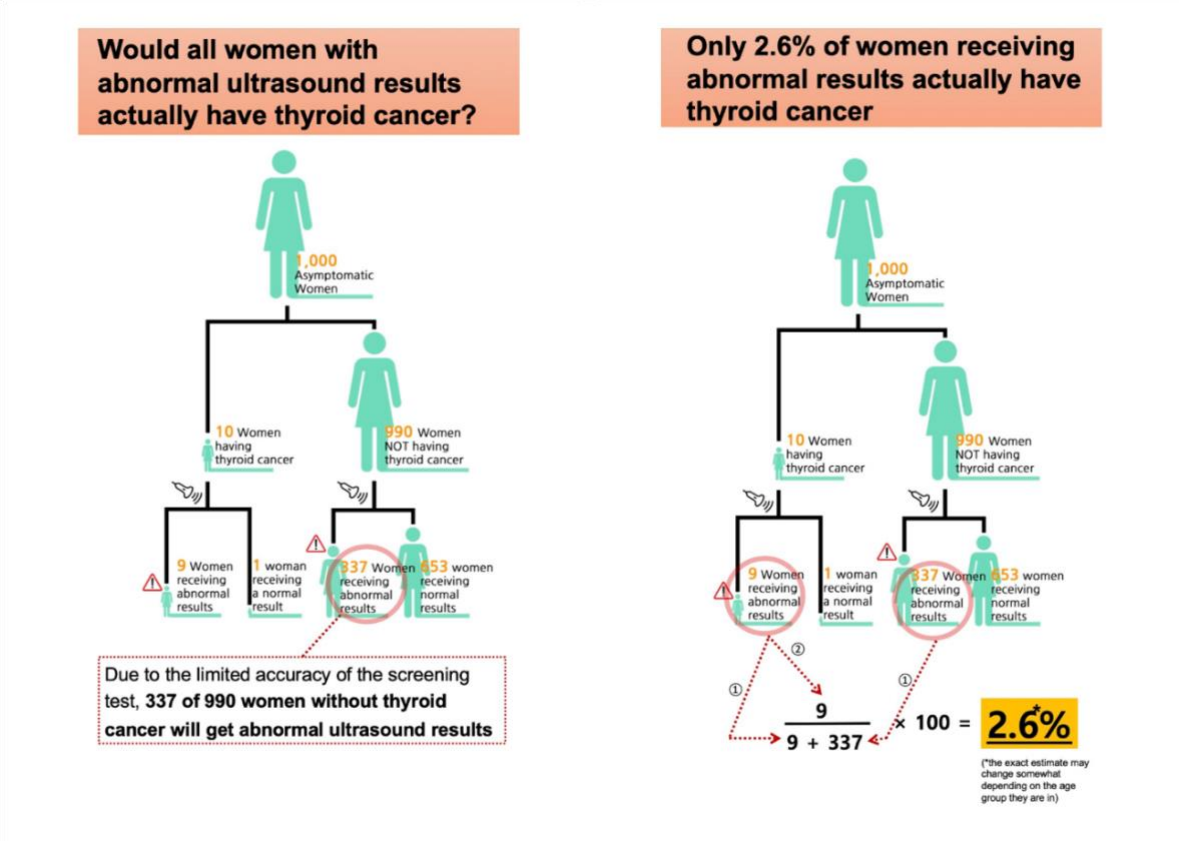

Figure 8. *The tree structure included in information about diagnostic uncertainty*

Affective consequences. In the conditions where a message about affective consequences of thyroid cancer screening was presented, the booklet briefly reminded readers of the potential harms of thyroid ultrasound screenings and asked them to think ahead of the regret they might experience after undergoing thyroid ultrasound screening in the event of experiencing its harms (e.g., overdiagnosis and overtreatment) (see upper two graphics in Figure 9). Furthermore, in the conditions where both information about both diagnostic uncertainty and a message about affective consequences were presented, the booklet additionally highlighted that undergoing thyroid ultrasound screening may not completely relieve cancer-related worry and anxiety or could even further increase worry and anxiety, due to the limited accuracy of screening tests (see the highlighted in the lower two graphics in Figure 9).

How much regret would you feel about your decision to undergo screening?

◆ If you undergo thyroid ultrasound screening, you may face **a regretful situation of experiencing overdiagnosis and overtreatment**

• Overdiagnosis and overtreatment **could cause irreversible effects to the quality of your life (e.g., taking hormone replacement pills permanently)**

How much regret would you feel about your decision to undergo screening?

◆ Even if you decide not to undergo thyroid ultrasound screening, **you can change your decision at any time later**

◆ **Another possible way is to vigilantly watch out symptoms and to go to the hospital if the symptoms actually occur later on**

• It won't be too late to do so because the vast majority of thyroid cancer is slow-growing and highly treatable

Women with abnormal results may need to undergo extra tests

◆ Extra tests would confirm the absence of thyroid cancer

◆ However,

• The extra tests could cause **inconvenience and possibly complications as well as stress and anxiety** in the process of reaching a conclusion

• Having experience of receiving an inaccurate test result, some may keep worrying about the possibility of having an active disease for a while afterwards

Will results of thyroid ultrasound screening quickly relieve anxiety and worry about the possibility of thyroid cancer?

◆ **Thyroid ultrasound is never 100 percent accurate**, like any other medical tests.

◆ Thyroid ultrasound screening **may not completely relieve your anxiety and worry about thyroid cancer**, as much as many people think

◆ Rather, **it could further increase the anxiety and worry**

Figure 9 *A Message about negative affective consequences*

Label. To manipulate labeling, in half of the booklets the disease was labeled *thyroid cancer* and in the other half, it was labeled *a borderline thyroid neoplasm*. The content of those version of the booklets was identical to the ones with that of the booklet with the label thyroid cancer except that it did not include information that explained the heterogeneity of disease progression and the slow-growing nature of the disease (see Figure 10).

Lastly, in the control condition, participants read a booklet containing a description of thyroid, thyroid cancer prevalence, and thyroid ultrasound screening. See Appendix B for the actual stimulus materials.

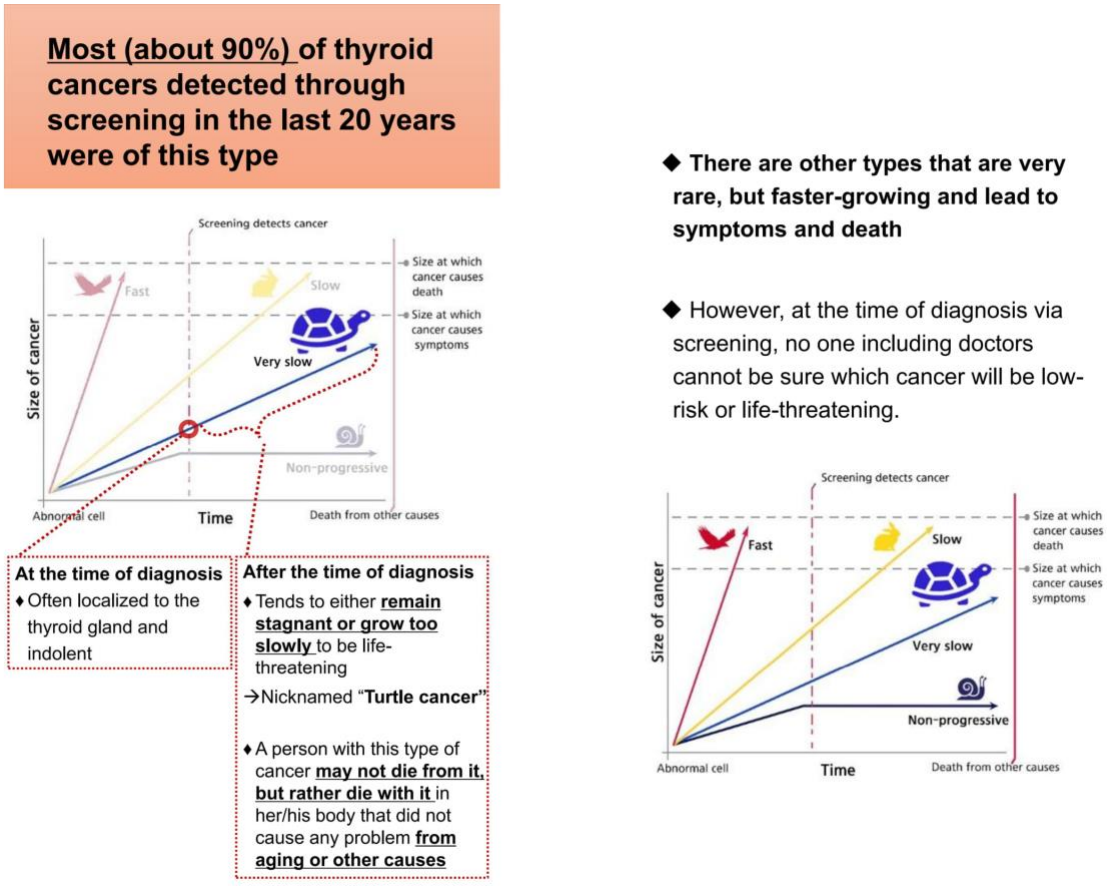

Figure 10 *Information about the slow-growing nature of thyroid cancer*

Measures

The baseline questionnaire included items designed to collect background information about participants' personal experience with cancer such as cancer history of close others, prior exposure to messages about the benefits of early detection and treatment of cancer through screening, thyroid cancer symptom experience, and stages of behavioral change. The post-exposure questionnaire included items designed to measure the primary outcome variables (i.e., the TPB components, anticipated regret, risk perception). Since participants were to complete the post-exposure questionnaire after reading a long stimulus material, shorter measures were needed to minimize completion time and participant burden, which are known to decrease data quality and increase an attrition rate (Rolstad et al., 2011). Therefore, to measure the TPB components, except affective and cognitive/ instrumental attitude, 2-item scales were developed for this dissertation based on prior research. The post-questionnaire also included measures of secondary outcomes (i.e., decision-relevant knowledge, decisional conflict, intention not to take a screening test, and medical skepticism). See Appendix C for the exact items for all measures.

Primary outcomes

Perceived severity. Participants' perceived severity of thyroid cancer (or a borderline thyroid neoplasm) was measured by asking participants to indicate the strength of their agreement with each of four statements adopted from a health belief model-based study involving cervical cancer screening (Bish et al., 2000). The four statements were: "Getting [thyroid cancer/a borderline thyroid neoplasm] would interfere with life," "If I got [thyroid cancer/a borderline thyroid neoplasm], I would have problems which would last a long time," "If I got [thyroid cancer/a borderline thyroid neoplasm] my whole life would change," and "Getting [thyroid cancer/a borderline thyroid neoplasm] would not be a problem for me" (reverse coded).

Responses were on a 4-point Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). There was also an additional option "*Undecided*" (9). For analysis, the values were recoded, in which 3 (agree) and 4 (strongly agree) were recoded as 4 and 5 respectively; and 9 (undecided) was recoded as 3 indicating 'neither agree nor agree' (M = 3.42, SD = .89, α = .80).

Perceived susceptibility. Perceived susceptibility was measured using the 6-item scale of experiential risk perception which is essentially a gut-level assessment of susceptibility to developing a disease (Ferrer et al., 2016). Examples of the experiential risk perception scale used in this dissertation are: "How easy is it for you to imagine yourself developing [thyroid cancer/a borderline thyroid neoplasm] in the future?" (1 = *Not at all*; 7 = *Extremely*), "I am confident that I will not get [thyroid cancer/a borderline thyroid neoplasm]" (1 = *strongly disagree*; 7 = *strongly agree*; reverse coded), and "My first reaction when I hear of someone getting [thyroid cancer/a borderline thyroid neoplasm] is 'that could be me someday'" (1 = *strongly disagree*; 7 = *strongly agree*, reverse coded) (M = 3.68, SD = 1.00, α = .75).

Attitudes (affective and cognitive/instrumental). Affective and cognitive/instrumental attitudes toward undergoing thyroid ultrasound screening were measured using four and three items, respectively. Each item started with the following sentence: "For me, undergoing thyroid ultrasound screening is…" Affective attitude items were anchored by very not reassuring/very reassuring, very not relieving/very relieving, very anxiety provoking/very not anxiety provoking, and very unpleasant/very pleasant, each scored on a 7-point bipolar scale ranging from -5 to 5. The average of the scores on the four items was used an overall measure of affective attitude (M = .78, SD = 1.14, α = .84). Cognitive/instrumental attitude was measured with three 7-point semantic differential scales ranging from -5 to 5. The bipolar word pairs used were: Very harmful/very beneficial, very worthless/very worthwhile, and very foolish/very wise. The scores

on the three items were averaged to obtain an overall measure of cognitive/instrumental attitude (M = .93, SD = 1.34, α = .91).

Subjective norms (injunctive and descriptive norms). To measure injunctive norm, three items were adapted from a TPB-based study about the role of social norms on men's prostate cancer screening behavior (Sieverding et al., 2010). Injunctive norms was measured by two items: "Most people I consider important, including doctors, would think I should undergo thyroid ultrasound screening," and "Most people I consider important, including doctors, would approve of me undergoing thyroid ultrasound screening." Responses were on a 7-point Likert scale with endpoints indicating strong disagreement (1) to strong agreement (7). (M = 3.73, SD = 1.39, r = .71). Descriptive norms was measured by two items "How many of women of your age regularly undergo thyroid ultrasound screening?" (1 = *none*; 7 = *all of them*) and "Women of your age regularly undergo thyroid ultrasound screening." (1 = *strongly disagree*; 7 = *strongly agree*) (M = 2.99, SD = 1.39, r = .82).

Perceived behavioral control (capability and autonomy). Capability was measured using two items adopted from Yzer (2012): "There can be a variety of obstacles to your participation in thyroid ultrasound such as cost, lack of transportation, taking time off work, fear or worry about the procedure and many others. Even in the face of such obstacles, how sure are you that if you really wanted to, you can participate in thyroid ultrasound?" and "How sure are you that you can get thyroid ultrasound if you really wanted to, even if your doctor does not tell you to get one?" Responses were on 7-pomt Likert scales with endpoints "completely sure I cannot" versus "completely sure I can" (M = 4.80, SD = 1.31, r = .65). Autonomy was measured using two items adopted from studies using the multicomponent TPB (e.g., Dobbs et al., 2020; Yzer, 2012): "How much control do you feel you have over whether or not you undergo thyroid

ultrasound screening?" (1 = *completely no control*; 7 = *complete control*) and "Whether or not I undergo thyroid ultrasound screening is up to me" (1 = *strongly disagree*; 7 = *strongly agree*) (*M* = 5.52, *SD* = 1.16, *r* = .74).

Screening intention. Informed by previous TPB studies (e.g., Bish et al., 2000) and Fishbein and Ajzen's (2010) guidelines for the questionnaire development based on TPB, two questions were developed for this dissertation to measure intention to undergo thyroid ultrasound screening. The two questions were: "If given the chance, do you intend to undergo thyroid ultrasound screening? The cost of a thyroid ultrasound is 45,000 KRW on average, but can be as high as 200,000 KRW depending on the type of hospital performing the test" (1 = *definitely not*; 4 = *definitely yes*) and "How likely is it that you would take up the offer of thyroid ultrasound screening if you were offered one? The cost of a thyroid ultrasound is 45,000 KRW on average, but can be as high as 200,000 KRW depending on the type of hospital performing the test" (1 = *very unlikely*; 4 = *very likely*). Each question also had an answer choice of "*undecided*" (9). For analysis, the values were recoded, such that the values of 3 and 4 were converted into 4 and 5 respectively; and 9 (undecided) was into 3 indicating the middle value (*M* = 3.59, *SD* = 1.00, *r* = .64).

Anticipated regret. Anticipated regret with respect to screening non-uptake was measured with three items adopted from previous studies on the role of anticipated regret (Conner et al., 2013; O'Carroll et al., 2015; Shaffer & Scherer, 2018; Zajac et al., 2017). The items were modified so that they would be appropriate for this dissertation. The three items were as follows" (1) If I did not get a thyroid ultrasound right away, I would regret it," "If I did not get a thyroid ultrasound right away, I would later wish that I had," and "If I did not get a thyroid ultrasound right away, I would be so worried about the possibility of having [thyroid cancer/a

borderline thyroid neoplasm] that I would regret much of the time. Responses were measured on a 7-point Likert scale ranging from *very unlikely* (1) to *very likely* (7) (anticipated regret with respect to screening non-uptake: $M = 3.26$, $SD = 1.54$, $\alpha = .92$).

Secondary outcomes

Decisional conflict. The 10-item decisional conflict scale (DCS) was used to measure participants' levels of decisional conflict. The scale consists of 4 subscales: Feeling uninformed, unclear about personal values, unsupported in decision making, and uncertainty in choosing options (O'Connor, 1995). Example items include "Do you know which options are available to you?" and "Are you clear about which benefits matter most to you?" Responses were on a 3-category Likert scale, anchored by 0 = *Yes*, 2 = *Unsure*, 4 = *No*. Following the scoring and interpretation guide (O'Connor, 1993), the scores from the 10 items were summed, divided by 10, and multiplied by 25. As a result, scores range from 0 (no decisional conflict) to 100 (extremely high decisional conflict) ($M = 16.76$, $SD = 18.61$, $\alpha = .88$, Median = 10).

Distribution on decisional conflict was highly skewed toward lower values (skewness = 1.18). Therefore, the total decisional conflict score was converted into a dichotomous variable, based on the literature (Garvelink et al., 2019) that defines clinically significant decisional conflict (i.e., a decisional conflict that is likely to have negative impacts on decision makers) as a score of 25 or greater on the DCS (Not experiencing clinically insignificant decisional conflict = 68.8%; Experiencing clinically significant decisional conflict = 31.2%).

Decision-relevant knowledge. Ten multiple choice questions were developed to assess participants' knowledge relevant to decision making about screening participation, based on previously used breast cancer screening-related knowledge items (Hersch et al., 2015). These questions were not for hypothesis testing, but for making sure that participants in experimental

conditions had sufficient exposure and cognitive activity in response to the messages that they could recall stimulus material. The questions asked the purpose of thyroid ultrasound screening, the symptoms and development of thyroid cancer (or a borderline thyroid neoplasm) and the benefits and harms of thyroid ultrasound screening, and the uncertainty involved in thyroid ultrasound screening. Example questions include "What do you think is screening for thyroid diseases?" "Do you think all women with an abnormal screening result (i.e., positive result) have [thyroid cancer/a borderline thyroid neoplasm]?" "Which of the following do you think is not a symptom of [thyroid cancer/a borderline thyroid neoplasm]?" "Who do you think is more likely to be diagnosed with [thyroid cancer/a borderline thyroid neoplasm]?" and "Which of these 2 statements do you think best describes overdiagnosis?" Each question, except one about the symptoms, had 3 possible answer: the correct answer, the distractor, and *I don't know*. The response *I don't know* was coded as incorrect. Participants' overall knowledge scores were computed by summing the number of correct answers for all 10 questions. As a result of this computation, the range of the total decision-relevant knowledge score became 0 to 10 (M = 5.66, SD = 2.30).

Informed decision. To assess whether participants' decision to undergo screening was an informed one, the scores of the decision-relevant knowledge, attitudes (the average of affective and cognitive/instrumental attitude scores), and intention to undergo screening were combined. Following previous studies (Dierks et al., 2019; Marteau et al., 2001), a participant was considered to have made an informed decision when: (1) having sufficient knowledge, having a positive attitude, and intending to undergo thyroid ultrasound screening; (2) having sufficient knowledge, having a negative attitude, and intending not to undergo thyroid screening; (3) having sufficient knowledge, having a neutral attitude, and being undecided about whether to

undergo thyroid screening. Any other combinations that those listed above were classified as uninformed decision.

Following previous research (Dierks et al., 2019; Michie et al., 2002; Smith et al., 2010; Van Den Berg et al., 2005), insufficient and sufficient knowledge were defined by the midpoint of the scale. That is, a score of 5 or higher was classified as having sufficient knowledge and score of 4 or lower was classified as having insufficient knowledge. Affective attitude and cognitive/instrumental attitude were averaged to form a single measure of attitude. Following Van Den Berg et al.'s (2005) rationale that the midpoint of attitude scales indicates a neutral attitude, a score of attitude higher than 0 was categorized as 'positive attitude,' a score lower than 0 was categorized as 'negative attitude,' and a score of 0 was categorized as 'neutral.' Lastly, a screening intention score lower than 3 was categorized as 'having no intention of undergoing screening,' a screening intention score higher than 3 as 'having intention of undergoing screening,' and a screening intention score of 3 as 'undecided.' As a result, 39.5% of participants was identified as having made an informed decision.

Intention not to undergo thyroid ultrasound screening. A question was developed for this dissertation to measure intention not to undergo thyroid ultrasound screening. The question was: "Instead of undergoing thyroid ultrasound right away, do you intend to see your doctor if you have unusual changes in your neck indicative of [thyroid cancer/a borderline thyroid neoplasm] in the future." Responses were on a 4-point Likert scale with endpoints of *definitely not* (1) and *definitely yes* (4). Each question also had an answer choice of "*undecided*" (9). For analysis, the values were recoded, such that the values of 3 and 4 were converted into 4 and 5 respectively; and 9 (undecided) was into 3 (M = 3.98, SD = 1.05).

Medical skepticism. Initially, medical skepticism was measured by the four-item scale of skepticism toward medical service and healthcare utilization toward medical care and health utilization (Fiscella et al., 1998). However, reliability analysis indicated that the four items did not form a reliable scale (α = .64). Thus, one item was dropped from the analysis. The remaining three items were "I can overcome most illness without help from a medically trained professional," "Home remedies are often better than drugs prescribed by a doctor," and "I understand my health better than most doctors do" (*M* = 2.91, *SD* = .87, α = .72)

Background Information

Cancer history of close others. "Do you have any family members or acquaintances with cancer including those who are already passed away?" (*No*= 33.2%; *Yes* = 66.8%) and "Do you have any family members or acquaintances who have found and been treated for cancer early through screening?" (*No*= 56.9%; *Yes* = 43.1%).

Previous message exposure. Previous message exposure was assessed by the question, **"**Have you seen, or heard about people who have found and been treated for cancer early through screening through media (e.g., TV, newspaper, the Internet)?" (*No*= 4.6%; *Yes* = 95.4%).

Thyroid cancer symptom experience. Participants' thyroid cancer symptom experience was assessed using four items adapted from a previous study by (Wardle et al., 2003). Four symptoms of thyroid cancer were listed: a painless lump, unexplained hoarseness, a sore throat that does not get better, and difficulty swallowing. Participants reported the frequency of each symptom lately using a 3-point scale (0 = *Never*; 1 = *Occasionally*; 2 = *Frequently*). The score of thyroid cancer symptom experience was based on the total number of symptoms experienced occasionally or frequently. If participants reported having experience each symptom occasionally

or frequently, they were recoded as having the symptom (=1). As a result, the scale ranges from 0 to 4 with 0 indicating no symptoms (M = .90, SD = 1.17).

Past screening behavior and baseline screening intention. To measure past screening behavior and baseline intention to undergo screening, this dissertation utilized a mutually exclusive stage of behavior change categorization scheme, following a previous transtheoretical model-based study (Cho & Salmon, 2006; Prochaska, 1994). Participants were asked to select one of the following that was closest to their thyroid screening experience and intention for future screening: "I have never had a thyroid screening test, and am not thinking about having one in the next 6 months" (precontemplation stage), "I have never had a thyroid screening test, but am thinking about having one in the next 6 months" (contemplation stage), "I have never had a thyroid screening test, but thinking about having one in the next month" (preparation stage), "I have had one thyroid screening test in the past year and intend to continue" (action stage), "I have had thyroid screening tests on a regular schedule and intend to continue" (maintenance stage) and "I have had thyroid screening tests regularly, but I have no intention to continue" (relapse stage).

Participants in precontemplation, contemplation, and preparation stages were classified as not having past screening behaviors (63.2%); and those in action, maintenance, and relapse stages were coded as having past screening behaviors (36.8%). Participants in preparation and relapse stages were coded as not having baseline intention to undergo screening (36.4%); whereas those in contemplation, preparation, action, and maintenance were classified as having baseline intention to undergo screening (63.6%).

CHAPTER 4

RESULTS

Preliminary Results

Participants. A total of 612 South Korean adult women completed the online survey. Participant characteristics are shown in Table 1. The participants' ages ranged from 20 to 59 years (M = 38.70, SD = 10.06, Median = 39). Around half of the participants were college graduates (46.6%), and the other half consisted of middle school graduates (0.2%), high school graduates (16.3%), continuing college students/technical college graduates (28.9%), and postgraduates (8%). The breakdown of the participants by total monthly household income after taxes was as follow: less than 1,500,000 KRW (approx. 1,400 USD, 4.9%); 1,500,000–3,000,000 KRW (approx. 1,400–2,800 USD, 18.0%); 3,000,000–4,500,000 KRW (approx. 2,800–4,200 USD, 22.7%); 4,500,000–6,000,000 KRW (approx. 4,200–5,600 USD, 25.8%); 6,000,000–7,500,000 KRW (approx. 5,600–7,000 USD, 12.9%); More than 7,500,000 KRW (approx. 7,000 USD, 15.7%). Most (93.1%) participants reported not working in the healthcare field.

In terms of other relevant characteristics, about 67% of participants reported having any family members or acquaintances who had been diagnosed with cancer including those who are already passed away. About 43% reported having any family members or acquaintances who had found and been treated for cancer early through screening. The vast majority of the participants (95.4%) reported having seen or heard about people who have found and been treated for cancer early through screening through media (e.g., TV, newspaper, the Internet). About half (52%) reported not having experienced any of the four symptoms of thyroid cancer listed. At baseline,

about 37% reported having undergone thyroid ultrasound screening; and about 64% reported they intended to undergo screening in the future. To summarize, most of the participants reported having heard of the benefits of cancer screening via interpersonal or mediated communication. In addition, even though more than half of participants had never experienced any thyroid cancer symptoms, about two-thirds of participants had intention to undergo thyroid screening at baseline.

Table 1 *Participants' characteristics*

Educational attainment	Middle school	1 (0.2%)
	High school	100 (16.3%)
	Technical college (or, continuing college students)	177 (28.9%)
	College graduate	285 (46.6%)
	Postgraduate	49 (8.0%)
Monthly household income	Less than 1,500,000 KRW (approx. 1,400 USD)	30 (4.9%)
	1,500,000–3,000,000 KRW (approx. 1,400–2,800 USD)	110 (18.0%)
	3,000,000–4,500,000 KRW (approx. 2,800–4,200 USD)	139 (22.7%)
	4,500,000–6,000,000 KRW (approx. 4,200–5,600 USD)	158 (25.8%)
	6,000,000–7,500,000 KRW (approx. 5,600–7,000 USD)	79 (12.9%)
	More than 7,500,000 KRW (approx. 7,000 USD)	96 (15.7%)
The number of thyroid cancer symptom experienced	None	319 (52.1%)
	1	139 (22.7%)
	2	80 (13.1%)

	3	44 (7.2%)
	4	30 (4.9%)
Prior Experience (% Indicating Yes)		
Having thyroid cancer screening experience		225 (36.8%)
Having intention to undergo screening for thyroid cancer		389 (63.6%)
Working in the healthcare field		42 (6.9%)
Having significant others who have been diagnosed with cancer (including those who are already passed away)		409 (66.8%)
Having significant others who have found and been treated for cancer early through screening		264 (43.1%)
Prior exposure to messages about the benefits of early cancer diagnosis and treatment through screening		584 (95.4%)

Note. $N = 612$.

Correlations among study variables. Bivariate correlation coefficients among variables are displayed in Table 2. To address a couple of bivariate correlations between important study variables, intention to undergo screening was significantly correlated with perceived severity ($r = .25$), perceived susceptibility ($r = .31$), affective attitude ($r = .44$), cognitive/instrumental attitude ($r = .45$), anticipated regret ($r = .45$), descriptive norms ($r = .27$), injunctive norms ($r = .43$), and capability ($r = .31$). However, autonomy ($r = -.03$) was not significantly correlated with intention to undergo screening. Anticipated regret was significantly and positively correlated with perceived severity ($r = .35$), perceived susceptibility ($r = .47$), affective attitude

(r = .33), cognitive/instrumental attitude (r = .38), descriptive norms (r = .33), and injunctive norms (r = .48).

Bivariate correlations between predictors of screening intention were reviewed to identify any potential threats of multicollinearity. According to Tabachnick et al. (2007), when a bivariate correlation between measures of two independent variables is greater than .70, it suggests that the two variables are redundant (not distinct) and their individual contribution to dependent variables are likely be biased. The bivariate correlation between measures of affective attitude and cognitive/instrumental attitude was .79 ($p < .001$). Any other bivariate correlation coefficient was not greater than .70. Before estimating the developed theoretical frameworks to test hypotheses, a measurement model of the latent constructs in the frameworks, including the two attitude variables, was examined in its convergent and discriminant validity. The results of the measurement model assessment and how a discriminant validity problem was treated are presented in the later section of this chapter starting on page 88.

Preliminary Tests of the Three Communication-Based Strategies. Since the variations in the stimulus materials were defined in terms of intrinsic features of the materials (e.g., the presence or absence of a particular communication-based strategy), following O'Keefe (2003), a manipulation check was not deemed necessary. Rather, prior to hypothesis testing, I did a preliminary check to see if the three communication-based strategies applied in the stimulus materials (i.e., the experimental factors) had the intended effects on targeted variables and there were in fact differences between conditions.

An alternative disease label. First, the effect of the alternative disease label on risk perception was examined. Independent t-tests were conducted to compare the conditions where the label of thyroid cancer was used (including the control condition) against the conditions

Table 2 *Zero-order correlations amongst study variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. SEV	1.00													
2. SUS	.26***	1.00												
3. AA	.27***	.16***	1.00											
4. CA	.30***	.21***	.79***	1.00										
5. AR	.35***	.47***	.33***	.38***	1.00									
6. DN	.09*	.20***	.15***	.14***	.33***	1.00								
7. IN	.20***	.41***	.37***	.41***	.48***	.57***	1.00							
8. CAPA	.07	.13**	.27***	.34***	.17***	.17***	.32***	1.00						
9. AUTO	-.12**	-.08	.10*	.15***	-.13**	.04	.06	.50***	1.00					
10. INT	.25***	.31***	.44***	.45***	.45***	.27***	.43***	.31***	-.03	1.00				
11. No INT	.01	-.03	-.11**	-.13**	-.16***	-.09*	-.17***	-.07	-.00	-.14***	1.00			
12. DC	.15***	.12**	-.00	-.02	.16***	.06	.12**	-.05	-.20***	-.01	-.05	1.00		
13. ID	.06	.19***	.16***	.15	.10*	.08	.16***	.17***	-.02	.48***	-.03	-.17***	1.00	
14. Skep	-.03	-.05	-.17***	-.15***	.01	.10*	-.02	-.13**	-.16***	-.06	-.02	.14**	-.04	1.00

Note. SEV = perceived severity, SUS = perceived susceptibility, AA = affective attitude, CA = cognitive/instrumental attitude, AR = anticipated regret, DN = descriptive norm, IN = injunctive norm, CAPA = capability, AUTO = autonomy, INT = intention to undergo screening, No INT = intention not to undergo screening, DC = decisional conflict, ID = informed decision, skep = medical skepticism. *$p < .05$; **$p < .01$; ***$p < .001$. $N = 612$

where the alternative label of a borderline thyroid neoplasm was used in terms of perceived severity and susceptibility. Participants in the alternative label conditions perceived the disease less severe (M = 3.13, SD = .91) than those in the cancer label conditions did (M = 3.62, SD = .82, t(491.68) = 6.76, p < .001, Hedges' g = .57. However, perceived susceptibility was not significantly different between the alternative label conditions (M = 3.64, SD = 1.04) and the cancer label conditions (M = 3.71, SD = .97), t(610) = .79, p = .43, Hedges' g = .07. Thus, the use of the alternative disease label was effective in modifying only the severity perception.

Affective consequences. A one-way analysis of variance (ANOVA) was conducted to determine the effect of the message about negative affective consequences of screening on affective and cognitive/instrumental attitude by comparing the experimental conditions where the message about affective consequences was presented, the experimental conditions where the message was not presented, and the control condition for the entire experiment. The result showed that there was a significant difference between conditions in affective attitude, F(2, 609) = 16.90, p < .001, Hedges' g = .32. A follow-up pairwise comparison with Tukey's adjustment revealed that significantly higher affective attitude in the control condition (M = 1.27, SD = 1.17), compared to the experimental conditions that did not receive the message about affective consequences (M = .75, SD = 1.07, p < .001), and to the other experimental conditions that received the message (M = .56, SD = 1.13, p < .001). However, the experimental conditions that received and did not receive the message were not significantly different in terms of affective attitude, p = .13. Another one-way ANOVA with cognitive/instrumental attitude as a dependent variable also found a significant difference between conditions, F(2, 609) = 16.90, p < .001, Hedges' g = .37. Cognitive/instrumental attitude was significantly higher in the control condition (M = 1.48, SD = 1.44) than in the experimental conditions that received the message (M = .64,

SD = 1.24, $p < .001$) and in the experimental conditions that did not received the message (*M* = .96, *SD* = 1.31, $p = .001$). Moreover, cognitive/instrumental attitude was significantly higher in the experimental conditions that received the message than in the experimental conditions that did not receive the message, $p = .02$. The results indicated that the message about affective consequences was effective in modifying cognitive/instrumental attitude, but not in modifying affective attitude.

Information about diagnostic uncertainty. Lastly, the effect of information about diagnostic uncertainty was examined in terms of its effects on anticipated regret. The result of another one-way ANOVA indicated a significant difference between conditions, $F(2, 609) = 4.83$, $p = .01$, Hedges' $g = .25$. The result of follow-up pairwise comparisons revealed that participants in the conditions where the information was presented reported significantly less anticipated regret over not undergoing screening (*M* = 3.04, *SD* =1.48), compared to those in the experimental conditions where the information was not presented (*M* = 3.37, *SD* = 1.61, $p = .05$) and the control condition (*M* = 3.51, *SD* = 1.48, $p = .02$). The experimental conditions where diagnostic uncertainty information was not presented did not significantly differ from and the control condition, $p = .66$. Thus, as anticipated, information about diagnostic uncertainty was effective in modifying anticipated regret.

Interaction effects on risk perception, attitudes, and anticipated regret. A series of 2 (disease label: thyroid cancer vs. a borderline thyroid neoplasm) × 2 (message about affective consequences of screening: absent vs. present) × 2 (information about diagnostic uncertainty: absent vs. present) 3-way ANOVAs were conducted to identify any significant interaction effects between the experimental factors on perceived severity, perceived susceptibility, affective and cognitive/instrumental attitudes, and anticipated regret. For these analyses, only data of

experimental conditions was utilized. The only significant interaction was a 2-way interaction between disease label and message about affective consequences on cognitive/instrumental attitude, $F(1, 484) = 11.90$, $p = .01$, $\eta_p^2 = .015$. Follow-up independent t-tests demonstrated that a significant main effect of the message about affective consequences, $t(490) = 2.72$, $p = .01$. The main effect of a disease label was not significant, $t(490) = -.245$, $p = .81$. The interaction of the two factors was further examined using a 2-way ANOVA with pairwise post-hoc comparisons using Bonferroni adjustments. The results showed that the affective message effect was significant only within the alternative label conditions, not within the cancer label condition. That is, within the alternative label conditions, participants who saw the affective message held significantly lower positive cognitive/instrumental attitude ($M = .50$, $SE = .12$) than those who did not see the message ($M = 1.12$, $SE = 1.1$), $p < .001$. By contrast, within the cancer label conditions, there was no significant difference in cognitive/instrumental attitude between participants who saw ($M = .79$, $SE = .11$) and did not see the message ($M = .78$, $SE = .12$), $p = .99$. Thus, the interaction between the use of alternative label and the message about affective consequences was included in the models tested.

Model and Hypothesis Testing

Overview. Structural equation modeling (SEM) was used to test the theoretical models of cancer screening intention. SEM is a multivariate technique that allows researchers to analyze interrelationships among variables (similar to a factor analytic approach) as well as to test the strength and direction of hypothesized relationships among multiple dependent, independent, and mediating variables in a given model (similar to a path analytic approach) (Kline, 2011). Consistent with the two-step approach advocated by Anderson and Gerbing (1988), I first estimated the measurement model that described the relationship between observed variables or

indicators (e.g., instruments) and their underlying latent constructs. Then, six different structural models were estimated:

1) the multicomponent TPB which is the base model of the proposed models

2) the multicomponent TPB with anticipated regret

3) the parallel model (the multicomponent TPB with anticipated regret and risk perceptions)

4) the serial model

5) the parallel multiple mediation model

6) the serial multiple mediation model

The first two models were estimated to see if the proposed additions of anticipated regret and risk perceptions (i.e., the parallel model) substantially improves prediction of screening intention and model fit. The remaining four models were examined for hypothesis testing. In the last two models, direct and/or indirect effects of the three communication-based strategies on screening intention were estimated. Mplus 8.3 (Muthén et al., 2017) was used for SEM analysis.

In SEM, the most popular estimation method is maximum likelihood (ML) estimation which assumes multivariate normality of continuous data (Kline, 2011). To test for multivariate normality for all observed variables, Mardia's tests of multivariate kurtosis and skew, implemented in Mplus by default, were applied. The tests were significant (all ps < .001), meaning that the data did not meet the multivariate normality assumption. However, univariate skew and kurtosis values fell within an acceptable range, with all skew values between -0.85 and 1.01, all kurtosis values between -1.32 and 4.43. Of note, the deviation from normality is considered acceptable if the absolute value of skew and kurtosis indexes do not exceed 3 and 10, respectively (Kline, 2011). Due to the multivariate non-normality of the data, in the analyses, I

used the maximum likelihood with robust standard errors (MLR) estimator, which does not assume multivariate normality. There were no missing data, so it was not necessary to exclude cases or impute missing values.

To assess model fit, I evaluated five different model fit indices in combination: Chi-square fit index, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and Akaike's information criterion (AIC). Chi-square test is the most common absolute fit index; and a nonsignificant chi-square value indicates that the hypothesized model is not significantly different from the observed data. However, for models with more than 200 cases, the chi-square is almost always statistically significant and thus less reliable as an assessment of fit (Fan et al., 1999). Therefore, to complement the chi-square significance test, I also examined three complimentary indices: CFI, RMSEA, and SRMR. CFI is less sensitive sample size and CFI values greater than .90 and .95 reflect acceptable and excellent fit. RMSEA and SRMR values less than .05 suggest good fit and values up to .08 indicate acceptable fit (Browne & Cudeck, 1989; Hair et al., 2010; Hu & Bentler, 1999; Kline, 2011). AIC was used to compare non-nested models (e.g., the parallel model vs. the serial model). The model with a lower AIC is the preferred model. A change in AIC greater than 10 implies that it is reasonable to accept one good-fitting model over another (Burnham & Anderson, 2002). To compare nested models (e.g., the multicomponent TPB with anticipated regret vs. the parallel model), I utilized the Satorra-Bentler scaled chi-square difference test which is recommended when using the MLR estimator (Satorra & Bentler, 2010).

For testing the equality of standardized coefficients, a model constraint option in Mplus was utilized. The model constraint option was used to compute the difference between a pair of path coefficients and test the difference for statistical significance. If the difference was

significant, I rejected the null hypothesis and concluded that the path with the larger coefficient was significantly stronger than the path with the smaller coefficient. The model constraint option was also used to compare the magnitude of indirect effects.

For estimating interactions between latent variables, a latent moderated structural equations approach (LMS) method built into Mplus was utilized. LMS is known as the most efficient and unbiased approach to testing interactions among latent variables (Klein & Moosbrugger, 2000). However, since LMS models do not produce the traditional model fit indices used in structural equation modeling, the fit indices of the model including interaction terms are not reported here. Instead, for the LMS method, the chi-square test based on log likelihood values was used to determine whether inclusion of the interaction term resulted in a significant improvement in model fit.

Measurement model. The measurement model was examined in terms of its overall model fit and the reliability and validity of each latent construct in the model. The measurement model fit was acceptable, χ^2 (360) = 901.013, $p < .001$; CFI = .93; RMSEA = .05 (.05, .05); SRMR = .05. As the overall model fit was acceptable, the measurement model was examined for convergent validity, reliability, and discriminant validity of all latent constructs. Convergent validity refers to the degree to which an item is related to other items designed to measure the same construct and can be determined through the magnitude of the standardized factor loadings, composite reliability (CR), and average variance extracted (AVE). CR is an estimate of the extent to which a set of latent construct indicators is internally consistent, whereas AVE is the amount of common variance among latent construct indicators (Hair et al., 2010). Thus, they are also used to assess construct reliability. The often used criteria for convergent validity requires standardized factor loading of all items greater than .5, CR greater than .7, and AVE greater

than .5 (Hair et al., 2010). Two perceived susceptibility items had factors loadings of .23 and .33. Except the two perceived susceptibility items, all items had standard factor loadings greater than .51. The CR coefficients for all constructs were in the range of .75 and .92. The AVE values for all constructs, except perceived susceptibility, were in the range of .53 and .82. The AVE value for perceived susceptibility was .37. Thus, the two perceived susceptibility items with factors loadings of less than .50 were dropped. After dropping the two items, the AVE and CR values of perceived susceptibility became .51 and .80. indicating an adequate level of convergent validity.

Discriminant validity refers to the degree to which the indicators of two or more latent constructs are distinct. To establish discriminant validity, the square root of AVE of a specific latent construct must be greater than the construct's correlations with other constructs in the measurement model (Fornell & Larcker, 1981). However, the square root of AVE value of affective attitude (.77) was smaller than its correlation with cognitive/instrumental attitude (.87), indicating poor discriminant validity between the two attitude variables. The correlations for any other construct were less than the square root of the AVE of the constructs, indicating adequate discriminant validity. It was impossible to identify attitude as a second-order construct with two first-order factors (i.e., affective and cognitive/instrumental attitudes) given at least three first-order factors were required to define a second-order factor. Instead of simply merging the two attitude constructs, this dissertation created composite indices of affective attitude and cognitive/instrumental attitude using average scores. Then, the created composite indices were specified as indicators of a latent construct of attitude. This modification made it impossible to test the differential effects of affective and cognitive/instrumental attitudes impossible. The model fit of the modified measurement model improved, χ^2 (194) = 491.05, $p < .001$; CFI = .95;

RMSEA = .05 (.05, .06); SRMR = .04. Table 3 shows the summary of construct reliability and validity indices in the modified measurement model. In Table 3, the diagonal values (i.e., the square-root of AVE for the respective construct) are greater than any values in their rows and columns, indicating the discriminant validity of the measurement model.

Structural models.

The multicomponent TPB. Prior to testing the proposed models, I tested the multicomponent TPB which only includes attitude, subjective norms (i.e., descriptive and injunctive norms), and PBC (i.e., capability and autonomy) as predictors of screening intention. No covariates were added to keep consistency with the assumption of TPB that the effects of background or distal factors (e.g., demographic, personality variables) on behavioral intention are fully mediated by attitude, subjective norm, and PBC (Fishbein & Ajzen, 2011). The results of the SEM analysis indicated that the initial model had a fair fit to the data χ^2 (39) = 166.33, p < .001; CFI = .96; RMSEA = .07 (.06, .09); SRMR = .04; AIC = 21309.54. The bivariate correlational analysis showed that affective and cognitive/instrument attitude, descriptive norm, injunctive norm and capability had significant association with intention to undergo screening, while descriptive norm and autonomy did not. However, when the variables were combined as predictors of screening intention, only attitude (β = .38, p < .001) and capability (β = .36, p < .001) emerged as significant positive predictors of screening intention (See Figure 11). Another unexpected finding was that autonomy significantly but negatively predicted screening intention (β = -.32, p < .001). The multicomponent TPB explained 47.2% of the variance in screening intention.

Table 3 *A Modified (final) measurement model. Average variance extracted (AVE), composite reliability (CR), latent zero-order correlations, and square root of AVE*

	AVE	CR	1	2	3	4	5	6	7	8	9
1. Perceived severity	.53	.82	.73								
2. Perceived susceptibility	.51	.80	.41***	.71							
3. Attitude	.79	.88	.34***	.26***	.89						
4. Anticipated regret	.80	.92	.39***	.66***	.41***	.89					
5. Descriptive norm	.82	.90	.11*	.32***	.17***	.36***	.91				
6. Injunctive norm	.72	.83	.23***	.53***	.45***	.54***	.68***	.85			
7. Capacity	.65	.83	.09	.10*	.38***	.19***	.21***	.35***	.80		
8. Autonomy	.74	.85	-.14**	-.20***	.16**	-.15**	.08	.04	.63***	.86	
9. Screening intention	.64	.78	.34***	.42***	.55***	.53***	.34***	.51***	.38***	-.04	.80

Note. The diagonal value is the square-root of AVE for the respective construct, while other values are the correlation between construct. *$p < .05$; **$p < .01$; ***$p < .001$. $N = 612$

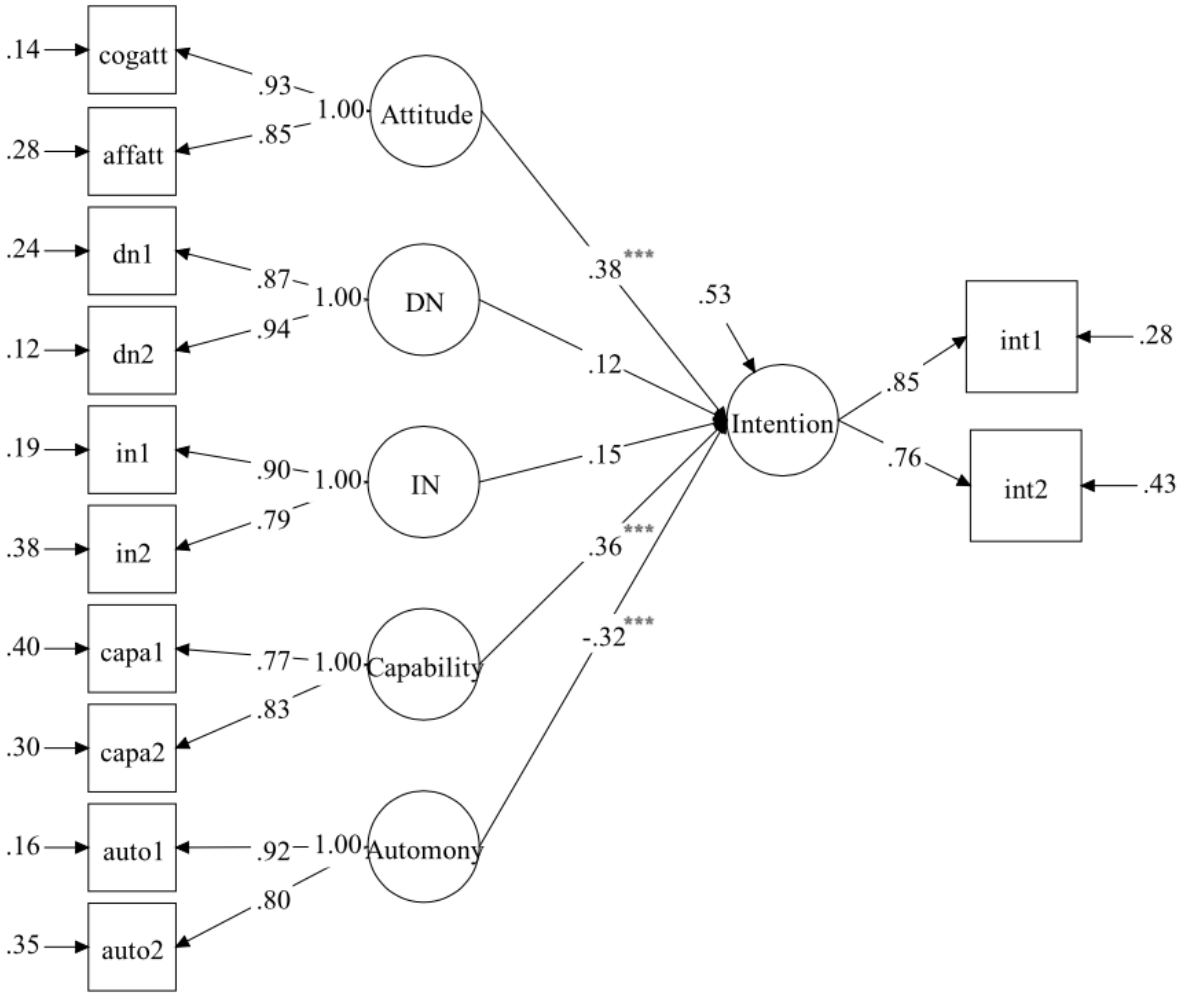

Figure 11 *The multicomponent TPB tested*

Note. χ^2 (39) = 166.33, p < .001; CFI = .96; RMSEA = .07 (.06, .09); SRMR = .04; AIC = 21309.54. The numbers in the figure are standardized path coefficients. For simplification, covariances between exogenous variables are not presented. *** p < .001. All factor loadings were significant at p <. 001. N = 612.

The multicomponent TPB with anticipated regret. Anticipated regret was then added as another predictor of screening intention to the multicomponent TPB. The multicomponent TPB with anticipated regret had an improved model fit, χ^2 (69) = 225.23, p < .001; CFI = .96; RMSEA = .06 (.05, .07); SRMR = .04; AIC = 26730.75. The Satorra–Bentler scaled chi-square difference test showed that the multicomponent TPB with anticipated regret provided a better fit to the data

than the multicomponent TPB (SBS-$\Delta\chi 2$ = 107.33, Δdf = 30; p < .001). Anticipated regret was a significant predictor of screening intention (β = .22, p < .001). As shown in Figure 12, the results of this model did not show different patterns of associations from the multicomponent TPB. 49.9% of the variance in screening intention was explained by this model.

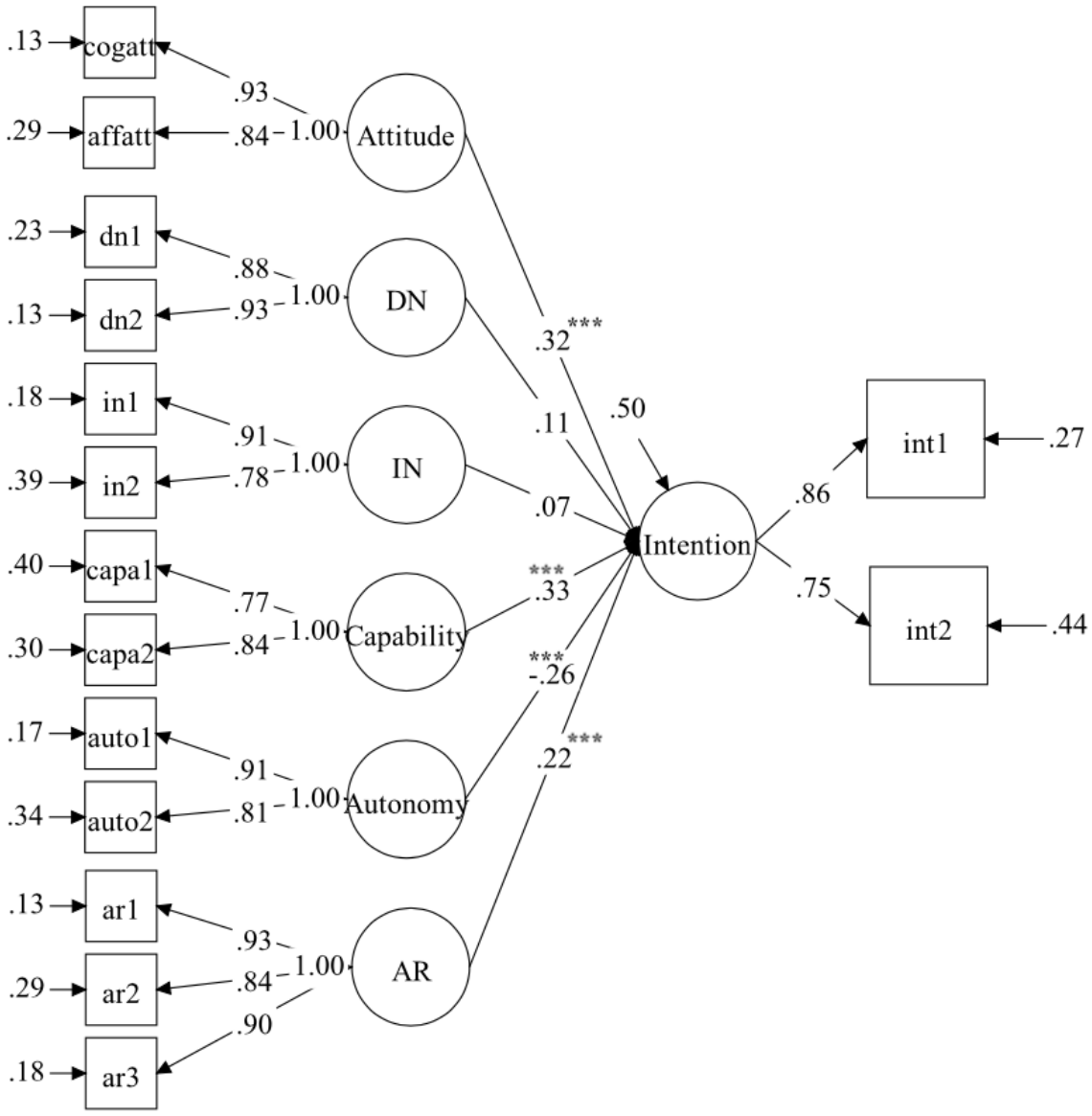

Figure 12 The multicomponent TPB with anticipated regret tested

Note. χ^2 (69) = 225.23, p < .001; CFI = .96; RMSEA = .06 (.05, .07); SRMR = .04; AIC = 26730.75. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. *** p < .001. All factor loadings were significant at p <. 001. N = 612.

The parallel model. The proposed parallel model, which is basically the TPB with anticipated regret, perceived severity and susceptibility, was then tested. The model results are found in Figure 13. With the two additional predictors, the model fit very slightly improved, χ^2 (194) = 491.06, $p < .001$; CFI = .95; RMSEA = .05 (.05, .07); SRMR = .04; AIC = 40889.09. The Satorra–Bentler scaled chi-square difference test was significant (SBS-$\Delta\chi 2$ = 267.23, Δdf = 128; $p < .001$), suggesting that the proposed parallel model was better fitting than the multicomponent TPB with anticipated regret. The parallel model accounted for 50.5% of the variance in screening intention. However, neither the newly added perceived severity (β = .05, p = .36) nor perceived susceptibility (β = .05, p = .46) significantly predicted screening intention. Thus, H1a and H1b did not receive support. Consistent with H2, H3, and H5a, in the parallel model, anticipated regret (β = .18, p = .01), attitude (β = .31, p < .001), and capability (β = .33, p < .001) significantly and positively predicted screening intention. Contrary to H4a and H4b, descriptive and injunctive norms were non-significant predictors of screening intention. Lastly, as observed in the previously tested models, autonomy significantly but negatively predicted screening intention (β = -.26, p = .001). Thus, H5b did not receive support.

To compare the relative strength of the significant positive predictors of screening intention, the model constraint option in Mplus was used. Results showed that both attitude (p = .01) and capability (p = .04) were significantly stronger predictors of screening intention than anticipated regret. Attitude and capability were statistically equally strong predictors of screening intention (p = .82).

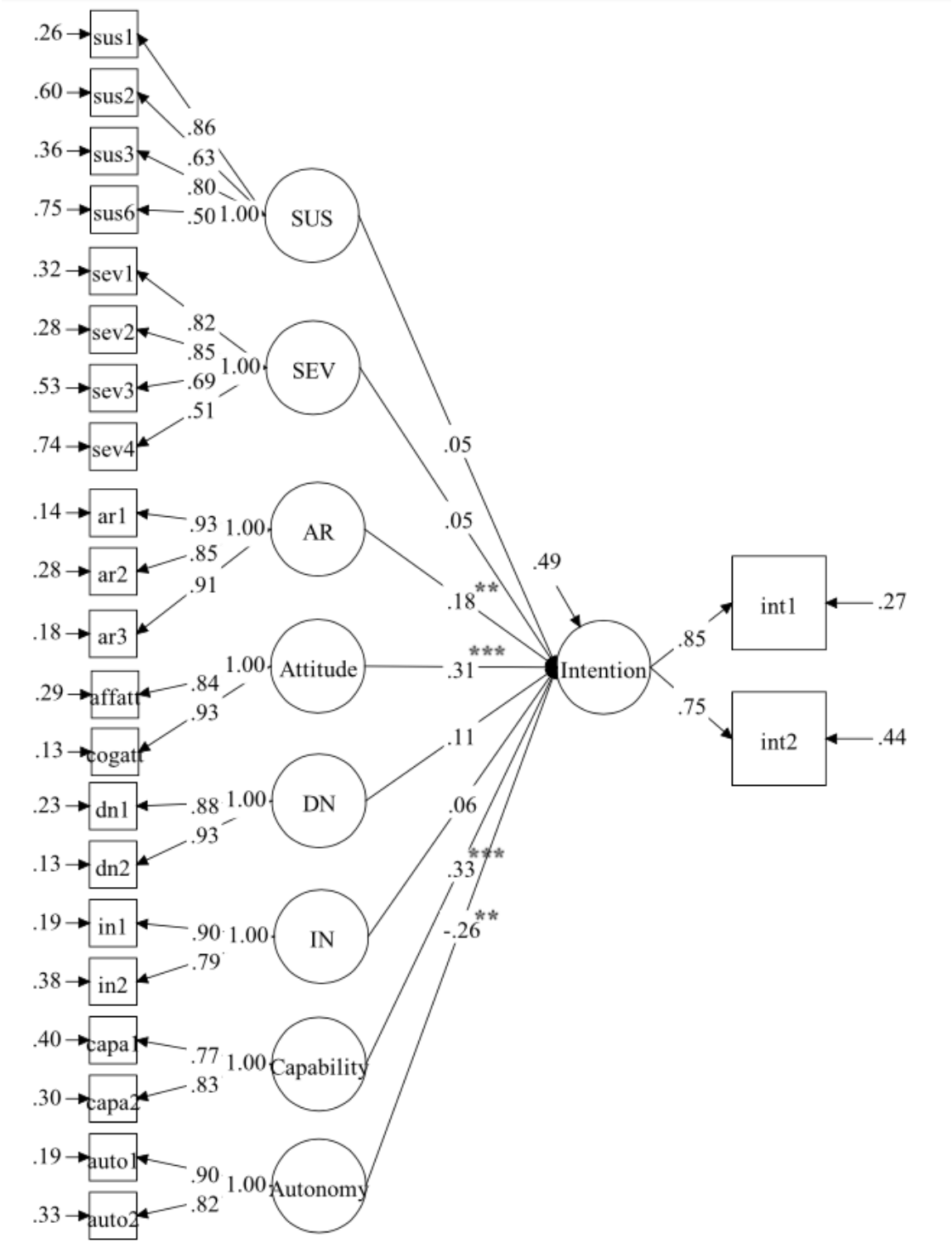

Figure 13 *The parallel model tested*

Note. χ^2 (194) = 491.06, $p < .001$; CFI = .95; RMSEA = .05 (.05, .07); SRMR = .04; AIC = 40889.09. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

RQ1 asked how perceived severity and perceived susceptibility may interact each other to influence screening intention. To answer RQ1, the interaction between perceived severity and susceptibility was tested. The interaction effect between perceived severity and susceptibility was significant but negative (β = -.14, p = .003). The likelihood ratio test indicated that inclusion of the interaction between perceived severity and susceptibility significantly improved model fit, χ^2 (1) = 10.53, p = .001. The model with the interaction term explained 52.9% of the variance in screening intention. To better grasp the significant interaction effect, a follow-up simple slope analysis was performed. The interaction was probed at ± 2 standard deviation of perceived severity. This approach allows for the calculation of simple slopes of screening intention on perceived susceptibility at different levels of perceived severity. By examining the relationship between perceived susceptibility and screening intention when individuals perceive severity to be very high, high, moderate, low, and very low, it can be estimated how perceived severity moderates the effect of perceived susceptibility on screening intention.

The result of simple slope testing suggested that when severity was perceived to be very low or low (-2 *SD* or -1 *SD* below the mean of perceived severity), perceived susceptibility significantly and positively predicted screening intention (b = .25, p = .004; b = .15, p = .02). However, when severity is perceived at the moderate level (the mean of perceived severity), the association between perceived susceptibility and screening intention diminished to the point where it was no longer statistically significant (b = .05, p = .30). More interestingly, when severity is perceived to be high or very high (+1 *SD* or +2 *SD* above the mean), the direction of prediction was reversed (b = -.05, p = .37; b = -.15, p = .05), indicating that perceived severity potentially attenuates the effect of perceived susceptibility on screening intention. Figure 14

shows the parallel model with the interaction of perceived severity and susceptibility. Table 14 shows the results of moderation and simple slope analyses

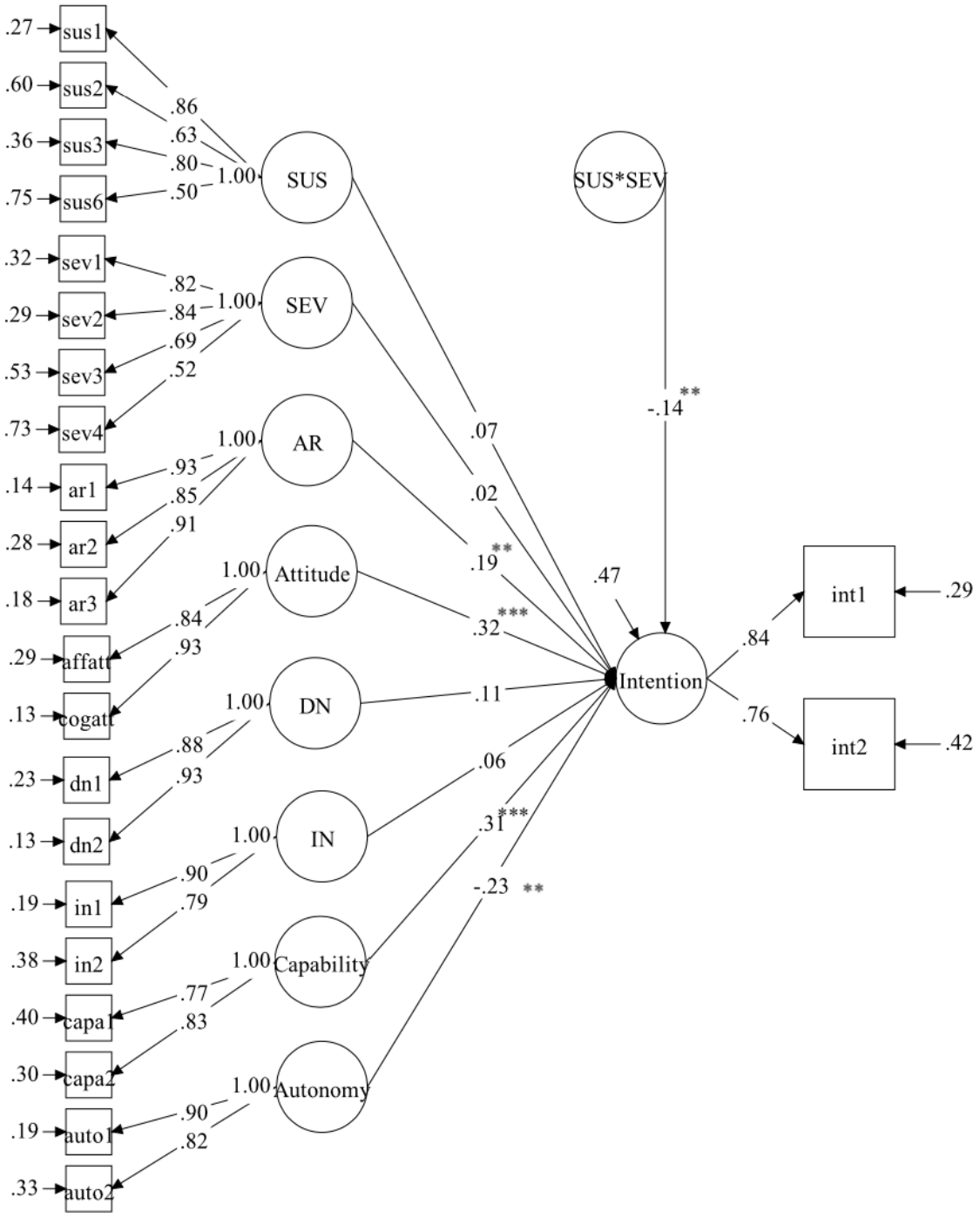

Figure 14 *The parallel model with perceived severity × perceived susceptibility tested*

Note. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

Table 4 *Results of moderation and simple slope analyses*

	Parallel model			Serial model			Parallel multiple mediation model			Serial multiple mediation model		
	b	*z*	*p*	*b*	*z*	*p*	*b*	*z*	*p*	*b*	*z*	*p*
Susceptibility	.05	1.04	.30	.03	.70	.48	.02	.39	.70	.01	.23	.82
Severity	.02	.41	.68	.03	.46	.65	.06	1.11	.27.	.05	1.06	.29
Susceptibility × severity	-.12	-3.09	.002	-.12	-3.12	.002	-.12	-3.02	.003	-.12	-3.07	.002
Values of severity	Simple slopes of screening intention on perceived susceptibility											
-2 *SD*	.25	2.91	.004	.24	2.76	.01	.22	2.82	.01	.21	2.69	.01
-1 *SD*	.15	2.43	.02	.24	2.19	.03	.12	2.20	.03	.11	1.96	.05
M	.05	1.04	.30	.03	0.70	.48	.02	.39	.70	.01	.23	.82
+1 *SD*	-.05	-.91	.37	-.07	-1.21	.23	-.08	-1.45	.15	-.09	-1.44	.15
+2 *SD*	-.15	-1.98	.05	-.17	-2.20	.03	-.18	-2.21	.03	-.19	-2.21	.03
Values of susceptibility	Simple slopes of screening intention on perceived severity											
-2 *SD*	.31	2.98	.003	.32	3.05	.002	.34	3.28	.001	.34	.3.31	.001
-1 *SD*	.17	2.41	.02	.17	2.48	.01	.20	2.97	.003	20	2.97	.003
M	.02	.41	.68	.03	.45	.65	.06	1.11	.27	.05	1.06	.29
+1 *SD*	-.12	-1.58	.11	-.12	-1.56	.12	-.09	-1.22	.22	-.09	-1.24	.22
+2 *SD*	-.27	2.33	.02	-.27	-2.32	.02	-.22	-2.09	.04	-.23	-2.11	.04

The serial model. Next, the serial model shown was tested. The result indicated that the model fit was good, χ^2 (201) = 550.78, $p < .001$; CFI = .95; RMSEA = .05 (.05, .06); SRMR = .05; AIC = 40940.11. The serial model in Figure 15 explained 53.2% of the variance in anticipated regret and 48% of the variance in screening intention. As predicted, perceived severity ($\beta = .09$, $p = .03$), perceived susceptibility ($\beta = .48$, $p < .001$), attitudes ($\beta = .18$, $p < .001$), and injunctive norms ($\beta = .16$, $p = .02$) significantly and positively predicted anticipated regret. Thus, H7a, H7b, H8, and H9b received support in the serial model. However, contrary to H9a, descriptive norms did not predict anticipated regret ($\beta = .06$, $p = .32$). Consistent with H6 and H11a, anticipated regret ($\beta = .38$, $p < .001$) and capability ($\beta = .60$, $p < .001$) significantly and positively predicted screening intention. Inconsistent with H11b, autonomy significantly but negatively predicted screening intention ($\beta = -.38$, $p = .001$).

Modification indices suggested that adding direct paths from attitude to screening intention and from injunctive norms to screening intention would improve the model fit. Thus, the two direct paths were added to the model, allowing partial mediation. With the modification, the modified model slightly improved, χ^2 (199) = 503.64, $p < .001$; CFI = .95; RMSEA = .05 (.05, .06); SRMR = .04; AIC = 40893.00. The Satorra–Bentler scaled chi-square difference was significant (SBS-$\Delta\chi 2$ = 68.43; $\Delta df = 2$; $p < .001$), suggesting that the serial model with the two direct paths provided a better fit to the data than the serial model tested initially. The modified model explained 52.8% of the variance in anticipated regret and 50.2% of the variance in screening intention (Figure 16).

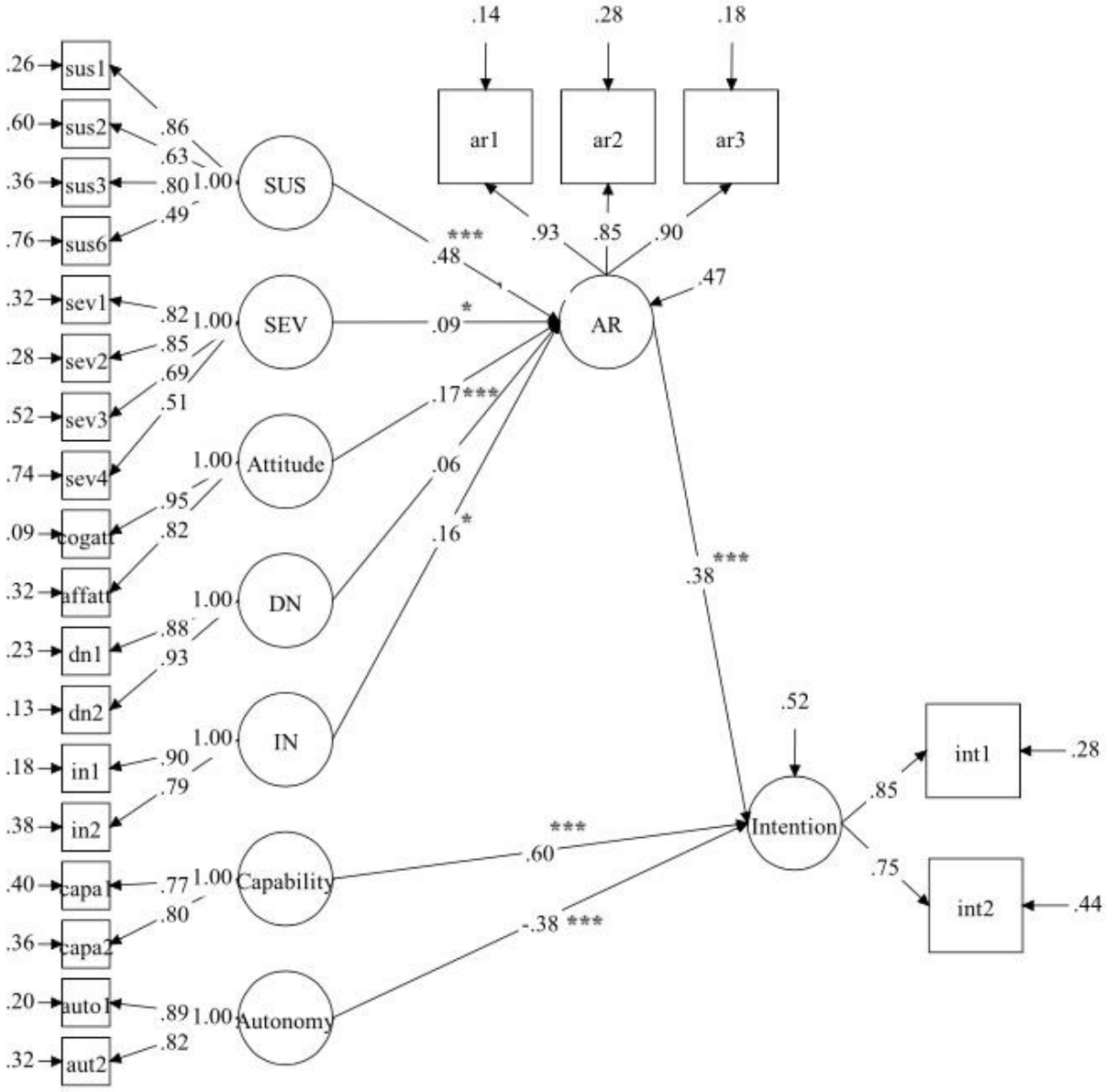

Figure 15 *The initial serial model tested*

Note. χ^2 (201) = 550.78, $p < .001$; CFI = .95; RMSEA = .05 (.05, .06); SRMR = .05; AIC = 40940.11. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

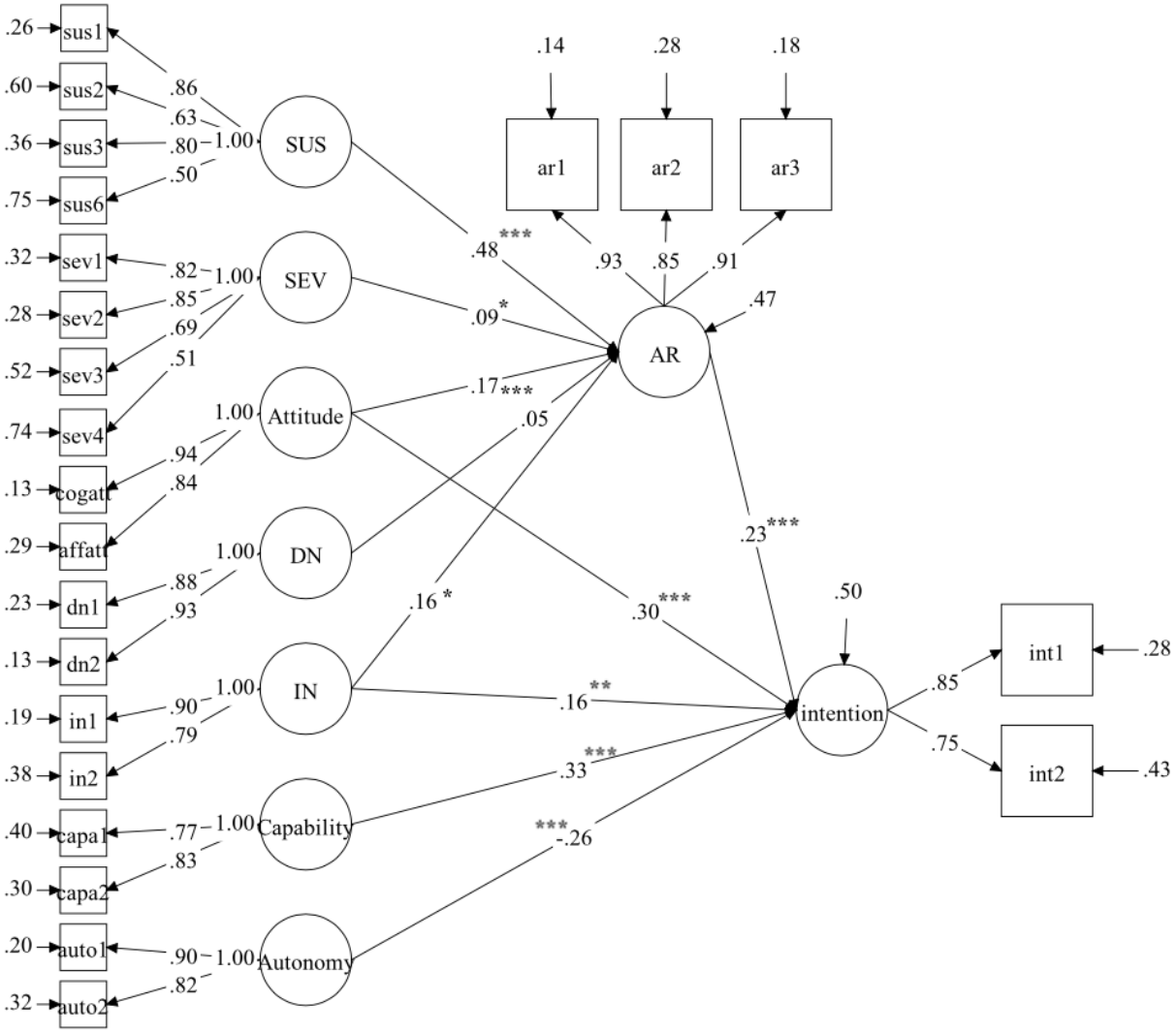

Figure 16 *The modified serial model tested with direct paths from attitudes and injunctive norms to screening intention*

Note. χ^2 (199) = 503.64, $p < .001$; CFI = .95; RMSEA = .05 (.05, .06); SRMR = .04; AIC = 40893.00. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

In the modified serial model, the direct paths from attitude to screening intention ($\beta = .30$, $p < .001$) and from injunctive norms to screening intention ($\beta = .16$, p = .01) were significant.

Other path coefficients were again very similar if not identical to the serial model before

modification. Anticipated regret (β = .23, p < .001) and capability (β = .33, p < .001) significantly and positively predicted screening intention. Autonomy significantly but negatively predicted screening intention (β = -.38, p = .001). Although the standardized path coefficients were different, the differences were not statistically significant amongst the predictors. For example, the highest path coefficient was capability to screening intention (β = .33); and the lowest significant one was from injunctive norms to screening intention (β = .16). However, the difference between these two path coefficients was not significant (p = .06).

Perceived severity (β = .09, p = .03), perceived susceptibility (β = .48, p < .001), attitude (β = .17, p < .001), and injunctive norms (β = .16, p = .02) significantly and positively predicted anticipated regret. Descriptive norms did not predict anticipated regret (β = .05, p = .32). Perceived susceptibility was a significantly stronger predictor of anticipated regret than perceived severity (p < .001), attitude (p < .001), and injunctive norms (p = .001). Although the standardized path coefficient of perceived severity on anticipated regret was smaller than those of attitude and injunctive norms, the difference was not statistically significant, ps > .67.

The results of mediational analyses showed that anticipated regret fully mediated the effect of perceived susceptibility on screening intention (b = .08, 95% CI = .04, .13), providing support for H10b. Anticipated regret partially mediated the effects of attitude (b = .03, 95% CI = .01, .05) and injunctive norms (b = .03, 95% CI = .01, .05) on screening intention. Thus, H10c (H10d) and H10f received partial support. Contrary to H10a, although perceived severity significantly predicted anticipated regret, the changes in anticipated regret due to perceived severity did not lead to changes in screening intention (b = .02, 95% CI = .00, .05). Also contrary to H10e, the effect of descriptive norms on screening intention was not mediated by anticipated regret (b = .01, 95% CI = -.01, .03).

Using the model constraint option in Mplus, I compared the indirect effects of perceived susceptibility, attitude, and injunctive norms on screening intention via anticipated regret. Results showed that the indirect effect of perceived susceptibility was significantly stronger than those of attitude (95% CI = .03, .09) and injunctive norms (95% CI = .02, .11). However, recall that attitude and injunctive norms also directly increased screening intention. Therefore, the overall impact of the three factors on screening intention should be judged by the total effect (the sum of significant direct and indirect effects). The total effect of attitude on screening intention (b = .24, 95% CI = .16, .33) was significantly greater than that of perceived susceptibility (b = .08, 95% CI = .04, .13), 95% CI = .07, .26. Although the total effect of attitude was also greater than that of injunctive norms (b = .13, 95% CI = .05, .21), the difference was not statistically significant (95% CI = -.01, .25). The effect of capability (b = .28, 95% CI = .14, .42) was also significantly greater than those of perceived susceptibility (95% CI = .04, .34), but not greater than those of attitudes (95% CI = -.14, .22) and injunctive norms (95% CI = -.03, .32). The difference between the total effect of injunctive norms and that of perceived susceptibility was not statistically significant (95% CI = -.06, .16). Taken together, these results generally suggest that attitudes, injunctive norms, and capability were similarly potent predictors of screening intention.

Lastly, the interaction between perceived severity and susceptibility was examined. The interaction effect on anticipated regret was not significant (β = .04, p = .26), but was significant for screening intention (β = -.14, p < .01). A simple slope analysis was performed again. The same pattern of attenuating effect of perceived severity was found. At very low and low levels of perceived severity (-2 and -1 SD below the mean) perceived susceptibility was a significant positive predictor of screening intention (b = .24, p = .01; b = .24, p = .03). At moderate and high

levels of perceived severity (0 SD and -1 SD), perceived severity did not significantly predict screening intention (b = .03, p = .48; b = -.07, p = .27). However, at very high level of perceived severity (2 *SD* above the mean), perceived susceptibility significantly and negatively predicted screening intention (b = -.17, p = .03). The modified serial model with the perceived severity and susceptibility interaction explained 53% of the variance in anticipated regret and 52.4% of the variance in screening intention (Figure 17). The model obtained at this step was considered as the final serial model. Table 5 summarizes the results of testing each hypothesis in the parallel and serial models.

Table 6 presents the fit indices of the tested models. As summarized in the table, overall model fit indices suggested acceptable fit for both the parallel and the final serial models. Furthermore, the difference in the comparative model fit index (AIC) between the two models was 4, which was below the threshold of 10, indicating the models provided similar fits to the data. To conclude, the results of the structural model estimation suggested that the two proposed models could provide equally efficient frameworks for tracing how the three communication-based strategies (i.e., using an alternative disease label, highlighting negative affective consequences, and providing information about diagnostic uncertainty) influence screening intention.

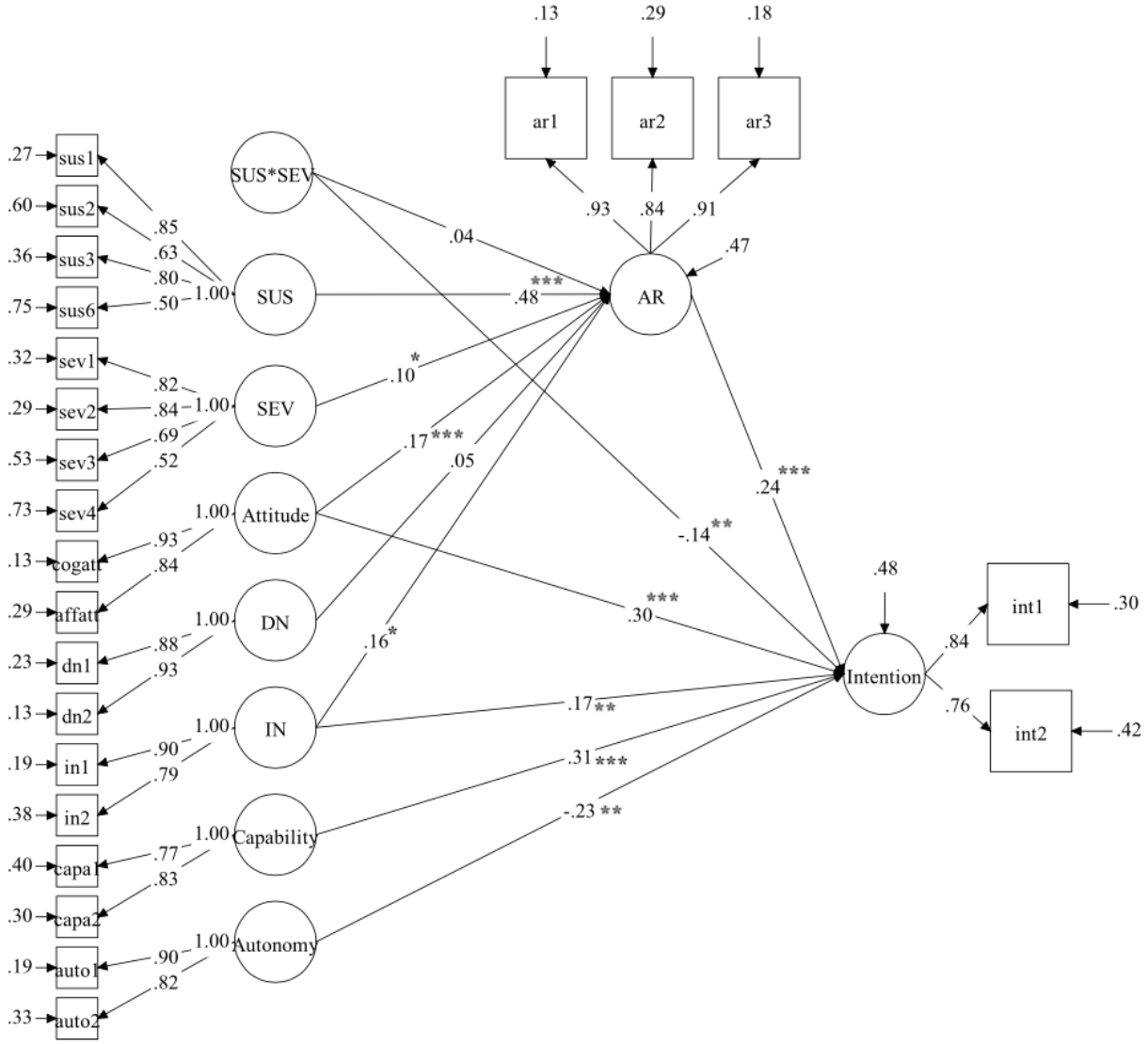

Figure 17 *The modified serial model with perceived severity × perceived susceptibility*

Note. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

Table 5 *A Summary of the results of test of each hypothesis in parallel and serial model*

	Hypothesis (direction)	Path	b (S.E.)	Standardized (β)	*p*-value	Results
Parallel model	H1a (+)	Severity → Screening intention	.05 (.06)	.05	.36	Rejected
	H1b (+)	Susceptibility → Screening intention	.04 (.05)	.05	.46	Rejected
	H2 (+)	Anticipated regret → Screening intention	.11 (.04)	.18	.01	Accepted
	H3a, b (+)	Attitude → Screening intention	.30 (.06)	.31	< .001	Accepted
	H4a (+)	Descriptive norms → Screening intention	.08 (.05)	.11	.12	Rejected
	H4b (+)	Injunctive norms → Screening intention	.04 (.06)	.06	.54	Rejected
	H5a (+)	Capacity → Screening intention	.30 (.07)	.33	< .001	Accepted
	H5b (+)	Autonomy → Screening intention	-.21 (.06)	-.26	.001	Rejected
Serial model	H6 (+)	Anticipated regret → Screening intention	.14 (.03)	.23	< .001	Accepted
	H7a (+)	Severity → Anticipated regret	.16 (.08)	.09	.04	Accepted
	H7b (+)	Susceptibility → Anticipated regret	.60 (.06)	.48	< .001	Accepted
	H8a, b (+)	Attitude → Anticipated regret	.21 (.05)	.17	< .001	Accepted
	H9a (+)	Descriptive norms → Anticipated regret	.06 (.07)	.05	.36	Rejected
	H9b (+)	Injunctive norms → Anticipated regret	.18 (.08)	.16	.03	Accepted
	H11a (+)	Capacity → Screening intention	.28 (.07)	.33	< .001	Accepted
	H11b (+)	Autonomy → Screening intention	-.21 (.06)	-.26	< .001	Accepted
	Hypothesis (direction)	Path		*b* (95% CI)		Results
	H10a (+)	Severity → Anticipated regret → Screening intention		.02 (.00, .05)		Rejected
	H10b (+)	Susceptibility → Anticipated regret → Screening intention		.08 (.04, .13)		Accepted
	H10c, d (+)	Attitude → Anticipated regret → Screening intention		.03 (.01, .05)		Accepted
	H10e (+)	Descriptive norms → Anticipated regret → Screening intention		.01 (-.01, .03)		Rejected
	H10f (+)	Injunctive norms → Anticipated regret → Screening intention		.03 (.01, .05)		Accepted

Note. For the results of mediation analyses, unstandardized regression coefficient and 95% confidence intervals (CI) are displayed.

Table 6 *A Comparisons of the fits of the structural models tested*

Model	df	χ^2	CFI	RMSEA (90% CI)	SRMR	AIC
1. Multicomponent TPB	39	166.33***	.96	.07 (.06, .09)	.04	21309.54
2. Multicomponent TPB with anticipated regret	69	225.23***	.96	.06 (.05, .07)	.04	26730.75
3. Parallel model	194	491.06***	.95	.05 (.05, .06)	.04	40889.09
4. Initial serial model	201	550.78***	.95	.05 (.05, .06)	.05	40940.11
5. Final serial model	200	511.39***	.95	.05 (.05, .06)	.05	40899.98
6. Parallel multiple mediation model	278	1166.89***	.87	.07 (.07, .08)	.16	41426.16
7. Serial multiple mediation model	276	843.50***	.92	.06 (.05, .06)	.11	41078.88

Note. ***$p < .001$.

Mediational analyses: Test of communication-based strategies. As both parallel and serial models fitted the data equally well, direct and indirect (i.e., mediation) effects of the three communication-based strategies on screening intention were estimated using both models. Experimental factors (i.e., the three communication-based strategies) were entered as observed, exogenous variables. Each experimental was dummy coded. For example, the conditions where the alternative disease label was used was coded as 1, while the conditions where the cancer label was used was coded as 0. Then, a direct path from each experimental factor to the variable that it had intended to modify was added. As the use of the alternative disease label did not significantly reduce perceived susceptibility perception, the path from the label to perceived severity was not included (see the result of preliminary analysis). Given the significant interaction effect between the use of disease label and the message about affective consequences on cognitive/instrumental attitude, a direct path from their interaction term to attitude was also included in the initial testing of the proposed models. However, the interaction term was not significant and thus dropped from the models. To estimate the indirect effects of the experimental factors, a bias-corrected bootstrapping approach with 1,000 resamples was used.

Asymmetric 95% confidence intervals (CIs) around estimates that do not include zero indicate statistically significant indirect effects.

Parallel multiple mediation model. The parallel multiple mediation model was a poor fit to the data, χ^2 (278) = 1166.89, $p < .001$; CFI = .87; RMSEA = .07 (.07, .08); SRMR = .16; AIC = 41426.16. A close examination of the result of the parallel model assessment indicated that the heightened SRMR was mainly due to the large residual variances in perceived severity (σ^2 = .91), attitude (σ^2 = .97), and anticipated regret (σ^2 = .99). That is, the large portion of the variance in the four constructs was left unexplained by the experimental factors. No attempt to overfit the model based on modification indices was made since the inclusion of the parameters could not be supported based on the theory.

As predicted, the use of the alternative disease label negatively predicted perceived severity (β = -.30, $p < .001$); the message about affective consequence negatively predicted perceived severity (β = -.19, $p < .001$); and the information about diagnostic uncertainty negatively predicted anticipated regret (β = -.12, p = .004). Thus, H12, H13, and H14 received support. In the parallel multiple mediation model, none of the direct paths from the three communication strategies to screening intention was significant. There were three significant indirect paths with bootstrapped 95% confidence intervals that did not include zero. Inconsistent with H15a, the use of the alternative label did not significantly reduce screening intention by reducing perceived severity (b = -.04, 95% CI = -.11, .01). As predicted by H15c and H15d, a message about affective consequences reduced screening intention by generating a less positive attitude (b = -.12, 95% CI = -.18, -.06). Also, as predicted by H15e, Information about diagnostic uncertainty reduced screening intention by reducing anticipated regret (b = -.05, 95% CI = -.11, -.02). The indirect effects of the two strategies (i.e., information about diagnostic uncertainty and

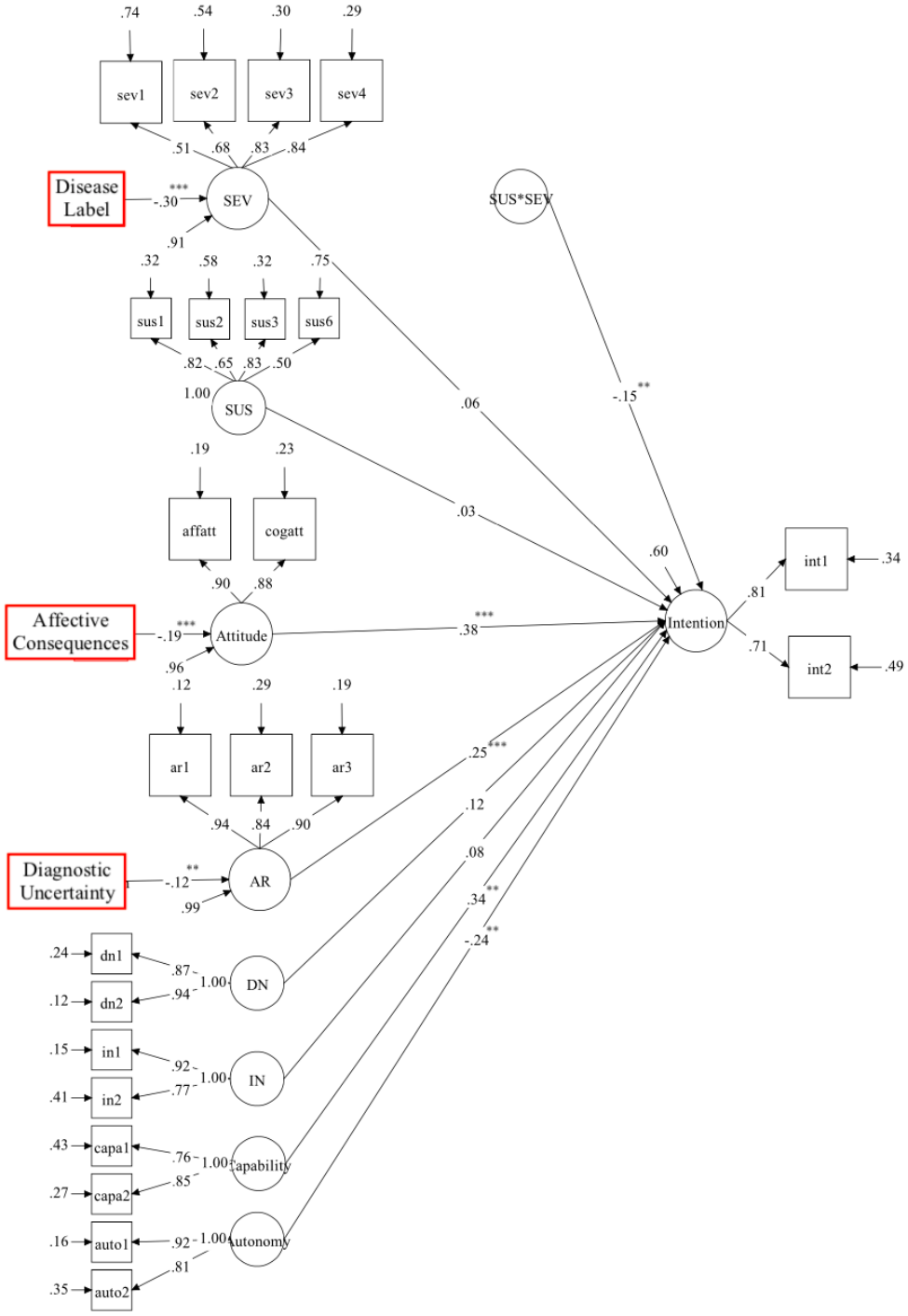

Figure 18 *The final parallel multiple mediation model tested*

Note. χ^2 (278) = 1166.89, $p < .001$; CFI = .87; RMSEA = .07 (.07, .08); SRMR = .16; AIC = 41426.16. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

a message about affective consequences) on screening intention were not significantly different (b = -.07, 95% CI = -.14, .01). The final parallel multiple mediation model with interaction term between perceived severity and susceptibility is presented in Figure 18.

Serial multiple mediation model. The fit of the serial multiple mediation model was also not good, but was clearly better in comparison with the parallel multiple mediation model, χ^2 (276) = 843.50, $p < .001$; CFI = .92; RMSEA = .06 (.05, .06); SRMR = .11; AIC = 41078.88. The improved model fit parameter, particularly SRMR, could be attributable to that the residual variance in anticipated regret reduced from .99 to .53 in the serial model.

As predicted in H12 and H13, the use of the alternative disease label negatively predicted perceived severity (β = -.30, $p < .001$); and the message about affective consequence negatively predicted attitude (β = -.19, $p < .001$). However, in this model, the path from the information about diagnostic uncertainty to anticipated regret became insignificant (β = -.05, p = .17). Thus, only H12 and H13 received support. The direct paths from the three communication strategies to screening intention were not significant. There were three significant indirect paths. The use of the alternative disease label reduced screening intention by reducing perceived severity, which lowered anticipated regret (b = -.02, 95% CI = -.03, -01). Thus, H16a was supported. A message about affective consequences significantly reduced screening intention by lowering attitude (b = -.12, 95% CI = -.18, -.06). A message about affective consequences reduced screening intention by lowering attitude, which in turn lowered anticipated regret (b = -.02, 95% CI = -.03, -.01). As the indirect paths both via and not via anticipated regret were significant, H16c and H16d was partially supported. Lastly, inconsistent with H16e, the indirect effect of diagnostic uncertainty information on screening intention through anticipated regret was not significant (b = -.02, 95% CI = -.06, .00).

The indirect effect of the affective message on screening intention via attitude was significantly stronger than the indirect effect via attitudes and anticipated regret operating in sequence (b = -.10, 95% CI = -.16, .05) and also stronger than the indirect effect of the use of alternative disease label via perceived severity and anticipated regret operating in sequence (b = -.10, 95% CI = -.17, -.05). Table 7 presents the results of mediation analysis. The final serial multiple mediation model with interaction term between perceived severity and susceptibility is presented in Figure 19.

Table 7 *Indirect effects of the three communication-based strategies on screening intention*

	Hypothesis	*b* (95% CI)	Results
Parallel multiple mediation model	H15a: Alternative label → severity → intention to undergo screening	-.04 (-.11, .01)	Rejected
	H15c, d: Affective consequences → attitude → intention to undergo screening	-.12 (-.18, -.06)	Accepted
	H15e: Diagnostic uncertainty → AR → intention to undergo screening	-.05 (-.11, -.02)	Accepted
Serial multiple mediation model	H16a: Alternative label → severity → AR → intention to undergo screening	-.02 (-.03, -.01)	Accepted
	H16c, d: Affective consequences → attitude → AR → intention to undergo screening	-.02 (-.03, -.01)	Accepted
	Not hypothesized but observed: Affective consequences → attitude → intention to undergo screening	-.12 (-.18, -.06)	Accepted
	H16e: Diagnostic uncertainty → AR → intention to undergo screening	-.02 (-.06, .00)	Rejected

Note. Severity = perceived severity, susceptibility = perceived susceptibility, affective consequences = a message about negative affective consequences of screening, diagnostic uncertainty = information about diagnostic uncertainty, AR = anticipated regret. Unstandardized regression coefficient and 95% confidence intervals (CI) are displayed. * $p < .05$.

Overall model fit indices suggested unacceptable fit for the parallel multiple mediation the parallel model and comparably better fit for the serial multiple mediation model (see Table 6). Furthermore, the AIC value was 347.28 point lower in the serial multiple mediation model

than in the parallel multiple mediation model. The substantial difference in the AIC index provides support for the serial multiple mediation model over the parallel multiple mediation model.

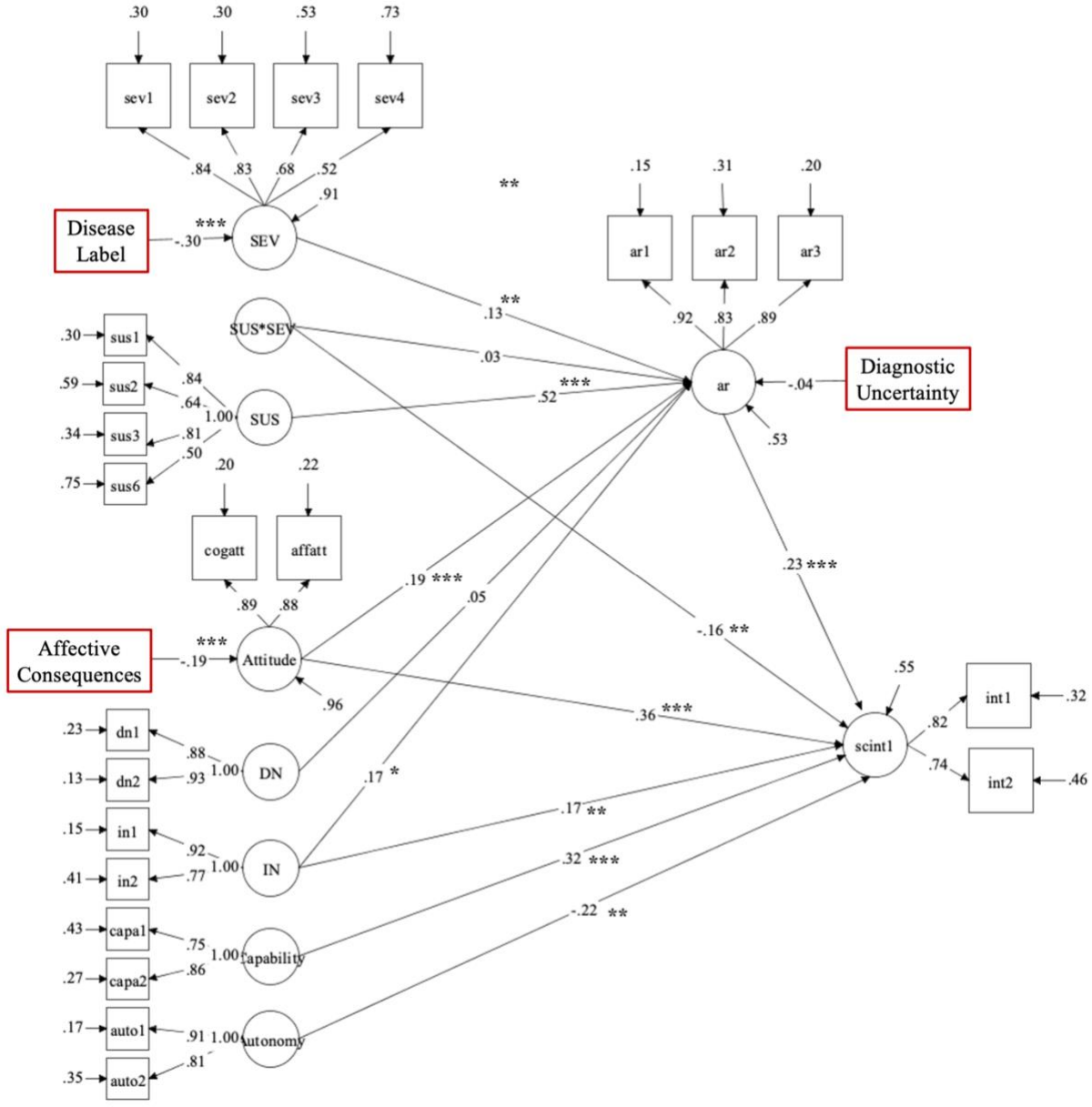

Figure 19 *The final serial multiple mediation model tested*

Note. χ^2 (276) = 843.50, $p < .001$; CFI = .92; RMSEA = .06 (.05, .06); SRMR = .11; AIC = 41078.88. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 612$.

Effects of the Communication-based Strategies on Secondary Outcomes

Effects on decisional conflict and informed decision. Recall a goal of the dissertation was to examine if the communication-based strategies had any impact on other important outcomes associated with decision making about cancer screening. Thus, RQ2 and RQ3 asked to what extent the three communication-based strategies reduce decisional conflict and increase the degree to which individuals make an informed decision, respectively. To answer RQ2, a 3-way ANOVA predicting decisional conflict was conducted with the three experimental factors as fixed factors. For these analyses, again, only data of experimental conditions was utilized. None of the main effects, nor of their interactions was significant when predicting decisional conflict (all *p*s > .05).

To answer RQ3, another 3-way ANOVA was conducted with informed decision as a dependent variable. As a reminder, informed decision is a variable created by combining the scores of decision-relevant knowledge, attitudes (i.e., the average of affective and cognitive/instrumental attitude), and screening intention (see methods section for more information). The result showed a significant 2-way interaction between a disease label and information about diagnostic uncertainty, $F(1, 484) = 6.48$, $p = .01$, $\eta_p^2 = .013$. None of the main effects, nor any other interactions were significant predictor of informed decision. A post-hoc 2-way ANOVA with pairwise comparisons with Bonferroni adjustments showed that within the alternative disease label conditions, participants who were given information about diagnostic uncertainty were more likely to make an informed decision ($M = .47$, $SE = .04$) than those who were not given the information ($M = .32$, $SE = .04$, $p = .01$). However, within the cancer label conditions, there was no significant difference in informed decision between participants who

saw (*M* = .38, *SE* = .04) and did not see the information about diagnostic uncertainty (*M* = .46, *SE* = .04), *p* = .26.

Effects on intention *not* to undergo screening. RQ4 asked if the three communication strategies increase intention not to undergo screening. Of note, the bivariate correlation between screening intention and intention not to undergo screening was only -.14 ($p < .001$), indicating intention not to undergo screening is not the opposite of intention to undergo screening. A 3-way ANOVA was conducted with intention *not* to undergo screening as a dependent variable and the three experimental factors as fixed factors. For these analyses, again, only data of experimental conditions was utilized. The result revealed a significant main effect of a disease label, $F(1, 484) = 4.99$, $p = .03$, $\eta_p^2 = .01$. Specifically, the alternative label conditions produced higher intention not to undergo screening ($M = 4.13$, $SD = .88$) than the cancer label conditions ($M = 3.93$, $SD = 1.11$), $t(466.47) = -2.21$, $p = .03$. There was also a significant 3-way interaction between the three experimental factors, $F(1, 484) = 6.37$, $p = .01$, $\eta_p^2 = .013$. Post-hoc 2-way ANOVAs were performed separately for the cancer label conditions and for the alternative disease label conditions.

The 2-way interaction between information about diagnostic uncertainty and message about affective consequences was significant only within the alternative label conditions, $F(1, 242) = 5.04$, $p = .03$, $\eta_p^2 = .02$, but not in the cancer label conditions, $F(1, 242) = 2.09$, $p = .15$, $\eta_p^2 = .009$. Within the alternative label conditions, neither the main effect of information about diagnostic uncertainty, nor that of message about affective consequences was significant, *p*s > .18. Pairwise comparisons with Bonferroni adjustments found that within the alternative label conditions where information about diagnostic uncertainty was not presented, participants who received the message about affective consequences reported significantly higher intention not to

undergo screening (M = 4.40, SE = .11) than those who did not receive the affective consequences message (M = 4.00, SE = .11), p = .01. However, within the alternative label conditions where the information about diagnostic uncertainty was presented, the message about affective consequences did not make a significant difference in intention not to undergo screening (in the absence of the message: M = 4.12, SE = .11; in the presence of the message: M = 4.02, SE = 0.11), p = .53. The result suggests that information about diagnostic uncertainty lessens the effect of a message about affective consequences on intention not to undergo screening (Figure 20).

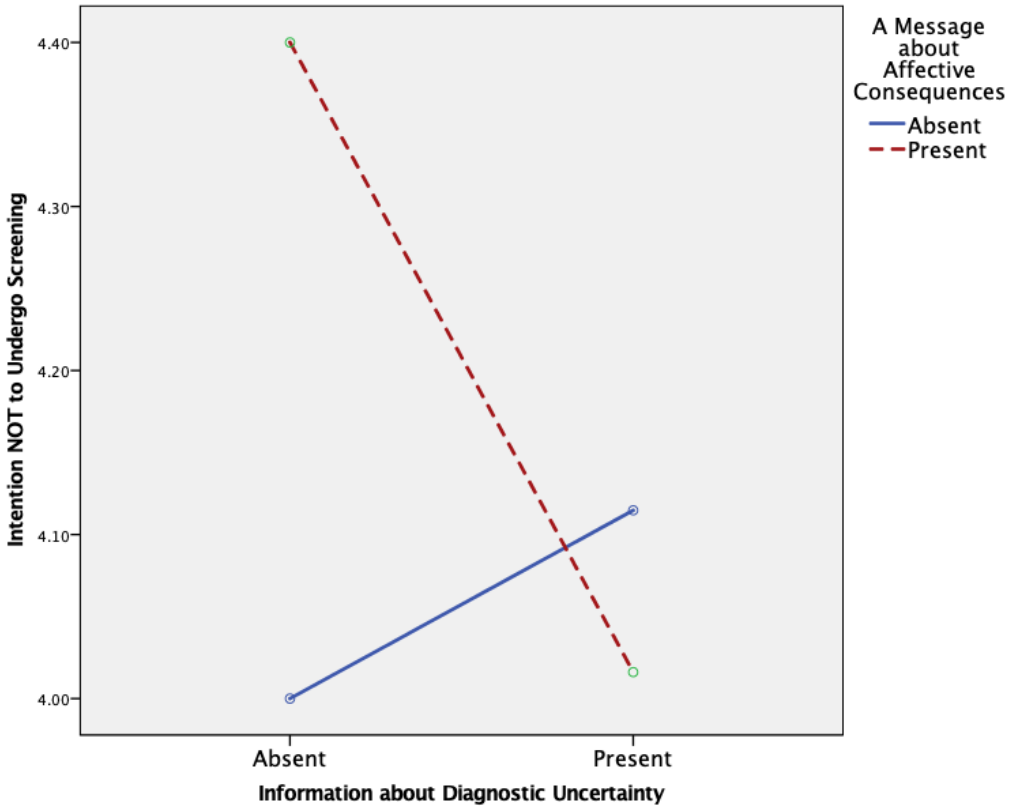

Figure 20 *Interaction between information about diagnostic uncertainty and a message about affective consequences on intention not to undergo screening within the alternative disease label condition*

In addition, to examine if the effects of the three communication-based strategies on intention *not* to undergo screening is mediated by the theoretical model proposed, the serial multiple mediation model was estimated with intention not to screening as a dependent variable. All the model fit indices except SRMR were in an acceptable range, χ^2 (254) = 789.75, $p < .001$; CFI = .91; RMSEA = .06 (.05, .06); SRMR = .11; AIC = 39717.735. In this model, only the direct path from the use of the alternative disease label to intention not to undergo screening was significant (β = .10, p = .01; b = .22, 95% CI = .05, .37). None of the other direct or indirect paths from the experimental factors to intention not to undergo screening were significant. Taken together, the results demonstrated that the use of the alternative disease label increased intention not to undergo screening; but the effect is not mediated by the serial model.

Effects on medical skepticism. RQ5 asked if the three communication strategies contribute to medical skepticism. A 3-way ANOVA predicting medical skepticism showed that only the main effect of information about diagnostic uncertainty was significant, $F(1, 481) = 4.51$, $p = .03$, $\eta_p^2 = .01$. The level of medical skepticism was higher in the conditions where information about diagnostic uncertainty was presented ($M = 2.33$, $SE = .04$), compared to the conditions where the information was not presented ($M = 2.21$, $SE = .04$), $p = .04$.

Post-Hoc Analyses

Sensitivity analysis. In this dissertation, I manipulated the presence or absence of message factors to modify the variance in three of the major predictors of screening intention: Risk perceptions (i.e. perceived severity and susceptibility), attitudes, and anticipated regret. The other predictors of screening intention, namely subjective norms (i.e., injunctive and descriptive norms) and PBC (i.e., capability and autonomy), were not targeted to elicit changes in screening intention. As discussed earlier, the decision was made on the considerations that 1) subjective

norms and PBC could be less of an important determinant in the context of this dissertation, and 2) attempting to modify subjective norms and PBC might not be plausible nor ethically justifiable. Since not all major predictors of screening intention were experimentally modified, there is a justifiable concern that the parallel and serial models tested using the experimental data may not provide a fair comparison of the effects of the predictors. With regard to that concern, in a post-hoc analysis, both the parallel and serial models were tested with only the control condition data to evaluate the stability of the model testing results and to better quantify respective effects of risk perceptions, attitudes, anticipated regret, subjective norms, and PBC on screening intention. Due to the number of cases in the control condition data (n=120) was small to obtain reliable results (Kline, 2011), I chose to use path analysis instead of structural equation modeling with latent variables for this post-hoc analysis.

When the parallel model was re-estimated using only the control condition data, the results did not show any different patterns of associations from the model estimated with the entire sample, except that the interaction between perceived severity and susceptibility was non-significant (β = -.11, p = .22). Figure 21 presents the parallel model after dropping the non-significant interaction term between perceived severity and susceptibility. Consistent with the results of parallel model tested using the entire sample, anticipated regret (β = .27, p = .01), attitude (β = .29, p = .01), and capability (β = .34, p = .003) significantly and positively predicted screening intention. Autonomy significantly but negatively predicted screening intention (β = -.27, p = .02). Perceived severity (β = -.10, p = .21), perceived susceptibility (β = .16, p = .07), descriptive norms (β = .05, p = .64), and injunctive norms (β = -.01, p = .97) did not emerge as significant predictors of screening intention. Although the parallel model tested with the entire sample suggested both attitude and capability were significantly stronger predictors of screening

intention than anticipated regret, in the model tested with the control condition data, the three were statistically equally strong predictors of screening intention (*p*s > .48).

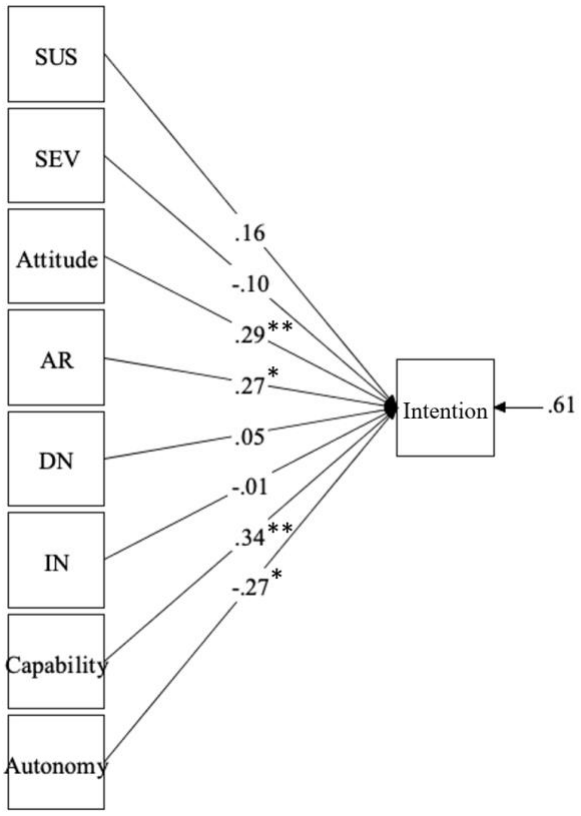

Figure 21 *The parallel model tested with the control condition data*

Note. Model fit cannot be assessed for this model because the model is saturated (with zero degrees of freedom). Standardized path coefficients are presented. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, ** $p < .01$. All factor loadings were significant at $p < .001$. $N = 120$.

Next, the serial model was re-estimated using only the control condition data. Different patterns of associations were observed for the entire data set and the control condition data (Figure 22). The first notable difference was that perceived severity ($\beta = .01$, $p = .88$), attitudes ($\beta = .12$, $p = .16$), and injunctive norms ($\beta = .24$, $p = .05$) did not significantly predict anticipated regret. Another notable difference was that descriptive norms emerged as a significant predictor

of anticipated regret (β = .21, p = .02). There were also associations consistent with the results of the serial model tested using the entire sample. Perceived susceptibility positively predicted anticipated regret (β = .29, p = .001). In addition, anticipated regret (β = .34, p < .001), attitudes (β = .27, p = .003), and capacity (β = .36, p = .001) were significant positive predictors of predicted screening intention, whereas autonomy (β = -.32, p = .01) was a significant negative predictor. Although the standardized path coefficients of perceived anticipated regret, attitudes, and capacity on screening intention were different, the differences were not statistically significant, ps > .63, meaning that they were similarly strong predictors of screening intention.

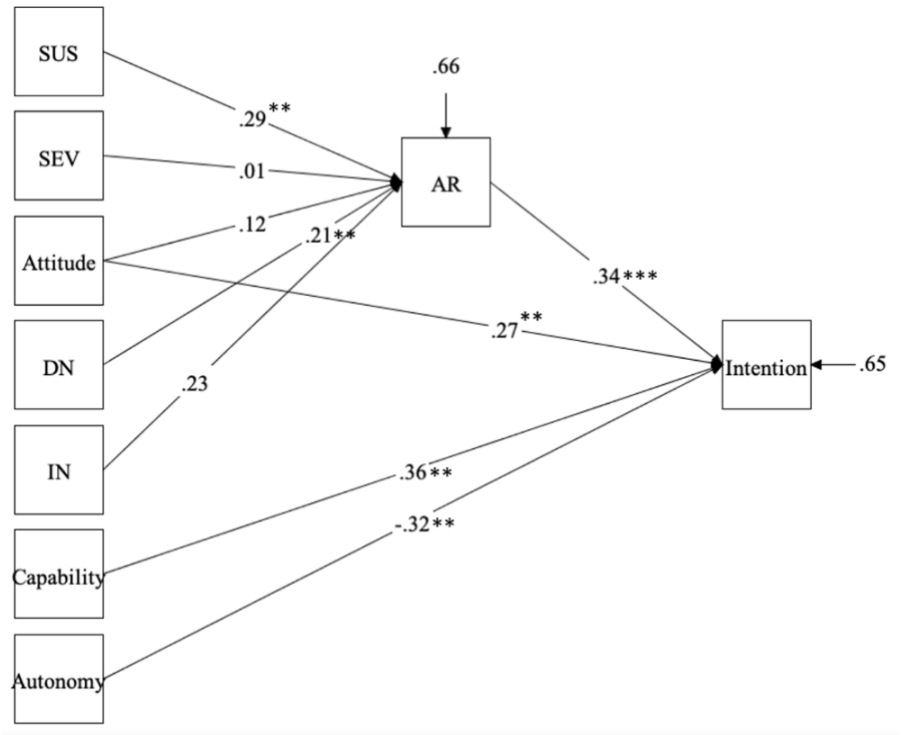

Figure 22 *The serial model tested with the control condition data*

Note. χ^2 (6) = 8.20, p = .22; CFI = .97; RMSEA = .06 (.00, .14); SRMR = .04; AIC = 670.72. Standardized path coefficients are presented. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * p < .05, ** p < .01, *** p < .001. All factor loadings were significant at p < .001. N = 120.

It should be reminded here that in the serial model tested using the entire data set, anticipated regret fully mediated the effect of perceived susceptibility partially mediated the effects of attitude and injunctive norms on screening intention (see pp. 100–106). By contrast, in the serial model tested using the control condition data only, anticipated regret fully mediated the effects of perceived susceptibility (b = .08, 95% CI = .03, .17) and descriptive norms (b = .05, 95% CI = .01, .11) on screening intention. The size of the indirect effects of perceived susceptibility and descriptive norms on screening intention via anticipated regret were not statistically different (95% CI = -.02 .12). Also inconsistent with the results of the serial model tested using the entire data set, the indirect effect of attitudes on screening intention via anticipated regret was not significant (b = .03, 95% CI = -.01, .09); and injunctive norms did not predict screening intention, neither directly (β = 04, p = .78) nor indirectly (b = .05, 95% CI = .00, .13).

The relative influences of perceived susceptibility, attitudes, descriptive norms, and capability on screening intention were evaluated based on the total effect (the sum of significant direct and indirect effects). Although the effect of attitudes on screening (b = .20, 95% CI = .06, .33) was greater than those of perceived susceptibility (b = .08, 95% CI = .3, .17) and descriptive norms (b = .05, 95% CI = .01, .11) via anticipated regret, the differences were not statistically significant (95% CI = -.06, .27; 95% CI = .00, .29, respectively). The effect of capability on screening intention (b = .25, 95% CI = .09, .41) was significantly greater than that of descriptive norms, 95% CI = .02, .38, but not than those of perceived susceptibility (95% CI = -.02, .34) and attitudes (95% CI = -.18, .28). Taken together, these results generally suggest that attitudes, capability, and perceived susceptibility are similarly important predictors of screening intention.

The results of sensitivity analysis show that the statistical importance of some parameters varies between the serial model tested using the entire data and that tested using the control group data. The varying importance of subjective norms seems particularly worthy of mention. The results of the serial model for the entire sample showed that injunctive norms predicted screening intention as strongly as attitudes and capability did. However, in the serial model tested for the control group, injunctive norms did not appear a significant predictor of screening intention. Instead, descriptive norms emerged as an equally important predictor as attitudes and capacity.

Effects of providing evidence-based information about health risks and benefits of cancer screening. As discussed in Chapter 1, the primary approach to tackling the overuse of low-value cancer screening at the individual level has been to provide individuals with scientific evidence and neutral information about potential health-related harms and uncertain health-related benefits of cancer screening. However, it has been repeatedly reported in previous research that such an approach alone is not enough to curb willingness to undergo low-value screening (Lee et al., 2016; McDowell et al., 2019; Pathirana et al., 2017; Shaffer & Scherer, 2018; Sheridan et al., 2016). To see if the same results are obtained in this dissertation, I compared the control condition for the entire experiment against one specific experimental condition where participants did not receive the message about affective consequences of screening and the information about diagnostic uncertainty. To clarify, the only difference between the two conditions was that the control condition did not receive evidence-based generic information about symptoms of thyroid cancer, overdiagnosis, overtreatment, limited efficacy in reducing mortality, explicit professional guideline that does not recommend screening for thyroid

cancer that was provided to all experimental conditions by default. The effect of the default generic information was estimated by comparing the two conditions using independent t-tests.

Dependent variables entered in the independent t-tests were decision-relevant knowledge, all the TPB components, perceived severity, perceived susceptibility, anticipated regret, intention to undergo screening, intention not to undergo screening, informed decision, decisional conflict, and medical skepticism. The two conditions were significantly different only in terms of decision-relevant knowledge (experimental: $M = 5.08$, $SD = 1.79$; control: $M = 4.65$, $SD = 2.09$, $p < .001$), affective attitude (experimental: $M = .68$, $SD = 1.08$; control: $M = 1.28$, $SD = 1.17$, $p = .001$), cognitive/instrumental attitude (experimental: $M = .83$, $SD = 1.24$; control: $M = 1.48$, $SD = 1.44$, $p = .002$), and decisional conflict (experimental: $M = .22$, $SD = .42$; control: $M = .37$, $SD = .48$, $p = .03$).

It should be emphasized that the two conditions were not significantly different in terms of intention to undergo screening (experimental: $M = 3.64$, $SD = 1.03$; control: $M = 3.89$, $SD = .91$, $p = .10$), intention not to undergo screening (experimental: $M = 4.07$, $SD = 1.06$; control: $M = 3.80$, $SD = 1.19$, $p = .12$), and informed decision (experimental: $M = .47$, $SD = .50$; control: $M = .35$, $SD = .48$, $p = .14$). That is, although the generic information significantly increased decision-relevant knowledge as well as significantly decreased attitudes toward screening uptake, and decisional conflict, it was not sufficient to affect screening decisions.

Pre-post difference in screening intention. At baseline, about 64% reported they intended to undergo screening in the future. As these data was available, I did a pre-test/post-test analysis looking for changes in screening intent. For this analysis, screening intention at post-exposure was converted into a dichotomous variable using a median split (0 = no intent to screen, 1 = intent to screen). Then, a difference score was calculated for each participant by

subtracting the post-exposure score from the response obtained at baseline (0 = no intent to screen, 1 = intent to screen). The results of frequency analysis showed that 127 out of 389 (32.6%) participants who reported intending to undergo thyroid ultrasound screening at baseline had changed their minds not to undergo screening after being exposed to the stimulus materials. 140 out of 223 (62.8%) participants who reported having no intention to undergo screening at baseline had not changed their minds at post-exposure; that is, 37.2% of participants who reported having no intention at baseline had changed their minds to undergo screening.

The same frequency analysis was performed for the experimental and control conditions, respectively. Of the 312 participants in the experimental conditions who expressed their intention to undergo screening at baseline, 112 (35.9%) changed their minds that they would not undergo screening. Of the 180 participants in the experimental conditions who reported having no intention to undergo screening, 121 (67.2%) reported they still did not have intention to undergo screening at post-exposure. In the control condition, 15 out of 77 (19.5%) changed their minds not to undergo screening. 19 out of 43 (44.2%) participants in the control condition who reported having no screening intention had not changed their minds. In other words, 55.8% in the control conditions changed their minds to undergo screening.

Interaction effects on changes in screening intention. A 3-way ANOVA was conducted to see if the pre-post difference in screening intention was different between experimental conditions. None of the main effects was significant, all *p*s > .30. A 2-way interaction between a disease label and a message about affective consequences was significant, $F(1, 484) = 5.91$, $p = .02$, $\eta_p^2 = .012$. A 2-way interaction between information about diagnostic uncertainty and a message about affective consequences was also significant, $F(1, 484) = 5.27$, $p = .02$, $\eta_p^2 = .011$. The significant 2-way interactions were further examined using 2-way

ANOVAs with pairwise post-hoc comparisons with Bonferroni correction. The results showed that participants in the conditions where a message about affective consequences was presented exhibited a greater reduction in screening intention when the alternative disease label was used (M = -.21, SE = .05), compared to when the cancer label was used (M = -.02, SE = .05), p = .02. That is, the use of alternative disease label significantly reduced screening intention only when it was coupled with a message about affective consequences.

With regard to the 2-way interaction between information about diagnostic uncertainty and a message about affective consequences, a significant difference was observed only between participants who were not given neither the information about diagnostic uncertainty nor the affective message (M = -.02, SE = .05) and those who were only given the diagnostic uncertainty information (M = -.19, SE = .05), p = .02. That is, in the absence of the affective message, the information about diagnostic uncertainty significantly reduced screening intention. However, the desirable effect of the information disappeared in the presence of the affective message. Of note, in the absence of the diagnostic uncertainty information, no significant difference was observed between conditions where the affective message was presented (M = -.15, SE = .05) and those where the message was not presented (M = -.02, SE = .05), p = .07.

CHAPTER 5

DISCUSSION

Overuse of cancer screening tests of questionable value and resultant overdiagnosis and overtreatment of low-risk cancer (e.g., thyroid cancer, prostate cancer) have increasingly become issues of worldwide concern. As the causes of overuse of low-value screening are complex and multifaceted, a wide range of countermeasures are required to address them. This dissertation focused on a demand-side intervention, particularly direct patient education using an information booklet, aimed at reducing the overuse of low-value thyroid cancer screening. This dissertation had three major objectives. The first objective was to develop theoretical frameworks that explicate the processes that are hypothesized to determine cancer screening intention. The second objective was to use the developed frameworks to propose communication-based strategies that could help reduce the use of low-value cancer screening. The third objective was to empirically examine the effectiveness of the strategies among South Korean women—the population in which the prevalence of thyroid cancer is significantly higher (and therefore are assumed to be more susceptible to overdiagnosis and overtreatment), compared to South Korean men and those from other countries (Ahn et al., 2014).

Drawing upon the multicomponent version of the theory of planned behavior (TPB), two frameworks were proposed to explain and predict cancer screening intention: a parallel and a serial model. The parallel model hypothesized that the 3 major components of TPB—attitudes (i.e., affective, cognitive/instrumental), subjective norms (i.e., descriptive and injunctive), and perceived behavioral control (PBC, i.e., capability and autonomy)—in conjunction with risk

perceptions (i.e., perceived severity, perceived susceptibility) and anticipated regret serve to predict cancer screening intention in parallel. The results of the SEM analysis of the parallel model showed that only attitudes, capability, and anticipated regret significantly and positively predicted screening intention. Unexpectedly, autonomy significantly but negatively predicted screening intention.

The serial model put more emphasis on the role of anticipated regret in determining screening intention, hypothesizing that anticipated regret mediates the effects of attitudes, subjective norms, and risk perceptions on screening intention. In other words, the serial model proposed anticipated regret as a parsimonious explanation of the underlying process determining individuals' decision to undergo cancer screening. In the serial model, capability and autonomy were hypothesized to directly predict screening intention. Results of the SEM analysis of the parallel model showed that anticipated regret significantly and positively predicted screening intention. In addition, attitudes and injunctive norms significantly and positively predicted screening intention both directly and also indirectly via anticipated regret. Perceived susceptibility significantly and positively screening intention only indirectly (via anticipated regret). As observed in the results of the parallel model, capability significantly and positively screening intention, but autonomy significantly and negatively predicted screening intention. The parallel model and serial model provided similarly good fits to the data.

The developed theoretical frameworks help identify important determinants of intention to undergo screening, and therefore, are worthy of targeting in intervention messages aimed at modifying cancer screening intention. Applying the developed theoretical frameworks, I proposed three communication-based strategies in a decision support material aimed at reducing intention to undergo low-value thyroid cancer screening: (1) removing the word cancer from the

disease label to reduce risk perceptions, (2) highlighting negative affective consequences of thyroid ultrasound screening to reduce attitudes, and (3) providing information about diagnostic uncertainty to reduce anticipated regret. The alternative disease label reduced perceived severity not susceptibility; and the reduction led to a decrease in anticipated regret, which in turn reduced screening intention. The alternative disease label also increased intention *not* to undergo screening as well, but the effect was not explained by the developed theoretical framework. The affective message reduced screening intention through two pathways: (1) lower positive attitudes and (2) lower positive attitude to less anticipated regret. Although the diagnostic uncertainty information reduced anticipated regret, the effect disappeared when the diagnostic uncertainty information was included in a structural model with other predictors of anticipated regret.

The following section reviews the major findings and discusses some unexpected findings. Implications of the results are discussed in detail along with theoretical contributions. Then, practical implications of this dissertation are discussed. This dissertation ends with the discussion of limitations. Suggestions for future research are addressed where needed along the discussion. (See Tables 5 and 7 for the summary of the results of hypothesis testing.)

The Parallel Model

Prior to model testing, the convergent and discriminant validity of the measurement model was assessed. The results of the measurement model were good except that for a high correlation and inadequate discriminant validity between affective and cognitive/instrumental attitudes. As the two components of attitude did not form separate factors, they were identified as indicators of a latent construct of attitudes and the latent attitudes variable was included as a single predictor in subsequent model testing. As a result, in this dissertation, I was not able to test differential effects of affective and cognitive/instrumental attitudes.

Two major models, the parallel and serial were tested. In this section I first review findings for the parallel model. In the final parallel model shown in Figure 13 on page 95, attitude, capability, and anticipated regret significantly and positively predicted screening intention. Compared to anticipated regret, attitude and capability were stronger predictors. This finding is comparable with a meta-analysis of the TPB studies (Cooke & French, 2008) that reported attitudes were the strongest predictor of screening intention, and also with a meta-analysis of multicomponent TPB studies (McEachan et al., 2016) that reported affective attitude and capability were the strongest predictors of health behavioral intentions.

Autonomy was hypothesized to be a significant positive predictor of screening intention. However, in the parallel mode, the reverse relationship was significant as autonomy negatively predicted screening intention. In discussing this perplexing finding, I start by noting that the bivariate correlation between autonomy and screening intention was negligible but also negative (-.03, p = .41), which suggests that the significant negative path from autonomy to screening intention could not be attributed to statistical suppression. What also should be noted is that no condition differences were found for autonomy (all ps > .27), which indicates that the three communication-based strategies did not have any unintended significant effects on autonomy. Although the significant negative path was unexpected, it perhaps should not be entirely surprising within this dissertation's context, considering that higher autonomy is associated with a greater engagement with personally relevant information (i.e., a greater reflection on information perceived to be useful to decision-making and less defensive or biased information processing) (Koestner et al., 1999; Pavey & Sparks, 2010). The stimulus materials (except for the control group) focused on explaining why screening for thyroid cancer (or a borderline thyroid neoplasm) is *not* recommended. Considering the nature of the information presented to

participants, it seems possible that highly autonomous individuals formed their screening intention based on a reflective weighing of uncertainty benefits and possible harms of screening that were described in the stimulus materials along with consideration of their needs, interests and values. As a result, they may have formed screening intentions that were consistent with the recommendation. In this perspective, the negative relationship between autonomy and screening intention could be interpreted as indicative of the effectiveness of the stimulus materials in promoting decision making that is consistent with a professional recommendation. Clearly, however, more research is needed to assess the importance of this finding and whether it is a one-time finding or something persistently relevant to studies that want to encourage less screening. Finally, given capability and autonomy significantly predicted screening intention but in opposite directions, it would be important to measure and test the two PBC components separately. The result also highlights the relative advantages of employing the multicomponent the TPB rather than a higher-order model where the subcomponents are conceptualized as reflective indicators of more general constructs.

Another unexpected finding was that neither descriptive norms nor injunctive norms were significant predictors of screening intention. This finding is inconsistent with previous studies that found subjective norms significantly predicted intentions to undergo screening for various cancers (Sieverding et al., 2010; Smith-McLallen & Fishbein, 2008; von Wagner et al., 2019; Zhao Martin et al., 2019). Fishbein and Ajzen (2011) noted that the relative importance of the different determinants of behavioral intention differs from population to population with variation in the contextual variables. Therefore, this unexpected finding may simply indicate that subjective norms variables are relatively less important in terms of predictors of screening intention among South Korean women. However, this explanation may not be fully satisfactory

because previous studies with South Korean women also reported significant positive associations of subjective norms with intention to undergo Pap testing (Kim, 2014) and mammography (Ham, 2006).

Another possible explanation is that participants might not have had to rely on their observation of others' screening behavior, or their inference of others' approval of screening behavior as a source of information that guide their decision-making because the cost-benefit ratio of undergoing thyroid ultrasound was not perceived to be uncertain. All participants (except those in the control group) received information about the uncertain benefits and potential costs of thyroid ultrasound screening along with professional recommendations against routine screening. Thus, to the participants in the experimental groups, the costs might have outweighed the benefits. To participants in the control group who were not given the default information, the benefits might have outweighed the costs. This speculation seems reasonable in that the general public tend to have positive attitudes toward cancer screening (Schwartz et al., 2004; Waller et al., 2015), and also that thyroid cancer screening is highly affordable/accessible and causes less physical inconvenience compared to other cancer screenings including mammography and Pap testing. This speculation receives some support from a study by Kim et al. (2015) who reported that descriptive norms more strongly predicted behavioral intention when scientific uncertainty existed regarding the effectiveness of the behavior in reducing cancer risk. Kim et al. (2015) also found that for behaviors that are more clearly established as effective ways to reduce cancer risk, self-efficacy was significantly more predictive of behavioral intentions. Recall that capability consistently emerged as a significant predictor of intention to undergo thyroid ultrasound screening in this dissertation. Extending Kim et al.'s (2005) finding to this dissertation, capability might have served as a stable predictor of screening intention because there existed

relatively little uncertainty regarding whether undergoing thyroid ultrasound screening is effective or not. By the same logic, it seems reasonable to speculate that the explicit recommendation against thyroid ultrasound screening reduced the relative importance of injunctive and descriptive norms.

Both of the risk perception components did not significantly independently predict screening intention, however, the interaction between perceived severity and susceptibility had a significant but negative effect. The results of simple slope analyses suggested that when severity was perceived to be low, perceived susceptibility was a positive predictor of screening intention. When severity was perceived to be high, perceived susceptibility was a negative predictor of screening intention. The interaction effect between perceived severity and susceptibility on screening intention could be explained in at least two ways. First, the notion of fear-control responses to a health threat (Janis, 1967; Witte, 1992) may offer one possible explanation. The extended parallel process model (EPPM: Witte, 1992) posits that the combination of risk perception and efficacy beliefs (e.g., perceived effectiveness of a given action in reducing a threat) determines the nature of the response (either fear or danger control). Specifically, the EPPM suggests that when individuals' risk perception is high, but efficacy beliefs are low, they are more likely to engage in fear control process where they focus on their fear and try to control the fear through defensive strategies (e.g., denial, avoidance), opposed to danger control process where they engage in any health-protective behavior. With the exception of the control group, the stimulus materials used provided evidence suggesting that screening for thyroid cancer (or a borderline thyroid neoplasm) might not be effective in reducing cancer-related mortality. Thus, even if participants perceived the given disease to be serious and they were susceptible to it, they might have resorted to focusing more on controlling fear through defensive strategies rather than

undergoing screening of questionable mortality-reducing benefits. Another explanation for the unexpected finding comes from uncertainty management theory (UMT: Brashers, 2001). UMT posits that if uncertainty is appraised as congruent with individuals' goal (e.g., an opportunity), it provokes hopes and drives them to maintain or even increase their current levels of uncertainty (Bradac, 2001; Brashers, 2001). From the perspective of the UMT, it is possible that when participants perceived both severity and susceptibility to be high, not knowing the presence or absence of the disease might not necessarily have been appraised as an aversive state; and therefore, they might have been motivated to maintain their levels of uncertainty by deciding not to undergo screening.

In summary, the proposed parallel model with anticipated regret and risk perceptions not only was better fitting than the multicomponent TPB but also contributed to a further significant 5.7% of the variance explained in screening intention over and above the multicomponent TPB. While the parallel model also fitted the data better than the multicomponent TPB and anticipated regret, it should be noted that the increase in the variance explained by the parallel model compared with the multicomponent TPB with anticipated regret was only 0.6%. Furthermore, in the parallel model, perceived severity and perceived susceptibility were not significant predictors of screening intention. The negligible increase in variance explained by adding the two risk perception variables suggests that the predictive ability of the parallel model may not be better than that of the multicomponent TPB with anticipated regret. However, I conclude the parallel model is more advantageous than the multicomponent TPB in that it accounts for a significant interaction effect between perceived severity and perceived susceptibility on screening intention. If risk perception is treated as a background factor that exerts its influences on screening

intention through the TPB components as the TPB does, such an interaction effect could not be theorized nor estimated.

The Serial Model

In contrast to the parallel model, the serial model found in Figure 17 on page 106 hypothesized that anticipated regret mediates the effects of risk perceptions (i.e., perceived severity and susceptibility), attitude, and subjective norms (i.e., injunctive and descriptive norms) on screening intention. Identical to the parallel model, capability and autonomy were hypothesized to directly predict screening intention. The results of the final serial model revealed that the effect of perceived susceptibility was fully mediated by anticipated regret, whereas those of attitudes and injunctive norms were partially mediated by anticipated regret. In addition, although perceived severity significantly increased anticipated regret, the increase in anticipated regret did not lead to a change in screening intention. Also inconsistent with prediction, descriptive norms did not emerge as a significant predictor of anticipated regret.

It should be noted that in the parallel model, neither descriptive nor injunctive norms significantly affected screening intention. In the serial model, by contrast, injunctive norms appeared to exert significant influence on screening intention, both directly as well as indirectly via anticipated regret. It is not straightforward to interpret the inconsistent and perplexing predictive value of injunctive norms. Still, these results are consistent with a previous study by Smith-McLallen and Fishbein (2008) that showed injunctive norms to be relatively more important than descriptive norms in the prediction of intentions to engage in three different cancer screening behaviors (i.e., mammogram, colonoscopy and PSA test). However, readers should keep in mind that there also exist mixed findings concerning the significance and magnitude of the effects of descriptive and injunctive norms on screening intentions (Juon et al.,

2017; Sieverding et al., 2010). Therefore, clearly, more research is needed to better understand the inconsistent independent contribution of injunctive norms to prediction of screening intention and to fully investigate the utility of injunctive and descriptive norms across a wide range of screening behaviors and populations.

The results of the serial model could be interpreted as that injunctive norms in particular, influences screening intention by increasing anticipated regret over screening non-uptake as well as by increasing perception of social pressure to take screening tests as the TPB posits. Then, the question that naturally arises is why descriptive norms does not have an anticipated regret-increasing capacity as injunctive norms does. One answer to the question can be found in the measure for subjective norms. A study by Cho (2006) demonstrated that the strength of the relationship between subjective norms and drinking behaviors depends on what the reference group is set to (i.e., typical students on campus vs. friends). In fact, the items used to measure subjective norms components in this dissertation specified different referent groups. The referent group was specified as "women of your age" in the items for descriptive norms, and as "most people I consider important including doctors" in the items for injunctive norms. Greater perceived approval of screening uptake by health professionals might have made screening non-uptake deemed less desirable and less justifiable, thereby increasing anticipated regret over screening non-uptake. It is equally possible that lay individuals determine the desirability and justifiability of screening (non-)uptake based on their perception of what the majority of similar others do. However, the similar others' behaviors might not be as influential as health professionals' approval. Keeping a relevant referent group consistent in measures of descriptive and injunctive norms in future research would help us clarify whether injunctive norms indeed (a) has a greater capacity to increase anticipated regret or (b) the differential effect of the

descriptive and injunctive norms observed in this dissertation is related to the difference in the referent group included in the measures of descriptive and injunctive norms.

In summary, attitude and injunctive norms increased screening intention both directly and indirectly via anticipated regret, while perceived susceptibility only indirectly increased screening intention via anticipated regret. The indirect effect of perceived susceptibility was significantly stronger than those of attitude and injunctive norm. However, when both direct and indirect effects (via anticipated regret) were taken into account, attitudes, capability, and injunctive norms emerged as having stronger effects on screening intention than perceived susceptibility than that of perceived susceptibility.

Consistent with the results of the parallel model estimation, in the serial model, *c*apability significantly and positively predicted screening intention, whereas autonomy significantly but negatively predicted screening intention. As the explanations for these findings were offered earlier, no further discussion is needed here. Lastly, perceived severity and susceptibility worked together to directly and negatively influence screening intention and the pattern of their interaction was identical to what was observed in the parallel model. The interaction effect of severity and susceptibility on anticipated regret was not significant.

Comparing Models

Going beyond the attitudinal model (i.e., the TPB), the parallel and serial model attempt to capture three different underlying reasons and drives that give rise to cancer screening intention: 1) maximizing utilitarian benefits while minimizing utilitarian costs (which the TPB primarily focuses on), 2) avoiding a health threat (with inclusion of risk perceptions), and 3) minimizing future regret (with inclusion of anticipated regret). Although both the parallel and

serial models provided similarly good fits to the data, I would suggest that the serial model is a better and more useful model in the light of theoretical and practical considerations.

The most important consideration is that the serial model offers a parsimonious explanation of the underlying process that leads to screening behavior. The serial model posits that increase in anticipated regret over screening non-uptake may be one important mechanism that explains risk perceptions, attitudes, and subjective norms affecting screening intention. In this dissertation, anticipated regret partially mediated the effects of attitude and injunctive norms on screening intention; and, moreover, it fully mediated the effect of perceived susceptibility on screening intention. It should be highlighted again that the independent and indirect effects of perceived susceptibility and injunctive norms on screening intention were not captured by the parallel model that focused on simple cause and effect relationships.

This dissertation is certainly not the first attempt to empirically study anticipated regret as another predictor of behavioral intention within the TPB framework. However, in the TPB literature, the role of anticipated regret in producing behavioral intention has remained rather atheoretical and undertheorized. The originators of the TPB (Fishbein & Ajzen, 2010) treat anticipated regret over engaging in a certain behavior as an emotional cost of the behavior that reduces the utility individuals gain from the behavior. By the same logic, anticipated regret over not engaging in a certain behavior is treated as an emotional benefit of the behavior that increases the utility that can be gained from the behavior. Although other researchers acknowledge a motivational or functional aspect of anticipated regret, such as its role in driving subsequent health behaviors that serve to manage future regret (Brewer et al., 2016; Sandberg & Conner, 2008; Sheeran & Orbell, 1999), their focus has been on testing if anticipated regret significantly adds to the prediction of behavioral intentions over and above the TPB components.

Differently put, they simply considered the TPB components and anticipated regret as predictors of behavioral intention that run in parallel. The underlying assumption of such a parallel model appears to be that attitude, subjective norms, PBC, and anticipated regret are activated simultaneously from the start of the decision-making process and simultaneously influence behavioral intention.

Based on previous research on regret in the decision-making literature (Connolly & Zeelenberg, 2002; Janis & Mann, 1977; Reb & Connolly, 2010), I argued that the assumption underlying the parallel model may not be entirely correct. Then, drawing primarily upon decision-justification theory (DJT; Connolly & Zeelenberg, 2002), I developed the serial model that explicates the mediating role of anticipated regret between attitudes, subjective norms, and newly added risk perceptions and screening intention. In the serial model, favorable attitudes toward screening, heightened perception of disease risk, and increased perception of social pressure to undergo screening are considered as antecedent conditions that give rise to anticipated regret over screening non-uptake; and screening intention is considered as a behavior that aims to manage (i.e., minimize) future regret.

Since attitudes, injunctive norms, and the combination of perceived severity and susceptibility also directly predicted screening intention in the final serial model as well, regret-minimizing may not be the only underlying reason that motivates screening behaviors. Other reasons and motivations for cancer screening (i.e., maximizing utilitarian benefits and avoiding a health threat) also appear to come into play. Nonetheless, the serial model is theoretically meaningful in that it sheds theoretical light on the role of anticipated regret that has been considered as an emotion that is highly relevant to preference-sensitive decisions as well as cancer-related decisions (Brehaut et al., 2003; Connolly & Reb, 2005; Feldman-Stewart &

Siemens, 2015; O'Carroll et al., 2015; Sandberg & Conner, 2009; Sorum et al., 2004). Lastly, by explicating the underlying causal mechanism, the serial model not only facilitates theoretical understanding of screening behavior, but also suggests that anticipated regret, a more proximal predictor of screening intention, may serve as a useful point of intervention to modify screening intention.

Health communication scholars and practitioners have given an exceptional amount of attention to fear and the role of fear appeals in motivating behavior change (Shen, 2017; Witte, 1992; Witte & Allen, 2000). It is not hard to see why, given that as one of primary emotions across cultures, fear not only is closely related to perception of imminent, concrete, and immense physical threats, but also has a capacity to motivate appropriate behaviors in relation to the perceived threats (e.g., the fight-or-flight response) (Folkman & Lazarus, 1984; Lazarus, 1991). However, in the real world, health threats are not always evident, and risks are seldom clear. Moreover, it is not uncommon that the benefits of countermeasures to prevent or mitigate the consequences of health threats do not clearly outweigh the associated harms, making the decision to accept (and reject) the countermeasures more challenging or preference sensitive. In such cases where health behavioral decisions involve uncertainty over the outcomes, fear may not be the most, or the only, dominant emotional response; and other emotions like anticipated-regret, anxiety, and hope are likely to play an important role in conjunction with, if not an alternative to, fear. Although a few health communication researcher recently have started paying attention to anticipated regret (Ahn & Kahlor, 2020; Kim et al., 2020; Martinez, 2014), the relevance and importance of anticipated regret in health behavioral decision making under scientific uncertainty is not acknowledged nor emphasized enough in the health communication literature. Considering the inevitability of scientific uncertainty, this dissertation calls for further

examination of the role of anticipated regret by health communication scholars and consideration by practitioners.

Effects of the Three Communication-based Strategies on Screening Intention

The results of the structural equation modeling analysis of the parallel and serial models suggested that the two models provide equally efficient frameworks for tracing how the three communication-based strategies (i.e., using an alternative disease label, highlighting negative affective consequences, and providing information about diagnostic uncertainty) influence screening intention. Thus, the communication strategies were entered as observed, exogeneous variables in each model; and the parallel and serial models with the communication strategy variables were named as the parallel multiple mediation model and the serial mediation model respectively. Both models were estimated and evaluated for model fit and significance of estimated parameters. Overall model fit indices and comparative fit indices (AIC) of the two models generally lend a stronger support for the serial multiple mediation model. In the following, the effects of the three communication strategies were discussed based on the parallel multiple and serial mediation models. Comparisons will also be made to contrast the differences in findings between the two models.

An alternative disease label. The use of the alternative disease label, *a borderline thyroid neoplasm*, reduced perceived severity when compared to when the label was *thyroid cancer*. Note again that participants in the cancer label conditions received additional information explaining that not all cancers progress in the same fashion to metastasis and cause death and that most (about 90%) of thyroid cancers detected through screening progress very slowly. This result suggests that the use of the alternative disease label could more effectively change how individuals view the disease compared to providing factual information about the

nature of the disease, especially if the disease has negative, social, and cultural meanings attached such as cancer. However, the use of the alternative disease label did not reduce perceived susceptibility. A simple and straightforward explanation for this finding is that because the same disease prevalence information (i.e., about 10 in every 1,000 adult women are known to have the disease) was provided equally for both the cancer label conditions and the alternative label conditions, there was no significant difference between conditions in terms of perceived severity. In the parallel multiple mediation model, the reduction in perceived severity due to the use of the alternative label did not lead to a decrease in screening intention. By contrast, in the serial multiple mediation model, the reduction in perceived susceptibility led to a decrease in anticipated regret, which in turn reduced screening intention.

Of the three strategies, the use of the alternative label was the only one that significantly increased intention *not* to undergo screening; and the effect was not mediated by cognitive, affective variables in the serial model. The finding that the use of the alternative label directly influenced intention not to undergo screening suggests that a disease label could function as a simple rule of thumb, or a heuristic, that individuals rely on when accepting or refusing screening tests (e.g., 'when it comes to cancer, it is better to be safe than sorry,' and 'if it is not a disease like cancer, I do not need to take screening tests at the risk of potential side effects'). Although reliance on a simple decision rule may lead to a premature choice that overlooks non-obvious consequences (Kahneman et al., 1982), as observed in this dissertation, it could also be adaptive in that it allows individuals to make a medical decision in a relative simple way under uncertainty with less information and limited resources such as time and knowledge (Gigerenzer & Brighton, 2009). To summarize the findings, the alternative disease label has potential to demote the utilization of low-value screening tests via at least two routes: 1) by decreasing

perceived severity, which in turn decreases anticipated regret over not taking the tests and intention to take the test; 2) by directly increasing intention to not take the tests.

This dissertation adds to the existing literature on the role of a disease label in shaping individuals' perception of the disease and medical decisions they make for the disease (Dixon et al., 2019; Kale & Korenstein, 2018; Nickel, Barratt, et al., 2017; Nickel, Brito, et al., 2017; Omer et al., 2013; Phillips et al., 2016; Shaffer & Scherer, 2018) by comparing the effectiveness of the two different strategies (i.e., explaining the heterogeneity of cancer progression and the indolent nature of small thyroid cancers vs. using the alternative disease label) in bringing risk perceptions in correspondence with actual risk and reducing screening decision.

Although the use of the alternative disease label was found to be more effective in reducing perceived severity of a disease and intention to take low-value screening tests, this result should be understood with the one-shot treatment aspect of the survey-based experiment study in mind. Separate issues also should be considered are that changing a disease label without explaining the rationales for the change could be understood as a form of medical paternalism and undermine the ideal of shared decision making (Hofmann & Stanak, 2018) and that changing the name of a person's disease retrospectively has uncertain effects on treatment regret and survivorship (Dixon et al., 2019). Since public perception of cancer is a product of the larger social and cultural forces (Dein, 2004), a single exposure to the information explaining the heterogeneity of cancer progression might not have been enough to change the long-held beliefs about cancer. Thus, to make a fairer comparison of the two strategies, future study may consider examining if repeated exposures to the information could result in similar findings. Such research endeavors will help policy and guideline makers weigh the benefits and risks associated with the two different approaches as well as determine if removing the word cancer from the

disease label is indeed an appropriate alternative to communication efforts aimed at advancing public knowledge regarding a low-risk cancer.

A message about affective consequences. The message about negative affective consequences not only reminded readers of thyroid ultrasound screening's potential health-related harms (i.e., overdiagnosis and overtreatment), but also asked participants to think ahead about the regret they might experience after undergoing thyroid ultrasound screening in the event of experiencing the harms. Furthermore, in the conditions where both a message about affective consequences and information about diagnostic uncertainty were presented, a message also highlighted that undergoing thyroid ultrasound screening may not completely relieve cancer-related worry and anxiety or could even further increase worry and anxiety, due to the limited accuracy of screening tests.

As intended, a message about the negative affective consequences of screening reduced positive attitudes toward undergoing screening. The reduction in positive attitude in turn led to a decreased screening intention in the parallel multiple mediation model. Results of structural model test for the serial multiple mediation model demonstrated that some, not all, of the effect that the affective message had on screening intention was transmitted through two mediators, attitude and anticipated regret, operating in sequence. Taken together, it is concluded that attitude explained the effect of affective message on screening intention through two indirect paths, from the message to attitude and from the message to attitude to anticipated regret; and that the former indirect path was significantly stronger than the latter.

There were also interesting findings concerning the interaction between the alternative disease label and the affective message. The affective message effect was significant only within the alternative label conditions and not within the cancer label condition. That is, when the

cancer label was used, there was no significant difference in (cognitive/instrumental) attitude between participants who saw and who did not see the affective message. It is worthy of reminding here that only within the alternative disease label condition, the message about affective consequences significantly increased intention not to undergo screening, and that the desirable effect of the affective message disappeared when information about diagnostic uncertainty was additionally provided. What can be inferred from this set of findings is that highlighting negative affective consequences may be the most effective when it is combined with the use of the alternative disease label.

I proposed a message highlighting negative affective consequences of screening as one way to reduce positive attitudes toward screening and the message actually had the intended effect. However, there are remaining questions of how and why the effect took place. Since the message about negative affective consequences included various message components, it remains still unclear if the specific message component that contributed to the reduction in positive attitude was either the reminder of the potential harms of screening (e.g., overdiagnosis, overtreatment, anxiety, and worry), or the question about future regret that might have caused participants to extend their time perspective and deliberate on the potential harms, or both. Future research may parse out the effects of different components of the affective message on attitudes through an experimental manipulation of the message components. It would provide a more in-depth understanding of potential causal mechanisms underlying the effect of the affective message observed in this dissertation.

One way to extend this dissertation is to explore audience characteristics that could moderate the effect of such an affect-laden messages or a message that highlights affective consequences. For example, need for affect—individual differences in the motivation to engage

with emotion-inducing situations (Maio & Esses, 2001)—may determine the degree to which individuals perceive the message as personally relevant and realistic, and thus, are influenced by the message. In addition, preference for intuition, which refers to individual differences in the tendency to rely on an intuitive (i.e., affect-based and automatic) decision mechanism (Rhodes & Courneya, 2003), may determine whether a greater weight is placed on health-related consequences or affective consequences when deciding to undergo screening.

Information about diagnostic uncertainty. Results of preliminary analysis indicated that as intended, anticipated regret with respect to not undergoing screening was significantly lower when information about diagnostic uncertainty was presented, compared to when the information was not presented. Consistent with this preliminary result, in the parallel mediation model, information about diagnostic uncertainty significantly reduced anticipated regret. The reduction in anticipated regret subsequently reduced screening intention. However, the effect of information about diagnostic uncertainty on anticipated regret became nonsignificant in the serial multiple mediation model.

One plausible explanation could be offered for this unexpected result. In the serial mediation model, risk perceptions, attitude, and subjective norms were hypothesized as other predictors of anticipated regret along with information about diagnostic uncertainty. Thus, one may interpret the unexpected result as a sign of multicollinearity. To explore the possibility of multicollinearity, independent t-tests were conducted, comparing the conditions where information about diagnostic uncertainty was presented against the conditions where it was not presented in terms of perceived severity and susceptibility, affective and cognitive/instrumental attitudes, injunctive and descriptive norms. The results of the tests showed that perceived severity, affective, and cognitive/instrumental attitudes were significantly lower in the conditions

where information about diagnostic uncertainty was presented than in the conditions where it was not, all *p*s < .01. However, this result should not be interpreted to imply that information about diagnostic uncertainty lowers perceived severity, affective, and cognitive/instrumental attitude. The result could be attributed to the fact that the control condition was coded as the condition that did not receive diagnostic uncertainty information. In fact, when the same independent t-tests were conducted again using only data of experimental conditions, the tests were not significant (all *p*s > .12), indicating no differences between conditions. When the serial multiple mediation model was re-estimated using only the experimental group data, the path from information about diagnostic uncertainty to anticipated regret was still non-significant (β = -.06, p = .11) (Figure 23) and the results did not show any different patterns of associations from the model estimated with the entire sample (see Figure 19). Although the possibility of multicollinearity was not completely ruled out, even if multicollinearity existed, it did not appear to have caused serious bias in the estimation.

The small effect size of information about diagnostic uncertainty on anticipated regret (Hedges' g = .25) could be another possible explanation as to why its effect on anticipated regret did not reach significance in the serial multiple mediation model, despite there was no clear indication of multicollinearity among predictors of anticipated regret. Since the effect size of information about diagnostic uncertainty was small to begin with, the difference between the parallel and serial multiple mediation models in the effect of information about diagnostic uncertainty could also attributable simply to chance. Future research with larger sample sizes may help reduce the risk of getting a non-significant effect of diagnostic uncertainty information in the serial multiple mediation model by chance.

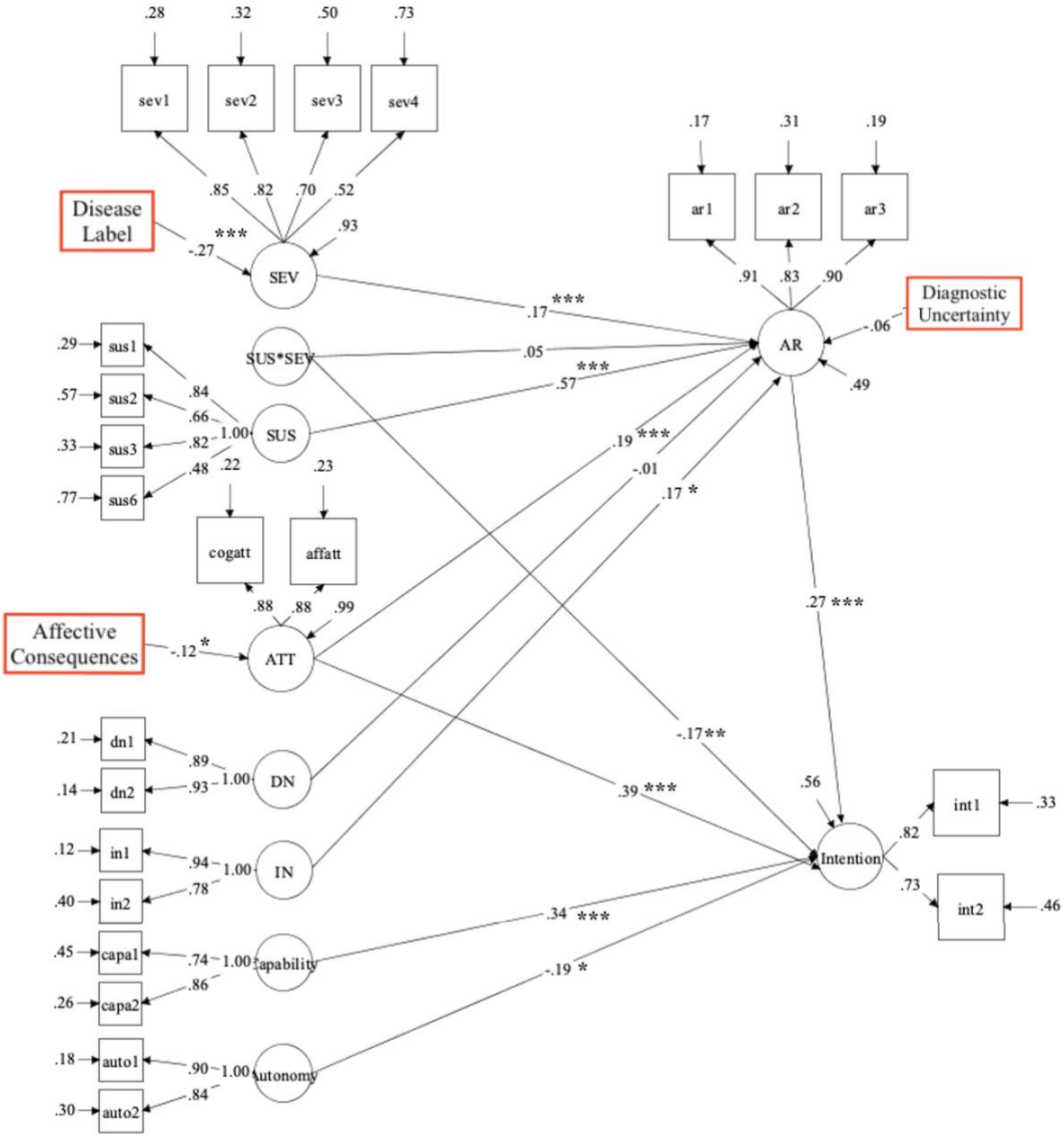

Figure 23 *Serial multiple mediation model tested using only the experimental condition data*

Note. χ^2 (277) = 721.38, $p < .001$; CFI = .92; RMSEA = .06 (.05, .06); SRMR = .12; AIC = 33052.58. Standardized path coefficients are presented. Covariances between exogenous variables are not presented. * $p < .05$, ** $p < .01$, *** $p < .001$. All factor loadings were significant at $p < .001$. $N = 492$.

Practical Implications

This dissertation provides several practical implications and recommendations for interventions aiming to facilitate lay individuals' informed decision making about thyroid ultrasound screening. These practical implications are first discussed in terms the theoretical model and them I focus on the communication strategies explored.

Theoretical Model. First off, the results of testing of the parallel and serial models provide information regarding constructs are likely to be important targets for intervention efforts to facilitate informed decision making about thyroid ultrasound screening. Across the models tested, attitude, anticipated regret, capability, and autonomy consistently emerged as significant predictors of screening intention. Among these constructs, attitudes would be the most viable target for intervention given its direct and indirect effects on screening intention. While the importance of targeting positive attitude, high anticipated regret and capability was expected prior to the data collection, that of targeting low autonomy was not. Given a heightened sense of autonomy decreased motivation to take low-value screening tests, when implementing decision aids for women contemplating thyroid ultrasound screening, designers should consider developing communication strategies to support autonomy for screening behaviors as well. One example of such strategies is using autonomy-supportive messages (e.g., supporting the person's volition, non-controlling languages, and offering choice) (Smit et al., 2019).

Another consistent finding across the models tested was that descriptive norms were not a significant predictor of screening intention. Interestingly, however, this dissertation also demonstrated that unlike descriptive norms, injunctive norms indirectly increased screening intention only by increasing anticipated regret over screening non-uptake. As thyroid cancer screening intention and possibly screening behavior of South Korean women are unlikely under

a descriptive normative influence, it might be a waste of resource to target messages based on descriptive norms to change screening intention. Still, targeting injunctive norms could be an effective means of altering cancer screening intention. A potentially effective strategy could be as simple as explaining professional screening recommendations in simple language.

The results concerning the influences of perceived severity and susceptibility on screening intention suggest that an intervention aiming to modify the two risk perceptions components needs to take a careful approach given their significant interaction effects on screening intention. In both the parallel and serial models, the direct and independent effects of perceived severity and susceptibility on screening intention were not significant. In the serial model, however, perceived susceptibility significantly increased screening intention by increasing anticipated regret. These results need to be interpreted with some caution in the context of other relevant evidence. Specifically, recall that further investigation of the significant interaction between perceived severity and susceptibility revealed that when severity was perceived to be low, higher perceived susceptibility was associated with higher screening intention. When severity was perceived to be high, higher perceived susceptibility was associated with lower screening intention. From these findings, two practical implications can be drawn. First, attempting to reduce disease severity perception would be beneficial if the goal of an intervention is to discourage highly susceptible individuals from engaging in defensive responses that may further increase their risk or behaviors aimed at maintaining/increasing uncertainty and hope (e.g., actively avoiding seeking medical care). Second, if the goal of an intervention is to deter individuals with low risks of developing cancer from seeking and using of low-value screening, attempting to reduce severity perception may also be valuable. In such a case, targeting susceptibility perceptions would become an equally important and necessary means for

the intervention to achieve the goal. For example, an intervention may also focus on explaining that rising incidences of a disease may not necessarily reflect rising true disease occurrences, but instead may reflect overdiagnosis as a result of increasing screening.

Communication Strategies. The findings of this dissertation provide further empirical support for the argument that to effectively demote the utilization of low-value screening tests like thyroid ultrasound, an intervention needs to move beyond simple provision of balanced factual information about its health-related risks and benefits (e.g., Scherer et al., 2019; Shaffer & Scherer, 2018). Providing generic information about potential health-related risks (i.e., overdiagnosis and overtreatment) along with an explicit recommendation against thyroid ultrasound screening significantly increased knowledge that was necessary to make an informed decision as well as significantly decreased attitudes toward screening uptake and relieve decisional conflict regarding decision making for screening uptake. However, the generic information did not affect participants' screening intention or whether the decision they made was an informed one or not. It can be inferred from these results that the desirable changes in decision-relevant knowledge, attitudes, and decisional conflict caused by the generic factual balanced information may not necessarily translate into improved decision making about screening. In other words, the generic information is necessary, but not sufficient, to promote individuals to make a cancer screening decision that is consistent with evidence-based guideline.

The findings regarding the effects of the three communication-based strategies on screening intention also have some practical implications. The first strategy, using the alternative disease label, *a borderline thyroid neoplasm,* reduced screening intention; and the effects was mediated by two mediating variables, namely perceived severity and anticipated regret. Moreover, the use of the alternative label was the only strategy that significantly and directly

(not via any cognitive, affective variables in the developed theoretical framework) increased intention *not* to undergo screening as well.

There exists a considerable variability in medical professionals' willingness to accept the proposal to change the terminology of low-risk cancer (Esserman & Varma, 2019; Huntington, 2018; Kohn & Malik, 2019; Nickel, Brito, et al., 2017; Omer et al., 2013). Some did not accept or felt unsure of the change due to concerns about the risk of progression of low-risk cancers (Nickel, Brito, et al., 2017); and some believed that educating patients about low-risk conditions, rather than renaming low-risk cancers, would be a more adequate strategy to reduce patients' anxiety and preference for unnecessary cancer screening and aggressive cancer treatments (Kohn & Malik, 2019; Nickel, Brito, et al., 2017). However, as demonstrated in this dissertation, such a patient education can increase decision-relevant knowledge and reduce decisional conflict, but it alone may not be sufficient to influence screening decisions. Thus, I argue the effects of the alternative disease label observed in this dissertation should be evaluated in the light of the limited effectiveness of patient education.

There is also documented evidence of resistance of medical professional to renaming low-risk cancers. The following statement of Kohn and Malik (2019) appears to capture the gist of medical professionals' resistance: "A cancer is a cancer, whether it is called a nodule, mass, tumor, neoplasm, or cancer. If there are malignant cells in the specimen, it is a cancer. The physician must know what the specimen contains, what the diagnosis portends, what the therapeutic options are, and the associated benefits and risks." (p. 784). Yes, a cancer is a cancer. However, the label of cancer is not value-free nor neutral. Lay individuals create their 'common-sense' understanding of, or 'lay beliefs' about, illness, or a health problem, based on various sources of information, including not only authoritative sources (e.g., a doctor) but also previous

social interaction and cultural knowledge of the illness (Diefenbach & Leventhal, 1996; Meyer et al., 1985); and their common-sense understanding of illness largely determines the away they manage the illness (Hagger & Orbell, 2003). Renaming low-risk cancers could be one way to help individuals not to solely rely on the strong lay beliefs associated with the label of cancer. It certainly may not be the only way. A discussion among clinicians and scientists regarding the change in low-risk cancer labels should start with recognizing the fact that the label of cancer is not value-free to achieve satisfactory solutions.

The second strategy, presenting a message about negative affective consequences reduced screening led to reduced screening intention through two indirect routes. The first was from the strategy to screening intention via attitudes; the second was passing through attitudes and anticipated regret. The effect of the third strategy, presenting information about diagnostic uncertainty was unclear. In the parallel multiple mediation model, as intended, it reduced screening intention by reducing anticipated regret. However, the same effect was not observed in the serial multiple mediation model. Overall, all the three strategies were effective in modifying the constructs they targeted; and the effects of the three strategies on screening intention were mediated by constructs in the proposed models. These results together point to the importance of targeting specific cognitive determinants of screening intention.

There is one remaining issue that deserves attention. That is, the effect of the diagnostic uncertainty information on anticipated regret was relatively smaller (Hedges' g = .25, a small size effect), compared to that of the alternative disease label on perceived severity (Hedges' g = .57, a medium size effect) and that of the affective message on affective attitude (Hedges' g = .32, about a medium size effect) and cognitive attitudes (Hedges' g = .37). Given the relatively smaller effect size of the information about diagnostic uncertainty, an alternative strategy may be

needed to effectively modify anticipated regret over screening non-uptake. Several studies have examined strategies implemented to activate or increase the salience of anticipated regret. For example, Abraham and Sheeran (2003, 2004) demonstrated simply asking people about their anticipation of regret with respect to unhealthy behavioral choices can increase their intention to perform the healthier behavior alternatives and actual behaviors (e.g., exercising, blood donation, and attending cancer screening). A similar finding was reported for attendance in a cervical cancer screening program by Sandberg and Conner (2009). As Sandberg (2005) notes, a potentially powerful way to manipulate the salience of anticipated regret is to merely measure it or not. However, unfortunately, to the best of my knowledge, no prior studies have examined ways to reduce the salience of anticipated regret.

What makes a decision more justifiable and therefore less regrettable? An answer to the question may be the starting point for what could become an alternative strategy to reduce the salience of anticipated regret. Reb and Connolly (2010) argued that the carefulness of a decision process is likely to provide a strong decision justification. Evidence supporting their argument comes from a series of studies by Pieters and Zeelenberg (2005) in which experienced regret was negatively related to the self-reported amount of thinking about the decision, an indicator of how careful a decision was made. Future decision support interventions might focus on designing and testing messages that can help create a perception that decisions are made through thoughtful and highly elaborated processes and with an understanding of the best available scientific evidence.

It should be emphasized, however, that there exists a trade-off between costs and benefits associated with providing information about diagnostic uncertainty. When combined with the use of the alternative disease label, information about diagnostic uncertainty significantly helped individuals to make an informed decision regarding cancer screening. However, information

about diagnostic uncertainty also increased medical skepticism. This result coincides with the literature on the negative impact of communicating scientific uncertainties on trust in authorities (Gordon et al., 2000; Jensen et al., 2011; Jensen et al., 2017; Longman et al., 2012; Santhosh et al., 2019). While critically evaluating the quality of available healthcare options and health information could be essential parts of an informed decision-making (Han, 2013; Woloshin et al., 2009), too much skepticism could make individuals distrusting of health professionals and healthcare system to the point that they neglect other health promoting and disease preventing behaviors all together (Fiscella et al., 1998; Jensen et al., 2017). Although it remains unclear whether the increase in medical skepticism represents too much skepticism or healthy skepticism, communicators and patient educators should be aware that information about diagnostic uncertainty could be a two-edged sword that reduces screening intention and helps people make an informed decision (i.e., a decision that is based on decision-relevant knowledge and consistent with attitudes) when coupled with the use of the alternative disease label, and yet, also triggers skepticism toward medical care and healthcare utilization. In that regard, future research may explore countermeasures that could prevent the negative spillover effects of communicating diagnostic uncertainty.

Limitations

This dissertation has several limitations. First, I had proposed collecting data using intercepts in a large hospital; Covid-19 intervened and thus I ended with a survey-based experiment using self-selected online panels. One limitation is related to sampling bias: Women who chose to participate in the survey may have done so because they were more interested in and have strong opinions about issues related to screening. In addition, the education level of the participants was higher than that of the general population. As higher education attainment is

associated with higher health literacy that is considered necessary to comprehend health information to make appropriate healthcare decisions (Van Der Heide et al., 2013), it remains unclear if the same effects of the three communication-based strategies observed would also be observed in a sample that includes more women with lower educational levels. Furthermore, the income level of the participants was higher than that of the general population. In a way, a higher income group may be a more important target population, as higher income is associated with higher rates of thyroid ultrasound screening in South Korea (Kang et al., 2020). Nonetheless, due to the oversampling of women from higher income households, the findings may not be generalizable to lower income female populations in South Korea. Future research may replicate this research with a more nationally representative sample of women in South Korea to confirm the current findings.

The second limitation grows out of the first. This dissertation relied on female participants from South Korea and focused on one particular health issue, the overuse of low-value thyroid cancer screening, all of which may limit the generalizability of the current findings. That is, the associations observed (and expected but not observed) may have been influenced by the unique characteristics of the setting, the participants, and the health issue of interest. In fact, there were some of the current findings that were unique to this dissertation. For example, the lack of direct associations between injunctive/descriptive norms and screening intentions was not consistent with previous studies (Ham, 2006; H. W. Kim, 2014; Sieverding et al., 2010; Smith-McLallen & Fishbein, 2008; von Wagner et al., 2019; Zhao Martin et al., 2019). This indicates the possibility that the current findings may not generalize to other settings. However, as mentioned earlier in the discussion chapter, other findings of this dissertation do coincide with previous meta-analyses of the TPB studies that reported attitude and capability as strongest

predictors of behavioral intentions (Cooke & French, 2008; McEachan et al., 2016) and that reported anticipated regret as an equally strong predictor (Sandberg & Conner, 2008). The consistency with the earlier studies may alleviate the concerns about the limited generalizability to some degree, but not entirely. In that regard, future study could explore whether the findings are generalizable across other populations or healthcare settings as well as other low-value cares such as antibiotics for sinusitis, imaging for low back pain, magnetic resonance imagery (MRI) for uncomplicated headache, and prostate-specific antigen (PSA) testing (Blumenthal-Barby, 2013).

The third limitation is that I selected only risk perceptions, attitudes, and anticipated regret to be modified through an experimental procedure. Since not all major predictors of screening intention were not attempted to be modified, one may raise a concern regarding the use of the experimental data in comparing the relative importance of the predictors of screening intention. However, the results of post-hoc sensitivity analysis of the parallel model conducted using the control group data were not different from those of the original analysis conducted using the entire sample data. Although some patterns of associations observed in the results of sensitivity analysis of the serial model were different from those observed in the original analysis, most of them were related to predictions of anticipated regret not screening intentions. That is, in the control group, perceived severity, attitudes, and injunctive norms did not predict anticipated regret; only perceived susceptibility and descriptive norms did. (In the entire sample, perceived severity, perceived susceptibility, attitudes, and injunctive norms significantly predicted anticipated regret.) The different patterns observed are not entirely surprising given that perceived severity and attitudes were attempted to be modified. Furthermore, as discussed earlier (pp. 132–133), since the control group participants were not given the generic information

about thyroid ultrasound screening (i.e., its uncertain benefits, potential harms, and professional recommendation against screening), they might have had to rely more heavily on their observation of others' screening behavior to determine the justifiability of their uptake or non-uptake of thyroid ultrasound screening. Despite this study has limitation that did not manipulate messages that affect all the major predictors of screening intentions, one strength of this dissertation compared to many other studies based on the TPB is that it attempted and succeeded to modify predictors of screening intentions and succeeded rather than simply measuring the predictors using a cross-sectional survey research design.

Another limitation stems from the measurement of the TPB components. There is no standard TPB measure. The originators of the TPB (Fishbein & Ajzen, 2010) recommend conducting a belief elicitation study to get insights on salient behavioral, normative, and control beliefs about a target behavior among the population of the primary interest and using findings from the elicitation study to develop indirect measures, of attitudes, subjective norms, and PBC. Indirect measures are essentially products of individuals' behavioral, normative, and control beliefs with their assessment of the strength of those beliefs (Ajzen, 2020) (see Appendix in Fishbein & Ajzen, 2010 for a detailed description). For this dissertation, however, no belief elicitation study was undertaken. Instead, direct measures (i.e., items that attempt to tap straight into attitudes, subjective norms, and PBC regarding undergoing thyroid ultrasound screening) were created based on a review of the literature including qualitative work done with South Korean women (Hersch et al., 2013; Lee et al., 2016; Moynihan et al., 2015; Park et al., 2015; Waller et al., 2013; Waller et al., 2014) and the TPB measures employed in prior studies on cancer screening (Roncancio et al., 2015; Sieverding et al., 2010; Tolma et al., 2006). As a result,

each of the constructs of the TPB were evaluated by abbreviated (e.g., 2- to 4-item) direct measures.

The use of the short direct measures was justified based on the following arguments. First, Ajzen (2020) notes that direct measures best reflect the immediate antecedents of behavioral intentions, and therefore, should be used to predict intention. Second, there was a need to keep the survey length and the time it would take participants to complete short. Third, the use of 2-item measures of the TPB constructs is not uncommon (see e.g., Bish et al., 2000; Roncancio et al., 2015). Third, two measured items per factor meets the minimum requirement for a model to be identified (Kline, 2011). However, it should be noted that when a sample size is less than 400 what has been recommended is to have at least three measured items per factor to prevent problems in analysis such as inadmissible solutions (i.e., negative estimates of residual variance—so-called Heywood cases) and convergence failures (i.e., non-convergence of iterative estimation) (Kline, 2011; Marsh et al., 1998). Although such problems in analysis may be less pertinent to this dissertation with the sample size of 612, future study should consider employing multi-items measurements with three or more measured items per factor in order to measure the latent constructs. Specifically, in strict adherence to guidelines by Ajzen and Fishbein (2010), future research may formally conduct an elicitation study (e.g., focus group interview) to understand the motivation to undergo cancer screening and develop measures of the TPB components suitable for a population of interest. Doing so would also help not only develop direct measures, but also understand the cognitive foundations of screening intention and behavior, thereby providing insights on messages that are appealing to a target population.

There is also a limitation related to the lack of discriminant validity between the two attitude components. Affective and cognitive/instrumental attitudes were too highly correlated to

be considered separate constructs (the latent zero-order correlation r = .87). As a result, this dissertation was not able to examine the separate effects of affective and cognitive/instrumental attitudes. This strong relationship between attitude components is inconsistent with previous studies that empirically supported the distinction between measures of affective and cognitive/instrumental attitudes and illustrated the relative importance of affective attitude in predicting intentions and behaviors across a number of health behaviors (Conner et al., 2007; Conner et al., 2015a; Lawton et al., 2009; Lawton et al., 2007). Both methodological and theoretical issues may have contributed to this unexpected result. A methodological issue lies in the measurements of the two attitude components. Fishbein and Ajzen (2010) pointed out that despite the fact that affective attitude could have both valence (i.e., the pleasantness or unpleasantness) and arousal (i.e., the degree of activation or deactivation) dimensions, the bipolar or semantic differential scales typically used to measure affective attitude fail to capture the arousal dimension of affective attitude. The attitude scales used in this dissertation cannot avoid such criticism. In this dissertation, affective aspects of attitude toward were assumed to involve such dimensions as *not reassuring–reassuring*, *not relieving–relieving*, *anxiety provoking–not anxiety provoking*, and *unpleasant–pleasant*, whereas cognitive/instrumental aspects were assumed to be reflected in such dimensions as *harmful–beneficial*, *worthless–worthwhile*, and *foolish–wise.* Since the scales for affective and cognitive/instrumental attitudes could be seen as all evaluative in nature, they might have not formed separate factors.

Fishbein and Ajzen (2010) also provide another possible explanation to the unexpected result from a theoretical point of view. They argued that even though evaluative semantic differential scales for attitude toward a health behavior could result in a two-factor solution (i.e., affective/experiential and cognitive/instrumental, the difference between the two identified

components of attitudes is likely to have more to do with positive versus negative valence than with affective versus cognitive/instrumental features. Their reasoning is that many health behaviors (e.g., getting a colonoscopy, exercising, and maintaining a healthy diet) are judged wise or beneficial in terms of their instrumentality, but experienced as unpleasant. By contrast, many health risk behaviors (e.g., exceeding the posted speed limit, smoking, and engaging in unsafe sex) are deemed foolish or harmful in an instrumental sense yet are experienced as pleasant. Differently put, individuals often find one attitude aspect is positive whereas the other is negative; and this tendency alone could explain the emergence of the two-factor structure of attitude toward health behaviors. From Fishbein and Ajzen's (2010) point of view, the unexpected result might have been caused by the stimulus materials that undergoing thyroid ultrasound is not very positive in terms of both its instrumentality and the experience of engaging in the behavior. Since affective-based and cognitive/instrumentality-based information is likely judged in the same direction in terms of valence, they ended up being not clearly distinguishable from one another. To determine the appropriate interpretation of the two-factor structure of attitude toward a behavior, further empirical research is needed that measures not only the valence dimension, but also the arousal dimension of affective attitude and re-examines the validity and reliability of attitude scales.

The last limitation is that participants responded to a hypothetical scenario and their actual screening behavior was not measured. Although a hypothetical scenario method is commonly employed in the study of patients' decision making (e.g., Dixon et al., 2019; Fagerlin et al., 2007; Sheridan et al., 2010; Tesson et al., 2016), screening intention that participants express may not translate into their real-life screening decision. Nonetheless, substantial research demonstrates that self-reported behavioral intentions for prevention behaviors are strong

predictor of actual behavior (Conner et al., 2016; McEachan et al., 2016). Furthermore, individuals' preference is increasingly important in the context where a medical decision is highly preference sensitive and a shared decision is explicitly recommended. Thus, it is important to study how lay individuals' screening intentions are formed and also changed in response to medical information (Lillie et al., 2015; Wolf et al., 2010).

Conclusion

Overuse of low-value cancer screening may result in overdiagnosis and overtreatment of low-risk cancer that can have significant adverse effects on patients' quality of life and place an undue economic strain on the healthcare system. This dissertation focused on a demand-side intervention, particularly direct patient education at the point of care using an information booklet, aimed at reducing the overuse of low-value thyroid cancer screening.

In this dissertation, I have accomplished three objectives. I developed and tested two theoretical frameworks (i.e., the parallel and serial models) that explicate the processes that are hypothesized to determine cancer screening intention. Although both the parallel and serial models provided similarly good fits to the data, based on both theoretical and practical considerations, I suggested the serial model as a better model. In the serial model, anticipated regret significantly increased screening intention. In addition, attitudes and injunctive norms significantly increased screening intention both directly and also indirectly via anticipated regret. Perceived susceptibility significantly increased screening intention only indirectly via anticipated regret. The two PBC components, capability and autonomy predicted screening in the opposite direction, such that capacity increased, but autonomy decreased screening intention.

Applying the developed theoretical frameworks, I proposed three communication-based strategies that can be employed in decision support materials aimed at curbing the use of low-

value cancer screening: (1) removing the word cancer from the disease label to reduce risk perceptions, (2) highlighting negative affective consequences of thyroid ultrasound screening to reduce attitudes, and (3) providing information about diagnostic uncertainty to reduce anticipated regret. The effectiveness of the strategies was tested among women living in South Korea, the country where the problem of the overuse of low-value thyroid ultrasound screening and resultant thyroid cancer overdiagnosis is most pronounced. The alternative disease label reduced perceived severity not susceptibility; and the reduction led to a decrease in anticipated regret, which in turn reduced screening intention. The alternative disease label also increased intention *not* to undergo screening as well, but the effect was not explained by the developed theoretical framework. The affective message reduced screening intention through two pathways: (1) lower positive attitudes and (2) lower positive attitude to less anticipated regret. Although the diagnostic uncertainty information reduced anticipated regret, its effect disappeared when included in a structural model with other predictors of anticipated regret.

Although the problem of the overuse of low-value cancer screening and resultant cancer overdiagnosis have been considered confined mostly to high-resource countries (Vaccarella et al., 2015; Vaccarella et al., 2016), it is increasing rapidly worldwide including less affluent countries (Li et al., 2020). It is my hope that the theoretical frameworks developed and tested in this dissertation could serve as a basis for patient educational intervention to demote the overuse of low-value screening. I also hope that the findings of this dissertation regarding the effects of the three communication-based strategies provide preliminary evidence that contributes to ongoing discussion about feasibility of renaming low-risk cancers and inform the design of patient education materials. Overdiagnosis can create a self-affirming, positive cycle. Thus,

future study may consider extending this study to less affluent countries before the problem of overdiagnosis accelerates.

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APPENDIX A

STRUCTURE OF STIMULUS MATERIALS

1. Experimental Conditions

	Thyroid cancer		A borderline thyroid neoplasm	
	A message about negative affective consequences: NOT presented	A message about negative affective consequences: Presented	A message about negative affective consequences: NOT presented	A message about negative affective consequences: Presented
Information about diagnostic uncertainty: NOT presented	Condition 1 (n = 60)	Condition 2 (n = 61)	Condition 5 (n = 63)	Condition 6 (n = 60)
Information about diagnostic uncertainty: Presented	Condition 3 (n = 62)	Condition 4 (n = 63)	Condition 7 (n = 61)	Condition 8 (n = 62)

2. The Structure of Stimulus Material for Experimental Conditions

(1) What is thyroid?

(2) How common is [thyroid cancer (*Conditions 1–4*)/a borderline thyroid tumor (*Condition 5–8*)]?

(3) Thyroid ultrasound screening

(4) Should I be screened? ***(****a clinical practice guideline for thyroid cancer screening*)

(5) The most common type of thyroid cancer (*This is the parts corresponding to information about the indolent nature of thyroid cancer and was presented to only condition 1, 2, 3, and 4 only*)

(6) Uncertain benefits and possible harms of thyroid ultrasound screening

Information about diagnostic uncertainty: NOT presented		Information about diagnostic uncertainty: Presented	
A message about negative affective consequences: NOT presented	A message about negative affective consequences: Presented	A message about negative affective consequences: NOT presented	A message about negative affective consequences: Presented
Condition 1 & 5	Condition 2 & 6	Condition 3 & 7	Condition 4 & 8
① Possibility of overdiagnosis and overtreatment ② Uncertain cancer mortality reduction	① Possibility of overdiagnosis and overtreatment ② Uncertain cancer mortality reduction ③ Possibility of regret related to screening uptake	① Possibility of overdiagnosis and overtreatment ② Uncertain cancer mortality reduction ③ Diagnostic uncertainty (i.e., false-positive and low positive predictive value etc.)	① Possibility of overdiagnosis and overtreatment ② Uncertain cancer mortality reduction ③ Diagnostic uncertainty (i.e., false-positive and low positive predictive value etc.) ④ Uncertain reassurance (uncertain reduction of health-related fear, anxiety, and worry) ⑤ Possibility of regret related to screening uptake

3. The Structure of Stimulus Material for Control Condition (n = 120)

(1) What is thyroid?

(2) How common is thyroid cancer?

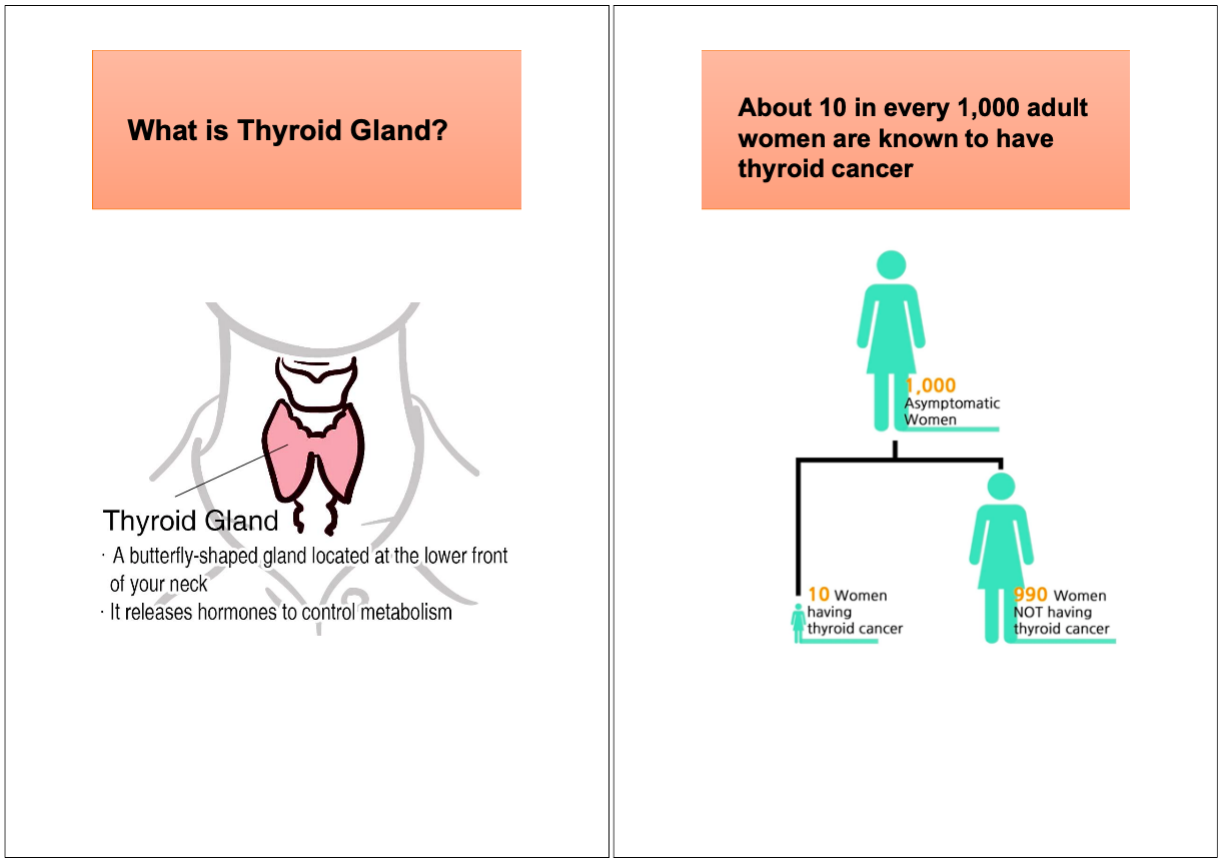
(3) Thyroid ultrasound screening

APPENDIX B

STIMULUS MATERIALS

Note. To facilitate understanding, the stimulus materials are color-coded. A part describing diagnostic uncertainty is shown in green. Parts highlighting the potential negative affective consequences of thyroid ultrasound screening are shown in dark blue and purple.

1. Stimulus Material for Conditions 1–4 ('Thyroid Cancer' Conditions)



Thyroid Ultrasound Screening

◆ A preventive medical service **for asymptomatic people**

◆ **Aims at early detection and treatment** of people with thyroid diseases or high risk of developing them

◆ **Locates and creates images of nodules/lumps, especially those smaller than 1cm** which are difficult to be detected by palpation test

◆ **Painless and quick**

Should I be screened?

◆**Symptoms of thyroid cancer**

✓ A painless lump or swelling in the front of the neck

✓ Unexplained hoarseness and/or a sore throat that does not get better

✓ Difficulty swallowing

① Have never experienced

② Have experienced occasionally

③ Have experienced frequently

① Have never experienced

❖**If have not experienced**

◆ Scientific evidence is insufficient to determine if the benefits of thyroid ultrasound screening outweigh the associated costs and risks to asymptomatic individuals → **The Korean Thyroid Association guideline does not recommend a routine thyroid ultrasound screening**

◆ **If you still want to get a screening test,** you should be informed of its benefits and risks

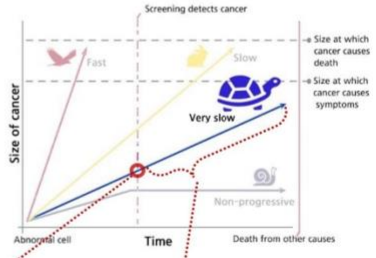
②, ③ Have experienced occasionally, or frequently

❖**If have experienced**

◆ Screening does not apply (It is for people without symptoms)

◆ **Must discuss with your doctor**

Most (about 90%) of thyroid cancers detected through screening in the last 20 years were of this type



At the time of diagnosis

♦ Often localized to the thyroid gland and indolent

After the time of diagnosis

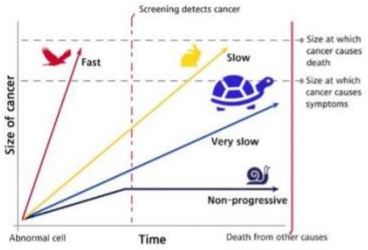
♦ Tends to either **remain stagnant or grow too slowly** to be life-threatening

→Nicknamed "**Turtle cancer**"

♦ A person with this type of cancer **may not die from it, but rather die with it** in her/his body that did not cause any problem **from aging or other causes**

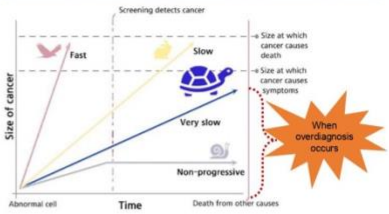
◆ **There are other types that are very rare, but faster-growing and lead to symptoms and death**

◆ However, at the time of diagnosis via screening, no one including doctors cannot be sure which cancer will be low-risk or life-threatening.



Overdiagnosis of Thyroid Cancer

♦**Overdiagnosis**: **Detecting low-risk, clinically insignificant diseases (e.g., *turtle cancer*) through extensive thyroid ultrasound screening** of people without symptoms



• Because **overdiagnosis** can **prompt more tests and treatments of diseases that are likely to never cause health problems for life, which is overtreatment**

Overtreatment of Thyroid Cancer

◆**Despite the risk of thyroid cancer detected through thyroid ultrasound is low, most people have undergone surgical treatment called thyroidectomy**

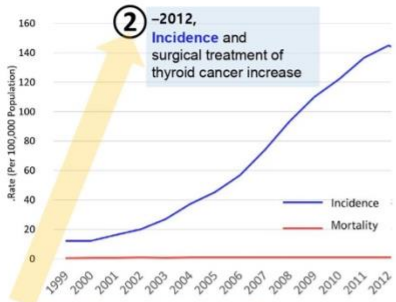
◆**Thyroidectomy**

• Generally very successful. Some people may experience side effects including:

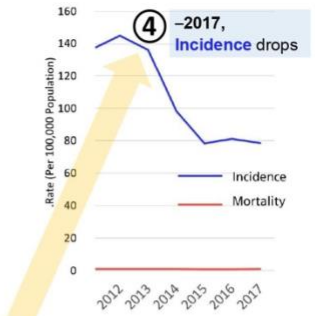
Side-effects of Thyroidectomy

- ***Damage to the parathyroid gland (next to the thyroid gland).*** This could cause temporary low blood calcium and muscle cramps which require people to take calcium supplements permanently
- ***Needing to take thyroid pills.*** If the entire gland is removed, thyroid hormone replacement pills must be taken. If part of the gland is removed, between 1 and 10 people out of every 1,000 will need to take hormone replacement pills.
- ***Damage to the vocal cords and having a hoarse voice afterwards.*** Generally, this is temporary, but in about 7 out of 1,000 people, the hoarseness is permanent.
- ***Getting an infection in the wound and needing antibiotics*** (about 3 out of 1,000 people).
- ***Bleeding during the operation and needing a blood transfusion*** (less than 1 out of 1,000 people).
- ***Dying from the anesthetic*** (less than 1 out of 1,000 people).
- Additional treatment, including radioactive iodine therapy, may be needed, depending on postoperative disease status, disease stage, and type of a thyroid cancer.

Would thyroid ultrasound screening reduce mortality?

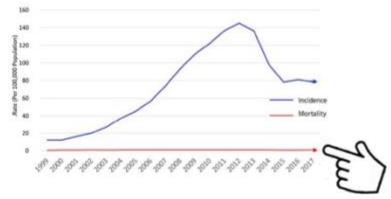


① **1999, The launch of national screening program**
It became easier and less expensive for the public to get ultrasound screening



③ **2014, The Coalition of Eight Physicians**

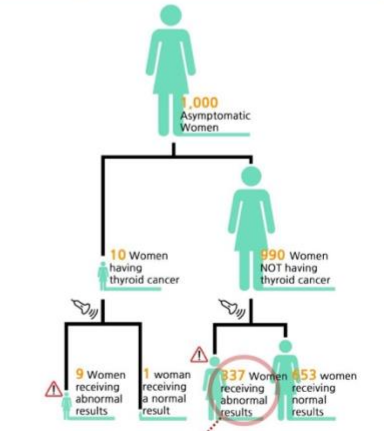
'Thyroid ultrasound screening should be discouraged…'



1999–2017,
Thyroid cancer specific mortality remained stable

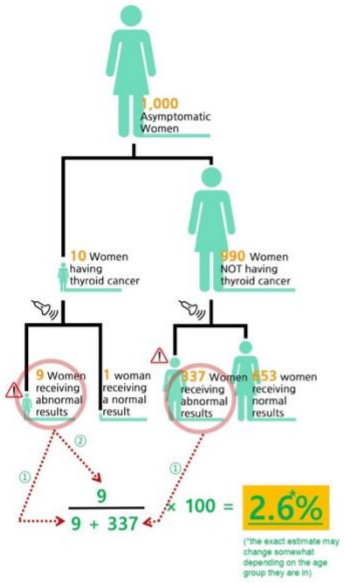
- Regardless of the obvious fluctuation in thyroid cancer incidence and treatment, every year, about 1 every 100,000 women died of thyroid cancer
- The pattern of incidence and mortality rates indicates that **thyroid ultrasound screening might not lower the chance of dying of thyroid cancer**

Would all women with abnormal ultrasound results actually have thyroid cancer?



Due to the limited accuracy of the screening test, **337 of 990 women without thyroid cancer will get abnormal ultrasound results**

Only 2.6% of women receiving abnormal results actually have thyroid cancer



Women with abnormal results may need to undergo extra tests

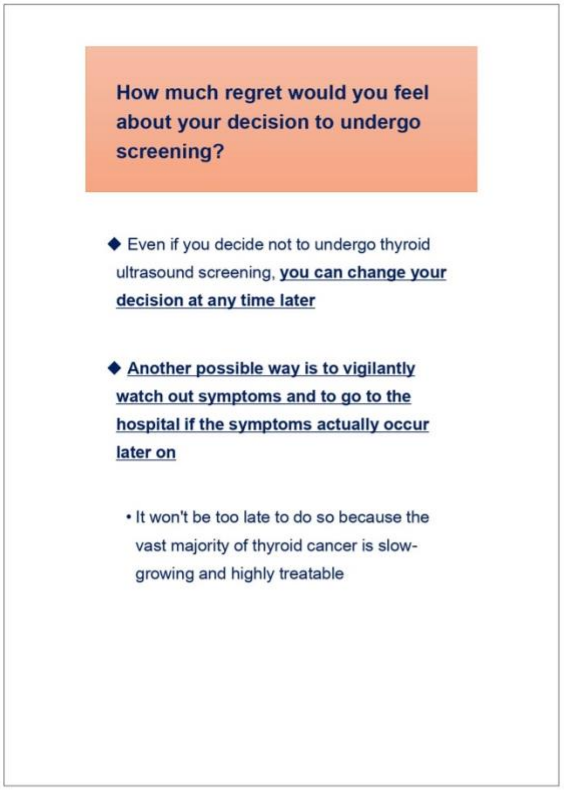
- ◆ Extra tests would confirm the absence of thyroid cancer
- ◆ However,
- The extra tests could cause **inconvenience and possibly complications as well as stress and anxiety** in the process of reaching a conclusion
- Having experience of receiving an inaccurate test result, some may keep worrying about the possibility of having an active disease for a while afterwards

Will results of thyroid ultrasound screening quickly relieve anxiety and worry about the possibility of thyroid cancer?

- ◆ **Thyroid ultrasound is never 100 percent accurate**, like any other medical tests.
- ◆ Thyroid ultrasound screening **may not completely relieve your anxiety and worry about thyroid cancer**, as much as many people think
- ◆ Rather, **it could further increase the anxiety and worry**

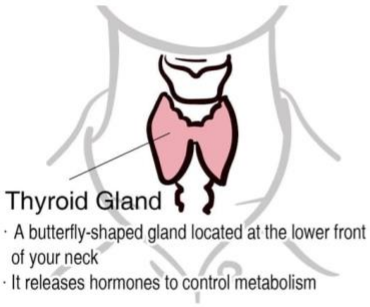
How much regret would you feel about your decision to undergo screening?

- ◆ If you undergo thyroid ultrasound screening, you may face **a regretful situation of experiencing overdiagnosis and overtreatment**
- Overdiagnosis and overtreatment **could cause irreversible effects to the quality of your life (e.g., taking hormone replacement pills permanently)**


How much regret would you feel about your decision to undergo screening?
◆ Even if you decide not to undergo thyroid ultrasound screening, you can change your decision at any time later
◆ Another possible way is to vigilantly watch out symptoms and to go to the hospital if the symptoms actually occur later on
• It won't be too late to do so because the vast majority of thyroid cancer is slow-growing and highly treatable

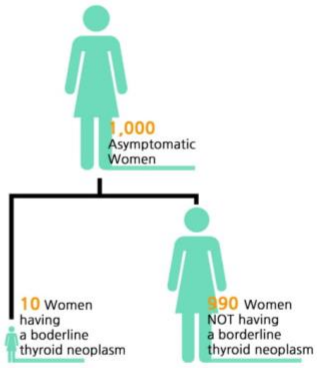
2. Stimulus Material for Conditions 5–8 (‘A Borderline Thyroid Neoplasm’ Conditions)

What is Thyroid Gland?



- A butterfly-shaped gland located at the lower front of your neck
- It releases hormones to control metabolism

About 10 in every 1,000 adult women are known to have borderline thyroid neoplasm



Thyroid Ultrasound Screening

◆ A preventive medical service **for asymptomatic people**

◆ **Aims at early detection and treatment** of people with thyroid diseases or high risk of developing them

◆ **Locates and creates images of nodules/lumps, especially those smaller than 1cm** which are difficult to be detected by palpation test

◆ **Painless and quick**

Should I be screened?

◆ **Symptoms of Borderline Thyroid Neoplasm**

✓ A painless lump or swelling in the front of the neck

✓ Unexplained hoarseness and/or a sore throat that does not get better

✓ Difficulty swallowing

① Have never experienced

② Have experienced occasionally

③ Have experienced frequently

① **Have never experienced**

❖**If have not experienced**

◆ Scientific evidence is insufficient to determine if the benefits of thyroid ultrasound screening outweigh the associated costs and risks to asymptomatic individuals → **The Korean Thyroid Association guideline does not recommend a routine thyroid ultrasound screening**

◆ **If you still want to get a screening test,** you should be informed of its benefits and risks

②, ③ **Have experienced occasionally, or frequently**

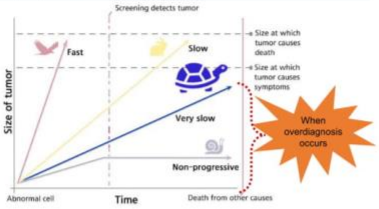
❖**If have experienced**

◆ Screening does not apply (It is for people without symptoms)

◆ **Must discuss with your doctor**

Overdiagnosis of Borderline Thyroid Neoplasm

♦**Overdiagnosis**: **Detecting low-risk, clinically insignificant diseases (e.g., *borderline thyroid neoplasm*) through extensive thyroid ultrasound screening** of people without symptoms



• Because **overdiagnosis** can **prompt more tests and treatments of diseases that are likely to never cause health problems for life, which is overtreatment**

Overtreatment of Borderline Thyroid Neoplasm

◆ **Despite the risk of borderline thyroid neoplasm detected through thyroid ultrasound is low, most people have undergone surgical treatment called thyroidectomy**

◆ **Thyroidectomy**

• Generally very successful. Some people may experience side effects including:

Side-effects of Thyroidectomy

➢***Damage to the parathyroid gland (next to the thyroid gland).*** This could cause temporary low blood calcium and muscle cramps which require people to take calcium supplements permanently

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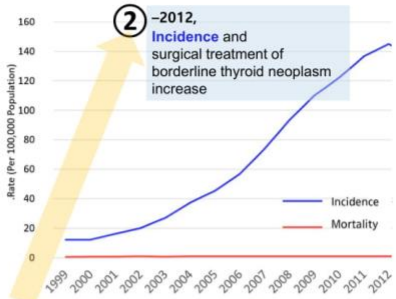
➢***Dying from the anesthetic*** (less than 1 out of 1,000 people).

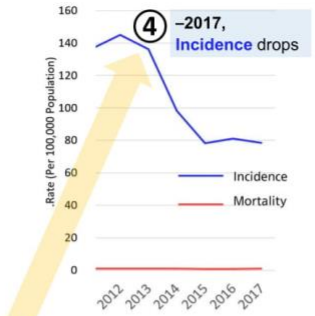
➢Additional treatment, including radioactive iodine therapy, may be needed, depending on postoperative disease status, disease stage, and type of a borderline thyroid neoplasm.

Would thyroid ultrasound screening reduce mortality?



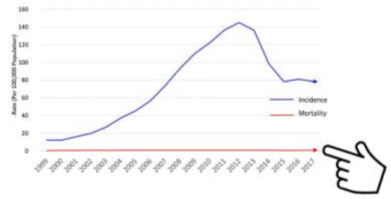
② –2012, **Incidence** and surgical treatment of borderline thyroid neoplasm increase

① **1999, The launch of national screening program**
It became easier and less expensive for the public to get ultrasound screening



④ –2017, **Incidence** drops

③ **2014, The Coalition of Eight Physicians**
'Thyroid ultrasound screening should be discouraged…'



1999–2017,
Borderline thyroid neoplasm specific mortality remained stable

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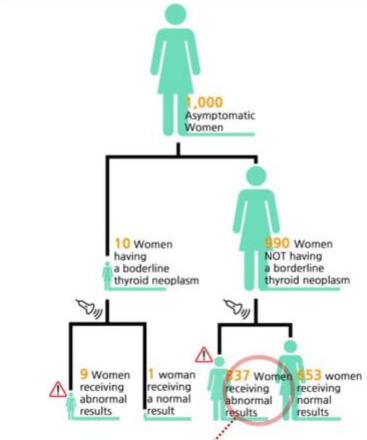
Would all women with abnormal ultrasound results actually have borderline thyroid neoplasm?



Due to the limited accuracy of the screening test, **337 of 990 women without borderline thyroid neoplasm will get abnormal ultrasound results**

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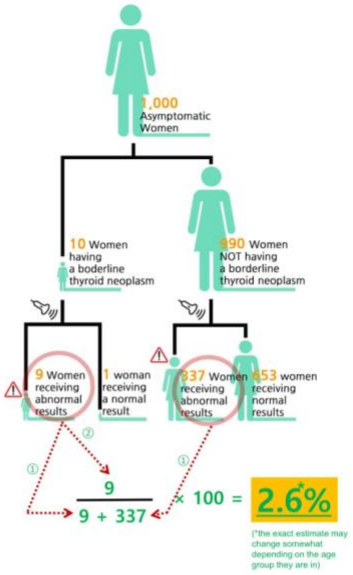

Women with abnormal results may need to undergo extra tests

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Will results of thyroid ultrasound screening quickly relieve anxiety and worry about the possibility of borderline thyroid neoplasm?

- ◆ **Thyroid ultrasound is never 100 percent accurate**, like any other medical tests.
- ◆ Thyroid ultrasound screening **may not completely relieve your anxiety and worry about borderline thyroid neoplasm**, as much as many people think
- ◆ Rather, **it could further increase the anxiety and worry**

How much regret would you feel about your decision to undergo screening?

- ◆ If you undergo thyroid ultrasound screening, you may face **a regretful situation of experiencing overdiagnosis and overtreatment**
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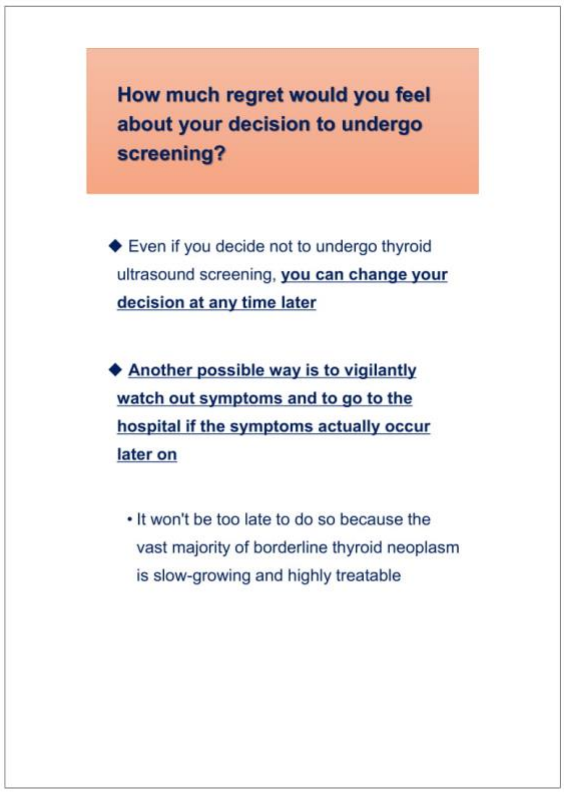
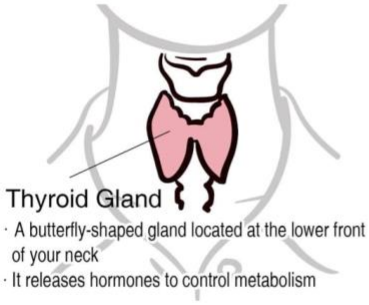
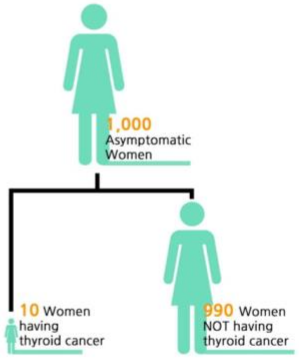

How much regret would you feel about your decision to undergo screening?
◆ Even if you decide not to undergo thyroid ultrasound screening, you can change your decision at any time later
◆ Another possible way is to vigilantly watch out symptoms and to go to the hospital if the symptoms actually occur later on
• It won't be too late to do so because the vast majority of borderline thyroid neoplasm is slow-growing and highly treatable

3. Stimulus Material for Control Condition

What is Thyroid Gland?



About 10 in every 1,000 adult women are known to have thyroid cancer



Thyroid Ultrasound Screening

- A preventive medical service **for asymptomatic people**
- **Aims at early detection and treatment** of people with thyroid diseases or high risk of developing them
- **Locates and creates images of nodules/lumps, especially those smaller than 1cm** which are difficult to be detected by palpation test
- **Painless and quick**

APPENDIX C

LIST OF MEASURES

Note. Questionnaire was administered in Korean. This is the English Translation. The text highlighted in blue was not displayed to respondents.

Baseline Questionnaire

There is no right or wrong answer, so please do not respond with what might be considered desirable or correct. Attempt to give a "correct" response merely distort the meaning of your answers and render the study valueless. Do not spend too much time on each question, just answer with your initial reaction to the question.

I. Demographic Information (Eligibility question)

■ Following questions are to obtain demographic information about you. Please check the box or provide an answer that best describes you.

1. [Biological sex] Are you male or female?

① Male (direct to the end of the survey)
② Female (direct to Q2)

2. [Age] What is your age?

_____ years old (Aged less than 19, direct to the end of the survey)

3. [Cancer history] Have you been diagnosed with any cancer?

① Yes, I have. (direct to the end of the survey)
② No, I have not. (direct to Q4)

II. Health Background and Experience with Cancer

4-1. [Cancer history of close others] Do you have any family members or acquaintances with cancer including those who are already passed away?

① Yes
② No

4-2. [Cancer history of close others] Do you have any family members or acquaintances who have found and been treated for cancer early through screening?

① Yes
② No

5. [Previous message exposure] Have you seen, or heard about people who have found and been treated for cancer early through screening through media (e.g., TV, newspaper, the Internet)?

① Yes
② No

6. [Thyroid cancer symptom experience] How frequently have you experienced the following symptoms lately?

- A painless lump or swelling in the front of the neck
- Unexplained hoarseness
- A sore throat that does not get better
- Difficulty swallowing

1---------- 2 ---------- 3
Never Occasionally Frequently

7. [Stage of behavioral change] Please select one that is closest to your thyroid screening experience and intention for future screening.

① I have never had a thyroid screening test, and am not thinking about having one in the next 6 months
② I have never had a thyroid screening test, but am thinking about having one in the next 6 months
③ I have never had a thyroid screening test, but thinking about having one in the next month
④ I have had one thyroid screening test in the past year and intend to continue
⑤ I have had thyroid screening tests on a regular schedule and intend to continue
⑥ I have had thyroid screening tests regularly, but I have no intention to continue

■ Please read a hypothetical scenario below carefully and answer the question that follow.

First, assume that it is not during COVID-19 pandemic. Then, try to imagine that you have a regular health checkup scheduled the next week. Before you visit the hospital for the checkup, you were handed a booklet that describes *a variety of optional screening tests you can receive for an additional fee*. The following is part of the booklet describing a thyroid ultrasound.

==========EXPOSURE TO EXPERIMENTAL STIMULUS==========

Post-exposure Questionnaire

■ Please answer the remaining questions, imagining that it is not during COVID-19 pandemic, and that you are in a situation with a week left before your regular health checkup. Remember that there is no right or wrong answer to questions in this survey. *Please do not answer the questions based on what you think we want to hear. After reading each question carefully, please respond as honestly as you can.*

1. [Decisional conflict] Now, thinking about the choice you just made, please answer the following questions.

1-1. Do you know which options are available to you?	① Yes	② Unsure	③ No
1-2. Do you know the benefits of each option?	① Yes	② Unsure	③ No
1-3. Are you clear about which benefits matter most to you?	① Yes	② Unsure	③ No
1-4. Do you know the risks and side effects of each option?	① Yes	② Unsure	③ No
1-5. Are you clear about which risks and side effects matter most to you?	① Yes	② Unsure	③ No
1-6. Do you have enough support from others to make a choice?	① Yes	② Unsure	③ No
1-7. Are you choosing without pressure from others?	① Yes	② Unsure	③ No
1-8. Do you have enough advice to make a choice?	① Yes	② Unsure	③ No
1-9. Are you clear about the best choice for you?	① Yes	② Unsure	③ No
1-10. Do you feel sure about what to choose?	① Yes	② Unsure	③ No

[Decision-relevant knowledge; *indicates correct answer]

■ Based on what you know from reading the booklet, please answer the following questions.

2-1. What do you think is screening for thyroid diseases?

① A test you have when you're healthy*
② A test you have if you notice a change or lump in your neck
③ I don’t know

2-2. Do you think all women with an abnormal screening result (i.e., positive result) have [thyroid cancer/a borderline thyroid neoplasm]?

① YES
② NO*
③ I don’t know

2-3. Who do you think is more likely to be diagnosed with [thyroid cancer/a borderline thyroid neoplasm]?

① Women who get thyroid ultrasound*
② Women who do not get thyroid ultrasound
③ I don't know

2-4. Which of these 2 statements do you think best describes over-diagnosis?

① Screening finds a disease that would never have caused trouble*
② Screening finds an abnormality but extra tests show it is not cancer
③ I don't know

2-5. Which of the following do you think is not a symptom of [thyroid cancer/a borderline thyroid neoplasm]?

① A lump or swelling in the neck
② A sore throat
③ Trouble swallowing
④ Hoarseness
⑤ Fatigue or lack of energy*

Indicate whether you believe that each one of the following statements about thyroid ultrasound screening is either "TRUE" or "FALSE."

2-6. Thyroid ultrasound will find every [thyroid cancer/a borderline thyroid neoplasm].

① TRUE
② FALSE*
③ I don't know

2-7. Undergoing thyroid ultrasound screening would reduce my chances of developing [thyroid cancer/a borderline thyroid neoplasm].

① TRUE
② FALSE*
③ I don't know

2-8. All [thyroid cancer/a borderline thyroid neoplasm] will eventually cause illness and death if they are not found and treated.

① TRUE
② FALSE*
③ I don't know

2-9. When thyroid ultrasound screening finds [thyroid cancer/a borderline thyroid neoplasm], doctors can reliably predict whether it will ever cause harm.

① TRUE
② FALSE*
③ I don't know

2-10. Thyroid ultrasound screening leads some women with a harmless [thyroid cancer/a borderline thyroid neoplasm] to get treatment they do not need.

① TRUE*
② FALSE
③ I don't know

■ Here are questions about how you think and feel about [thyroid cancer/a borderline thyroid neoplasm]

[Perceived severity of a disease]

3-1. Getting [thyroid cancer/a borderline thyroid neoplasm] would interfere with life

1---------- 2 ---------- 3 ---------- 4 □

Strongly disagree | Disagree | Agree | Strongly agree | Undecided

3-2. If I got [thyroid cancer/a borderline thyroid neoplasm], I would have problems which would last a long time

1---------- 2 ---------- 3 ---------- 4 □

Strongly disagree | Disagree | Agree | Strongly agree | Undecided

3-3. If I got [thyroid cancer/a borderline thyroid neoplasm] my whole life would change

1---------- 2 ---------- 3 ---------- 4 □

Strongly disagree | Disagree | Agree | Strongly agree | Undecided

3-4. Getting [thyroid cancer/a borderline thyroid neoplasm] would not be a problem for me (R)

1---------- 2 ---------- 3 ---------- 4 □

Strongly disagree | Disagree | Agree | Strongly agree | Undecided

4. [Perceived susceptibility]

4-1. How concerned are you about developing [thyroid cancer/a borderline thyroid neoplasm] in your lifetime.

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Not at all Extremely

4-2. How easy is it for you to imagine yourself developing [thyroid cancer/a borderline thyroid neoplasm] in the future?

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Not at all Extremely

4-3. I feel very vulnerable to [thyroid cancer/a borderline thyroid neoplasm].

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree Strongly agree

4-4. I am confident that I will not get [thyroid cancer/a borderline thyroid neoplasm]. (R)

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree Strongly agree

4-5. I would be lying if I said "There is no chance of me getting [thyroid cancer/a borderline thyroid neoplasm]"

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree Strongly agree

4-6. My first reaction when I hear of someone getting [thyroid cancer/a borderline thyroid neoplasm] is "that could be me someday."

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree Strongly agree

■ Questions about thyroid ultrasound screening are presented below. Please express your opinion on each question.

5. [Affective attitudes]

"For me, undergoing thyroid ultrasound screening is…"

	-5	**-3**	**-1**	**0**	**1**	**3**	**5**
5-1	□	□	□	□	□	□	□
	Very not reassuring	Not reassuring	Fairly not reassuring	Neutral	Fairly reassuring	Reassuring	Very reassuring

5-2	□	□	□	□	□	□	□
	Very not relieving	Not relieving	Fairly not relieving	Neutral	Fairly relieving	Relieving	Very relieving
5-3	□	□	□	□	□	□	□
	Very anxiety-provoking	Anxiety-provoking	Fairly anxiety-provoking	Neutral	Fairly not anxiety-provoking	Not anxiety-provoking	Very not anxiety-provoking
5-4	□	□	□	□	□	□	□
	Very unpleasant	Unpleasant	Fairly unpleasant	Neutral	Fairly pleasant	Pleasant	Very pleasant

6. [Cognitive/instrumental attitudes]

"For me, undergoing thyroid ultrasound screening is…"

	-5	**-3**	**-1**	**0**	**1**	**3**	**5**
6-1	□	□	□	□	□	□	□
	Very harmful	Harmful	Fairly harmful	Neutral	Fairly beneficial	Beneficial	Very beneficial
6-2	□	□	□	□	□	□	□
	Very worthless	Worthless	Fairly worthless	Neutral	Fairly worthwhile	Worthwhile	Very worthwhile
6-3	□	□	□	□	□	□	□
	Very foolish	Foolish	Fairly foolish	Neutral	Fairly Wise	Wise	Very wise

7. [Descriptive norms]

7-1. How many of women of your age regularly undergo thyroid ultrasound screening?

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7

None — All of them

7-2. Women of your age regularly undergo thyroid ultrasound screening.

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7

Strongly disagree — Strongly agree

8. [Injunctive norms]

8-1. Most people I consider important, including doctors, would think I should undergo thyroid ultrasound screening.

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree — Strongly agree

8-2. Most people I consider important, including doctors, would approve of me undergoing thyroid ultrasound screening.

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree — Strongly agree

9. [Capability]

9-1. There can be a variety of obstacles to your participation in thyroid ultrasound such as cost, lack of transportation, taking time off work, fear or worry about the procedure and many others. Even in the face of such obstacles, how sure are you that if you really wanted to, you can participate in thyroid ultrasound?

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Completely sure I cannot — Completely sure I can

9-2. How sure are you that you can get thyroid ultrasound if you really wanted to, even if your doctor does not tell you to get one.

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Completely sure I cannot — Completely sure I can

10. [Autonomy]

10-1. How much control do you feel you have over whether or not you undergo thyroid ultrasound screening?

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Completely no control — Complete control

10-2. Whether or not I undergo thyroid ultrasound screening? is up to me.

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7
Strongly disagree — Strongly agree

11. [Intention to undergo thyroid ultrasound]

11-1. If given the chance, do you intend to undergo thyroid ultrasound screening? The cost of a thyroid ultrasound is 45,000 KRW on average, but can be as high as 200,000 KRW depending on the type of hospital performing the test.

1---------- 2 ---------- 3 ---------- 4 □

Definitely not — Definitely yes — Undecided

11-2. How likely is it that you would take up the offer of thyroid ultrasound screening if you were offered one? The cost of a thyroid ultrasound is 45,000 KRW on average, but can be as high as 200,000 KRW depending on the type of hospital performing the test.

1---------- 2 ---------- 3 ---------- 4 □

Very unlikely — Very likely — Undecided

12. [Intention not to undergo screening] Instead of undergoing thyroid ultrasound right away, do you intend to see your doctor if you have unusual changes in your neck indicative of [thyroid cancer/a borderline thyroid neoplasm] in the future.

1---------- 2 ---------- 3 ---------- 4 □

Definitely not — Definitely yes — Undecided

13. [Anticipated affects related to screening non-uptake]

*"If I **did not** get a thyroid ultrasound right away… "*

1---------- 2 ---------- 3 ---------- 4 ---------- 5----------6----------7

Very unlikely — Very likely

13-1. [Anticipated regret] I would regret it.	□ □ □ □ □ □ □ 1 2 3 4 5 6 7
13-2. [Anticipated regret] I would later wish that I had.	□ □ □ □ □ □ □ 1 2 3 4 5 6 7
13-3. [Anticipated regret] I would be so worried about the possibility of having [thyroid cancer/a borderline thyroid neoplasm] that I would regret much of the time.	□ □ □ □ □ □ □ 1 2 3 4 5 6 7

14. [Medical skepticism]

1---------- 2 ---------- 3 ---------- 4 ---------- 5

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

14-1. I can overcome most illness without help from a medically trained professional	□ □ □ □ □ 1 2 3 4 5
14-2. Home remedies are often better than drugs prescribed by a doctor	□ □ □ □ □ 1 2 3 4 5
14-3. If I get sick, it is my own behavior that determines how soon I get well again	□ □ □ □ □ 1 2 3 4 5
14-4. I understand my health better than most doctors do.	□ □ □ □ □ 1 2 3 4 5

Finally, following questions are to obtain demographic information about you. Please check the box or provide an answer that best describes you.

15. [Education/Highest education completed] What is your highest level of education?

① Elementary school or less than elementary school
② Middle school
③ High school
④ Technical college
⑤ College graduate
⑥ Postgraduate (Graduate Diploma, Master and PhD)

16. [Income] What is total monthly household income after taxes?

① Less than 1,500,000 KRW
② 1,500,000 KRW ~ 3,000,000 KRW
③ 3,000,000 KRW ~ 4,500,000 KRW
④ 4,500,000 KRW ~ 6,000,000 KRW
⑤ 6,000,000 KRW ~ 7,500,000 KRW
⑥ More than 7,500,000 KRW

17. [Profession] Do you work in the healthcare field?

① Yes
② No