

Behavioural Economics of Cardio-Vascular Screening Decisions: Drivers and Interventions

Swee-Hoon Chuah, Jack T. Evans, Seana Gall, Robert Hoffmann, Ananta Neelim
University of Tasmania

3 March 2025

Table of Contents

Executive Summary	4
1 Introduction	6
1.1 Background.....	6
1.2 Objectives.....	6
1.3 Approach	7
1.3.1 Application of behavioural science	7
1.3.2 Review of scientific literature	7
1.4 How to read this document	7
2 Behavioural economics of health	8
2.1 Health policy.....	8
2.2 Behavioural economics policy.....	8
2.3 Behavioural economics policy in health.....	9
2.4 Behavioural policy for cardio-vascular disease (CVD).....	10
2.5 Behavioural insights	10
2.5.1 Rational (slow) choice	11
2.5.2 Fast and slow thinking	11
2.5.3 Social thinking	12
2.5.4 Individual differences.....	12
3 Health screening decisions	13
3.1 The health belief model of screening decisions.....	13
3.2 Behavioural insights into screening decisions	14
3.2.1 Slow thinking.....	14
3.2.2 Fast thinking.....	15
3.2.3 Social thinking	17
3.2.4 Individual differences.....	18
4 Health screening interventions	22
4.1 Behaviour change interventions	22
4.2 Literature review approach.....	22
4.3 Interventions to promote health screening uptake.....	23
4.3.1 Informational interventions.....	23
4.3.2 Behavioural interventions.....	24
4.3.3 Incentive-based interventions	25
5 Conclusions	27

5.1	Health screening decisions	27
5.1.1	Promoting rational screening decisions.....	27
5.1.2	Leveraging fast screening decisions.....	27
5.1.3	Making screening choice more social	28
5.1.4	Managing individual differences in screening	29
5.2	Health screening interventions	29
5.2.1	Informational interventions.....	29
5.2.2	Behavioural interventions.....	30
5.2.3	Incentive-based interventions	30
	References	31

Executive Summary

Research requirement

Cardio-vascular disease (CVD) screening has the potential to positively affect health outcomes on a significant scale. This report is part of a St Lukes commissioned project to design behavioural interventions to increase CVD screening uptake in older Tasmanians. The report delivers stage 2 of the project (see appendix 1, section 4.2.), a review of the scientific literature regarding drivers of screening decisions and potential interventions. It informs stage 3, intervention design.

Procedure

We used a mixture of systematic and narrative literature review techniques to survey two academic literatures

- a literature regarding the factors (drivers and barriers) that influence participation in screening for non-communicable diseases (NCD), which includes CVD. We cast the net more widely to identify relevant, potentially applicable factors that research has not yet examined in the specific CVD context; and
- a literature identifying interventions which have been implemented to increase NCD screening uptake and have evidenced potential to be effective.

In line with the aim of this project, our approach focuses particularly on *behavioural* factors and interventions (those that affect the psychological factors underlying choice) rather than regulation- or incentive-based ones.

We complement the literature reviews with discussions of the conceptual background regarding

- the behavioural approach to health policy; and
- the potential of behavioural insights for policy design.

These discussions provide the context for the two literature reviews.

Key findings of literature reviews

Individual screening decisions are driven by

- slow, rational thinking that identifies best decisions based on information including
 - screening benefits (perceived disease susceptibility and awareness of screening options and availability)
 - screening costs (time, money, inconvenience)
 - learning and use of emerging screening costs and benefits information
- fast thinking using heuristics, emotions and intuition, and is affected by
 - reasoning errors and biases that result in poor decisions, such as loss aversion, status quo and availability biases
 - overconfidence and biased optimism about own skills and outcomes
 - fear and anxiety of screening process, diagnosis, symptoms and treatment
 - poor willpower and pursuit of immediate gratification
 - decision failure or procrastination due to cognitive overload

- social thinking that responds to others' persuasion, information and needs, and is affected by
 - influence from media, social and close contacts
 - information transmitted in social and peer networks, such as social norms
 - health concerns of loved ones
- individual differences and distinguishing personality traits including
 - self-efficacy to perform screening tasks
 - general optimistic outlook that screening can lead to successful management of health risks
 - a conscientious personality that allows health literacy and screening perseverance
 - positive attitudes towards good health, technology and the medical profession
 - risk averseness that prefers screening to manage health risks.

Interventions that have successfully increased screening uptake include

- Informational interventions – providing information to raise awareness and educate
 - Direct correspondences and large scale multi-week media campaigns
 - Active delivery of information (e.g., individually, face-to-face), rather than passive (e.g. brochures, leaflets)
 - Educational programs in workplaces, accompanied by help in navigating screening process
- Behavioural interventions – targeting psychological barriers that hinder screening
 - Personalisation
 - Translated messages (particularly for hard-to-reach populations)
 - Messages tailored to specific context
 - Easing cognitive load
 - Clear information, simple language
 - Help in navigating screening process
 - Reminders of screening
 - Endorsements from trust authorities (mixed results)
 - Framing messages using loss-frame (mixed results)
- Incentive-based interventions – addressing practical barriers to attend screening, such as financial constraints
 - Financial incentives
 - Transport vouchers

Conclusions

The empirical evidence regarding behavioural insights and interventions relating to NCD screening informs the next stage of the project. We identified specific behavioural insights amenable to intervention and also appropriate intervention channels and messaging that can be used to this end.

1 Introduction

1.1 Background

St Lukes has a vision to make Tasmania the healthiest island on the planet. Researchers from the Tasmanian Behavioural Lab (tasbelab) at the University of Tasmania (UTAS) were commissioned to conduct a research project to support the vision (see Appendix 1 for the UTAS proposal). A research team was assembled with members of tasbelab and Menzies Institute of Medical Research at UTAS.

In a co-design workshop with the research team, St Lukes and external medical experts, a specific research question for this project was developed (see Appendix 2 for the workshop summary document). This research question needed to identify an individual behaviour that:

1. is responsible for poor health outcomes in Tasmania
2. is specific enough to be targeted by an intervention by St Lukes
3. can feasibly be affected by the intervention
4. contributes significantly to health outcomes in Tasmania

The workshop identified cardio-vascular disease (CVD) screening as the target behaviour. The research question was formulated as follows:

What interventions can raise the participation in CVD screening of Tasmanians between 30 and 60 years of age?

The project will answer the research problem by conducting a review of relevant academic literature as well as designing, testing and evaluating an intervention based on the literature.

1.2 Objectives

This report constitutes the literature review component of the project. Our objective is to survey what peer-reviewed academic research tells us about:

- The decision **drivers** that influence whether someone decides to screen. These are the barriers and motivators to screen including social and economic factors as well as health awareness and knowledge. In line with the overall project aims we focus on the *behavioural* drivers. These are the psychological factors that influence screening decisions.
- The **policy interventions** that can target these drivers to encourage individuals to screen. We examine factors regarding non-communicable diseases generally to identify ones with potential for the specific CVD context.

We also provide the context of these two literatures in the **background to behavioural economics** and its application to health policy.

This stage of the project does not involve intervention design. We do however offer **preliminary conclusions** of the literature review for the design.

1.3 Approach

1.3.1 Application of behavioural science

We adopt a behavioural science approach throughout. In this project, the term ‘behavioural’ can be read to mean psychological. Behavioural science uses quantitative methods (such as human participant experiments, psychometric questionnaires, and physical measurements) to understand the drivers of human decisions and behaviour. The aim is to inform the design of policies to improve individual and social outcomes.

Behavioural science has developed rapidly over the last decades and revolutionised our understanding of human decision making. It has a growing impact on public and organisational policy because most (if not all) policy challenges involve human behaviour at their root. Health-related behaviours are a prime example. Behavioural science has two parts:

- Behavioural **insights** are empirical facts about how humans typically decide and behave.
- Behavioural **interventions** are policies designed to encourage and empower individuals to make decisions that lead to better outcomes for themselves and others.

1.3.2 Review of scientific literature

We reviewed the academic literature related to behavioural insights and interventions in health screening. We used two complementary survey methods: a systematic literature review and a traditional narrative review. The systematic review is a standardised technique compared to the traditional narrative review approach that relies on researcher expertise, intuition and discretion.

The two approaches have different strength and are complementary. The systematic approach is comprehensive, transparent, reproducible, objective and unbiased as it does not rely on researcher expertise and experience. However, professional researchers can have an advantage in appraising research, understanding context and identifying niche contributions that the systematic approach may miss (MacLure, 2005; Boell and Cecez-Kecmanovic, 2015).

Our literature review was therefore based on both methods:

- A narrative review to identify and apply behavioural insights to health screening choice.
- A systematic review to identify and assess potential behavioural interventions to promote screening.

1.4 How to read this document

This document contains the main deliverable for this project stage, a review of behavioural insights and interventions relating to screening, along with additional materials the research team prepared for St Lukes. Some of these may be skipped in reading the document:

- The narrative literature review of behavioural insights regarding screening decisions is in section 3.
- The systematic literature review of behavioural interventions to encourage screening is:
 - appended in appendix 3 as a technical report; and
 - summarised in section 4 below as a plain-English version.
- A scene-setting introduction to the behavioural science approach to health is in section 2.
- Some preliminary conclusions for the intervention design stage of this project are in section 5.

2 Behavioural economics of health

To provide context, we begin with the general background to behavioural science applied to health.

2.1 Health policy

Health has been the target for policy by individuals, private and public sector organisations since antiquity. One reason is the strong mutual relationship between an individual's good health and well-being (Dolan et al., 2008; Angner et al., 2008; Hawkes, 2012; Binder and Coad, 2013): Being (un)healthy makes people (un)happy. But the evidence also suggests that happiness, in turn, improves health. Happy people take better care of themselves and have better psychological coping mechanisms that reduce stress, blood pressure and boost the immune system. In addition to helping individuals, health policy can counter negative societal consequences of ill health in higher healthcare costs and lost productivity.

On average human health has improved markedly over the past 150 years. The reasons are exploding productivity and innovations leading to better nutrition, medical treatments as well as healthcare infrastructure and programmes. But two recent developments mean that policymakers need to redouble their efforts. One is new threats to future health including the rising possibility of pandemics in the globalising world. Environmental degradation and climate change also increase global health risks (Tong et al., 2022; GBD 2017). Economic inequality is increasing within and between nations, making the best health care and treatment innovations increasingly unavailable for disadvantaged groups. At the same time, with aging populations and increasingly expensive treatment options, health care costs are skyrocketing.

A potential solution to these health policy problems is preventative in addition to curative intervention. There is great scope for individuals to engage in healthy behaviours that reduce illness and the need for care. This means that, given current medical technologies and care availability, there is a large gap between achievable health outcomes and those that people experience (Volpp and Asch, 2017).

The gap can be closed to the extent that policy is effective in encouraging individuals to make better health decisions. It is, in essence, a behavioural gap. Behavioural factors – a person's own decisions - are particularly important in health because the individual has both motive and opportunity to improve their health outcomes. The individual has control over their body and access to the signals it sends about their health. They *directly* experience benefits and costs of the health outcomes that result from the decisions they make in response. The same is not true for other key challenges - social, environmental and technological ones - that affect individuals. As Rice (2013) states,

“Many of the most vexing problems facing individuals and society as a whole in health care are neither medical nor scientific in nature; they are behavioral.”

2.2 Behavioural economics policy

For this reason, policy in health and similar challenges increasingly adopts a behavioural economics approach. Behavioural economics is behavioural science applied to resource allocating decisions including policy. According to a consensus statement by an expert panel convened by the *U.S. National Academies of Sciences, Engineering, and Medicine*, over the last 20 years,

“Core principles of behavioral economics have been tested repeatedly across six domains—health, retirement benefits, social safety net benefits, climate change, education, and (to a lesser extent) criminal

justice—and the evidence for their importance and value in the design of policy interventions is well established.” (Buttenheim et al., 2023, p. 3)

What is behavioural economics and how can it help health policy? Behavioural economics is the application of behavioural science to economics. It uses psychological insights and methods to improve our understanding of how people decide and behave in economic and social situations.

The central idea is that people often fail to make rational decisions. For economists, rationality is the traditional view of human choice known as *homo economicus*. It means that individuals adopt the course of action that brings about the best outcome for them, based on clear goals and all relevant information. In reality however people often fail to act in their own self-interest but fall prey to a catalogue of systematic reasoning errors and biases.

Behavioural economics uses this more realistic understanding of choice to design more effective policies to bring about better outcomes for individuals and societies. Policy ultimately targets people’s decisions and behaviour. An evidence-based understanding of the drivers of behaviour is therefore important for policy design. Richard Thaler and Cass Sunstein’s bestselling book *Nudge* (2008) introduced behavioural policy to public debate and policy. Health was the key application they discussed – and was namechecked in the book’s subtitle.

2.3 Behavioural economics policy in health

How is behavioural economics applied to design health policies? Behavioural health policy addresses both the individual and the health care provider. Both groups, including highly educated medical professionals, are prone to the systematic reasoning errors and biases that hinder people from being rational. These errors and biases can cause behaviours that harm individual health.

Health-related decisions are particularly prone to error and bias. The reason is that the three ingredients to making rational decisions are particularly compromised: First, health and treatment information is often complex and ambiguous. People have limited ability to perceive, recall and process information correctly even in less demanding situations. Second, individual goals are compromised because health has both short and long-term consequences that are hard to square. This harms long-term health because many healthy behaviours are aimed at one’s future and do not come with immediate necessity to act. People are also generally impatient, i.e. biased towards the present, preferring instant gratification to good future outcomes. Health decisions like exercise and avoiding fat and sugary foods require long-term thinking instead. Lacking willpower and temptation may lead to wrong decisions in favour of instant gratification. Finally, even with clear goals and information, people may not adopt the best course of action when it comes to health. Because information processing is hard people tend to put off acting in favour of procrastination.

Behavioural health policy tries to empower individuals and health professionals to make better decisions. In individuals, behavioural policy discourages unhealthy behaviours such as physical inactivity, under-insurance, treatment avoidance, poor health literacy, over-treatment seeking, drug non-compliance, unhealthy diet and substance abuse (including alcohol and tobacco). Policy targeting health care providers encourages evidence-based prescription and treatment practices, preventative measures, compliance with public health advice and better clinical decision making.

2.4 Behavioural policy for cardio-vascular disease (CVD)

These two areas - individual engagement with preventative individual health and clinician behaviour - were highlighted by the expert panel of the *U.S. National Academies of Sciences, Engineering, and Medicine* as priority areas for behavioural health policy (Buttenheim et al., 2023, p. 95). The third area was CVD, the challenge of the current project. The rationale was that CVD remains the leading cause of morbidity worldwide.

Similar to the co-design workshop we conducted for this project, the expert panel identified three specific behaviours to address CVD, chosen because they “have a demonstrated impact on cardiovascular disease and are potentially amenable to interventions grounded in behavioral economics” (Buttenheim et al., 2023, p. 96). They were: smoking cessation, medication adherence and physical activity.

Smoking is associated with a range of conditions that exacerbate CVD. Behavioural health interventions focus on encouraging smoking cessation. Smoking is a good example of a decision error – a departure from rational choice: Survey evidence shows that two-thirds to three-quarters of smokers want to quit. Many ex-smokers regret the activity, especially when health problems arise. Many smokers suffer from overconfidence that they are exempt from health consequences. Many heavily discount the future in favour of satisfying immediate desires. Few are ignorant of the information regarding health outcomes of smoking, owing to the success of health policies over the last 50 years. As a result, many policies revolve around financial (dis)incentives from (not) stopping smoking.

CVD can be mitigated by appropriate medication. However evidence suggests that even following the first heart attack, only around 40% of patients adhere to prescribed cardio-vascular medication (Choudhry et al., 2011). Reasons include inconvenience of refill ordering and complexity of synchronising multiple medications. Policies target refill availability, longer intervals and automatic re-ordering. In addition, social interventions include reporting of adherence to medical professionals.

Among other benefits, physical activity reduces CVD risks. Again, lack of exercise has several behavioural reasons including inconvenience, temptation and present bias. A large amount of research has been devoted to interventions encouraging exercise including financial incentives, providing information and habit formation (see Chuah and Hoffmann, 2025).

This project focuses on behavioural health intervention to address CVD in a fourth way: To increase the uptake on CVD screening.

2.5 Behavioural insights

Behavioural health policy works by designing interventions based on behavioural insights. These constitute current scientific knowledge about these psychological drivers of behaviour. Behavioural insights are established facts about how individuals regularly perceive, think and decide. They come from behavioural science methods of observing human thinking and behaviour. These methods include:

- Psychometric measures of personality, motivation, attitudes and cognitive performance.
- Experiments where human behaviour is observed in controlled environments under different conditions.
- Physiological measures such as heart rate, brain activity, facial expressions and eye movements.

There are two kinds of behavioural insight. The first are regularities in how most humans typically respond to external conditions or environments (situational factors). The second are regularities in how one individual responds differently to the same condition or environment compared to other individuals (individual difference factors).

These behavioural regularities have two sources. The first is evolution. Our thinking is influenced by how the human brain has adapted to the environment over generations. Early humans who could better solve adaptive problems (obtaining food, avoiding predators) survived longer and procreated more, passing better adapted thinking on. Modern brains have hardwired mechanisms adapted to our ancestral environment that influence our behaviour today. Some of these are maladaptive (overeating, avoiding physical exertion) in today's world and can explain poor behaviour in health and other contexts.

The second source of behavioural insights is socialisation. Humans are uniquely able to communicate and pass on information about (un)acceptable behaviour. We also share a strong motivation to conform and seek social approval. Our behaviours are therefore strongly shaped by the influence of others and social norms.

Four general behavioural insights provide the foundation of how people decide. They are the product of generations of human evolution and cultural socialisation.

2.5.1 Rational (slow) choice

The first is rationality, sometimes known as rational choice. It is closely related to the economist's assumption of *homo economicus*. In essence it means that people tend to decide purposefully to advance their own self-interest. A person takes that course of action which best satisfies their clear and consistent goals given the information they have about the choice. If a person is fully aware of the health consequences of smoking and values their long-term health more than the nicotine rush and social image, they will decide against smoking.

For the policymaker there are several takeaways from rationality. People respond to incentives – taxation of cigarettes or prohibitions of smoking will reduce smoking. The non-smoker's cost-benefit calculation above is integral to choosing rationally. Trade-offs between what we gain and what we lose (opportunity cost) are expressly considered. People also learn and respond to new information. Health warnings and public awareness campaigns also reduce smoking. People do not always act rationally but the unprecedented success of smoking cessation policies demonstrate the power of this insight (Buttenheim et al, 2023, p. 95).

2.5.2 Fast and slow thinking

Evolution also equipped humans with non-rational decision making. In some situations it is maladaptive to invest time and effort to make slow, careful and deliberate decisions. These situations include ones that are low-stakes and repetitive. Some situations are too complex to be handled effectively by reasoning. There are also situations that demand immediate and urgent responses. This is the second basic behavioural insight, that in addition to slow, rational thinking, people also think fast. This is known as the dual processing model – thinking fast (System 1) or slow (System 2) depending on the situation (Kahneman, 2011).

There are three mental processes behind fast thinking: Humans use heuristics (mental shortcuts such as routines, procedures and rules of thumb) that determine decisions without much conscious thought. Humans also use instincts, which means they come up with decisions intuitively using unconscious processes that pattern-match a situation to experiences stored in memory. Emotions are an important part of fast thought that

use physiological signals (heart rate, perspiration) to alter the decision maker to the need to act or to listen to instinct.

The policy implications are that when fast thinking is engaged, people can act against their own self-interest and make errors or biased decisions. Smokers may not have reasoned about the whole raft of health problems they risk. They may pay undue attention to examples of healthy long-term smokers. They may follow habits. They may give in to immediate temptations. Information campaigns may not enter into their decision making. Policies that rely on more than incentives and information are needed.

2.5.3 Social thinking

Human evolution has made us the most social of species. In ancient environments humans survived in groups of individuals that acted in unison against more powerful predators. These groups also had the advantage that they could share information. Social thinking is hardwired in our genes. Parts of our brain are purpose-designed to deal with our complex social world.

There are several aspects of human behaviour that reflect our social minds. One is that we seek others' approval. We care about good social standing, we listen to others in authority, we can be persuaded to conform, to do or think what others want. The other is that we seek company – we derive happiness from being and interacting with others. Humans are also very tribal meaning we favour those who belong to our group at the expense of those considered outsiders. Finally, humans will sometimes act unselfishly to help others or repay their kindness.

The social side of human thinking has significant policy effects. Cigarette advertisers use this in celebrity endorsements, associating a positive image with smoking, or emphasising the social side of people who smoke together. Anti-smoking campaigns also make use of this – highlighting the side-effects of passive smoking on others, especially children.

2.5.4 Individual differences

The final general behavioural insight is that each person has their own distinct behaviour patterns. Each individual responds to situations differently to others, but consistently over time. This lends people their individuality. Evolution may have produced these individual differences to give human groups a range of needed skills to better solve adaptive problems. Individual differences are somewhat stable but can be shaped by personal experiences. The four types of individual differences are personality (how a person typically feels, thinks and behaves), motivation (what drives a person), cognitive performance (how well and in what way a person reasons) as well as attitudes and values (how a person evaluates situations, people and things).

Individual differences are important to policy because they suggest different types of people will respond differently to interventions. For example, the social status aspects of smoking are more important to people who are more motivated to follow social pressure and have extroverted personalities. People with positive attitudes to risk may be more prone to smoke. Policies against smoking need to match the intervention or message with the target audience.

3 Health screening decisions

We now discuss the literature regarding the drivers of the individual choice to screen for health conditions. As in other medical and non-medical contexts, a wide range of factors are responsible for an individual's screening decisions. These include external factors such as available resources and other constraints individuals face, as well as physical abilities and skills.

There is an academic literature that applies these general drivers to specific cases of screening for different diseases. It provides empirical evidence for different specific factors that influence an individual's decision to participate in screening. We now outline the findings regarding all non-communicable diseases including CVD. We cast the net more widely to identify relevant, potentially applicable factors that research has not yet examined in the specific CVD context. In line with the aims of this project, we particularly focus on behavioural factors, i.e. the psychological drivers that affect which decision, among feasible alternatives, a person makes.

3.1 The health belief model of screening decisions

We begin by contextualising the specifically *behavioural* insights and interventions we identified in terms of the more general health belief model (Champion and Skinner 2008). It was adopted by U.S. health officials in the 1950s to address poor uptake of available preventative health measures. In the model, a person engages in preventative measures to the extent that they believe that they are at risk (high susceptibility) from the illness, that the consequences would be significant (high severity), that preventive measures can be taken (low barriers) by them (high self-efficacy) and are likely to work (large benefits).

An immense literature has since examined specific barriers and facilitators in the content of screening for a range of different medical conditions in different locations across the globe. We surveyed this literature to identify these factors. After evaluating a total of 66 studies, saturation was deemed reached when no new factors were identified by adding further studies to the review.

Most of these studies use questionnaires to gauge individuals' self-reports of drivers and barriers to screening, relevant psychometric measures and demographics. Some studies establish factors using experimental treatments or quasi-experimental designs, where asking different types of participant (by age, gender or ethnicity) is the treatment. We now outline the factors identified in these studies using the concepts of the health belief model.

Screening behaviour – the decision to engage in the screening process – is partly the result of a slow thinking rational process. It weighs up the costs of screening with the benefits as perceived by the individual (e.g., Aro et al. 1999; Madrik et al. 2021). Costs have three sources – financial costs are considered in the light of any price payable for the screening, and the availability of insurance cover. Time is another investment, and depends on the time the screening takes, including access to facilities and travel (Plumb et al. 2017; Bongaerts et al. 2020; McKay et al. 2025). Timing includes limited availability of appointments and their timings. Time invested comes at the cost of delaying or reducing other commitments. The third type of cost is from the screening itself, in particular any embarrassment (in front of medical staff or social contacts) or discomfort from performing the screening (Bulliard et al. 2004, Bongaerts et al. 2020).

These costs are weighed up against the benefits of screening an individual perceives. The first component of benefit, on the demand side, speak to whether screening is likely to be beneficial. This may be felt by individuals who believe themselves to be susceptible (because of poor health or family history of the illness) or show symptoms (Plumb et al. 2017; Bongaerts et al. 2020; McKay et al. 2025). On the supply side, these benefits can

only be realised to the extent that screening is effective. This belief rests on the individual's confidence in the screening technology, the medical professionals who administer it and evaluate results, and the physician who may have suggested the screening (Plumb et al. 2017 ; Bongaerts et al. 2020). This assumes that the individual is aware of the potential medical value of screening and its availability as well as knowledge of the disease (Madrik et al. 2021 ; Kang et al. 2024).

The literature has also ascertained robust relationships between different demographic characteristics and screening behaviour (e.g. Aro et al. 1999; McGregor et al. 2016; Bongaerts et al. 2020). The reason is that these demographics underlie the factors mentioned above. For example, income affords any financial burden of screening. Education makes the individual more aware of diseases and their consequences as well as the availability and effectiveness of screening. Both education and income are closely related to occupation, another predictor of screening decisions. In general it has been found that screening rises with socio-economic status. Ethnicity is also associated with these variables, as many immigrant communities have lower educational attainment and income. Age is related to disease susceptibility and awareness. Women are generally more likely to screen because of personality (e.g., lower risk taking, greater conscientiousness) and greater health awareness (Bulliard et al. 2004). Finally, family status (partner and children) is related both to the opportunity cost of screening time in terms of family commitments and the social influence from the concern of loved ones.

Later versions of the health belief model added two additional factors to the four original ones focussing on perceived costs and benefits. These were proposed by psychologists and focussed on behavioural drivers related to individual differences, social relations and affect (e.g. Aro et al. 1999; Bongaerts et al. 2020). They enrich the cost-benefit calculus with psychological insight that go beyond information and clear goals the individual has regarding their health and treatments. Examples are, among others, self-efficacy, treatment, disease or diagnosis anxiety and social influence. These factors relate closely to the general behavioural insights outlined in section 2. We include the evidence regarding these factors in our literature review of behavioural insights in screening, to which we turn next.

3.2 Behavioural insights into screening decisions

We now review the literature that applies these general behavioural insights to health screening-related behaviours.

3.2.1 Slow thinking

When slow thinking is engaged, people will carefully weigh the costs and benefits of getting screened when deciding whether to screen. Psychologists measure the tendency to think rationally as maximisation behaviour, making the effort to identify the best among alternative courses of action. Evidence suggests this type of decision making is associated with healthy lifestyles and behaviours (Tomljenovic and Bubić, 2019). Some factors impact this process.

Awareness: Before people can think about getting screened, they first need to know that screening programs are available. There is a lot of evidence showing that not being aware of these programs is a big reason why many do not participate in screening (e.g., Ogedegbe et al., 2005; Trigoni et al., 2008; Vernon et al., 1990).

Knowledge: In order to perform cost-benefit calculations, knowledge about the costs and benefits is required. Evidence shows that those who have low levels of knowledge about what is involved in screening were 50% less

likely to attend (Schueler et al., 2008). Similarly, a lack of knowledge about health risk factors also leads to lower screening rates (Marvan et al., 2013).

Beliefs: How people view what is true or false about the costs and benefits of screening strongly influences how they weigh up the pros and cons. For example, research shows that if a woman believes she is at low risk of developing cancer—perhaps because of her family history—she is less inclined to go for cancer screening (e.g., Ekechi et al., 2014; Katapodi et al., 2004). Another example is studies which show that women who did not believe in the efficacy or accuracy of these tests were 50% more likely to not attend (Schueler et al., 2008; Waller et al., 2009).

Barriers: In their calculations, people consider barriers that can raise their costs in terms of money, time, or both. One key barrier is accessibility. A study on breast cancer screening in England found that the farther women live from screening facilities, the less likely they are to participate (Maheswaran et al., 2008). Those in remote areas or without reliable transportation often have lower participation rates too (Trigoni et al., 2008; Caplan et al., 1996). On top of transportation issues, having limited access to doctors or primary care providers also reduces the likelihood of people attending screening (Schueler et al., 2008).

Another barrier is time constraints. People juggle various demands from work, family, and social obligations, and many say they do not have enough time to go to screenings (e.g., Brown et al., 2013; Feldstein et al., 2011; Glanz et al., 1992; Jepson et al., 2000). Those with caregiving responsibilities often need to pay for childcare, and self-employed individuals might miss out on earnings if they take time off for the screening. Money worries are also a barrier, as people often worry about the potential costs of follow-up tests or treatments that might come from the screening (e.g., Crump et al., 2000; Glanz et al., 1992; Moshkovich, et al., 2015).

3.2.2 Fast thinking

People are boundedly rational, which means they have limits when it comes to information and cognitive functions (Simon, 1972). Because of this, they tend to rely on fast thinking for most of their everyday decisions—it is easier and requires less mental effort than slow, careful thinking (Kahneman, 2011). However, relying on fast thinking can lead to decision errors and biases that result in poorer health outcomes.

Overconfidence and optimism bias: People often fall into the trap of being a bit too confident about their skills and perceptions. For example, many consider themselves “above average” drivers or think their personalities are better than most (Moore and Healy, 2008; Mynttinen et al., 2009). Overconfidence can lead to poor health choices. Even though people know that habits like smoking can lead to cancer, they often believe they are less likely to be affected than others (e.g., Khwaja et al., 2009).

When it comes to predicting what might happen in the future, people usually tend to be overly optimistic -- thinking the chances of good things happening are higher and the chances of bad things are lower (e.g., Sharot 2012; Weinstein 1980; Weinstein et al., 2005). This mindset also applies to health screenings. Studies on health screening show that many eligible people view their risk of developing the disease as unrealistically low, which makes them less likely to prioritise or take screenings seriously (e.g., Crump et al., 2000; Leventhal et al., 1999; Marlow et al., 2015).

Availability bias: People often estimate how likely an outcome is based on how easily it comes to mind. They typically rely on information that's readily available or particularly salient. Because of this, they tend to

overestimate the chances of memorable or emotional events, especially those they have seen or heard about recently (Tversky and Kahneman, 1973). An example is the high level of insurance purchases made immediately after disasters such as floods and earthquakes, which gradually decline as memories fade (Slovic, 1987).

In the health sphere, immediately following the sudden death of a friend from a heart attack, a person may overestimate their own personal risk and be more likely to screen. But over time, this dissipates alongside vividness (Luoto and Carman, 2014). Alternatively, if someone does not know anyone who has been affected by CVD in their circle, they may underestimate their personal risk and find screening less important (Purnell et al., 2015).

Loss aversion: People have been shown to dislike losing something roughly twice as much as they like gaining it (Kahneman and Tversky, 1979), hence they have a natural tendency to avoid losses. Research shows that this tendency occurs frequently in people's healthy choices (Attema et al., 2013). For example, making healthy food cheaper was less effective at encouraging healthy eating compared to taxing unhealthy foods. People saw the discount on healthy options as a gain, but they valued that less than the pain of paying more for unhealthy foods (Cawley, 2011).

In terms of screening behaviour, the small friction costs of attending screening (like those discussed in section 3.3.1) may serve as much bigger barriers than they should. However, loss aversion may also help: For example, messages to patients can be loss-framed to encourage them to get tested and keep up with health screenings (Moses, 2013).

Status quo bias: People have a strong tendency to stick with current choices or patterns of behaviour. In other words, they have an exaggerated preference for the status quo (Samuelson and Zeckhauser, 1988). Sticking with the status quo involves less mental effort than considering more pro-active courses of action. A clear example of the status quo bias is in organ donation policies across different countries. Johnson and Goldstein (2004) found that nearly everyone in Austria is willing to donate, while only about 12% are in Germany. Sweden's willingness rate is 86%, compared to just 4% in Denmark. These differences largely stem from default options: in places where people are assumed to be willing to donate unless they opt out, the rates are much higher, whereas those needing to opt in see significantly lower numbers.

This bias can affect how people participate in screenings in several ways. For instance, people who attended screenings in the past are more likely to do so again, while those who did not are less likely to show up in the future (e.g., Fallowfield et al., 1990; Lechner et al., 1997). Studies also show that when people are asked to opt in or actively book an appointment for health screening, they are less likely to follow through (e.g., Allgood et al., 2017; Tinmouth et al., 2015).

Present bias: Intertemporal decisions involve choosing between immediate and delayed rewards. Initially it was assumed that people would be consistent in their choices over time, but it turns out that the longer people have to wait, the more they downplay the value of future rewards, a phenomenon known as hyperbolic discounting (Laibson, 1997). This leads to present bias, where people tend to chase instant gratification and go for smaller, immediate rewards instead of waiting for bigger, more valuable ones later (O'Donoghue and Rabin, 1999; 2000). So, while we might plan to exercise or quit alcohol when thinking about the future, when comes time to take action, we often end up watching TV or drinking another glass of wine instead.

Present bias has a huge impact on our health behaviours as many such behaviours involve putting in effort or incurring cost today for benefits in the future. In the case of screening, this explains why people often procrastinate or just do not get around to participating. They tend to focus on the immediate hassles of getting screened (taking time off work, organising transport etc.) while downplaying the longer-term benefits of early detection (Chapman and Elstein, 1995; Luoto and Carman, 2014).

Emotions and affect heuristic: Emotions play a big role in decision-making, especially regarding preventive health behaviours. The affect heuristic refers to how fast emotional reactions can influence our choices more than careful risk assessments, especially in stressful situations (Slovic et al., 2007). For example, a study in the U.S. found that immediate emotions linked to certain behaviours can predict young people's engagement in positive and risky health behaviours based on their responses in a word-association test (Benthin et al., 1995).

When receiving an invite for health screening, a person's emotional state can significantly impact their decision, as anxiety about potential pain or fear of a negative outcome (diagnosis) may deter them (e.g., Fallowfield et al., 1990; Knops-Dullens et al., 2007; Marvan et al., 2013). Other biases discussed above may also play a role: Loss aversion magnifies the weight of a potential negative outcome, while the uncertain positive outcome (early detection) is downplayed. The availability heuristic makes negative stories about screening experiences more memorable, heightening anxiety about attending. On the flip side however, knowing someone who has faced CVD or cancer may encourage participation in the hope of early detection.

Cognitive (over)load: Cognitive load refers to the amount of mental effort required to process information to make decisions. As people are cognitively bounded, they get overwhelmed when presented with too many options or too much information that they cannot easily process. When this happens, they suffer a cognitive overload, which causes them to fail to act, procrastinate or make poor choices (Cherney et al., 2015; Deck and Jahedi, 2015).

Experimental studies show the effect of cognitive load on health choices, suggesting that managing cognitive load could significantly improve health behaviours. For example, when participants faced a challenging mental task, like remembering a seven-digit number, they were 50% more likely to choose cake over fruit salad compared to those given a simpler task (Shiv and Fedorikhin, 1999). When it comes to health screening, dealing with lengthy forms, complex information and confusing instructions—along with emotional anxieties and logistical details—creates a heavy cognitive load, which often leads to avoidance (e.g., Brown et al., 2007; Downs et al., 2008). This is especially true for those already under financial, social, and health pressures, as these factors add to their cognitive burdens (e.g., Mani et al., 2013; Shah et al., 2012).

3.2.3 Social thinking

People are social creatures who take others into account when making decisions.

Social preferences: People often act to benefit others even at a cost to themselves. People are inequality-averse (Fehr and Schmidt, 1999), reciprocal (Falk and Fischbacher, 2006) and altruistic (Andreoni, 1989). Evidence suggests that people may decide to screen when close others, especially partners and children, express concerns about their health (e.g., Teo et al. 2016).

Social norms: People rely on social cues to guide their actions, the most powerful of which is the perceived social norm. Social norms are unwritten rules about how people should behave in a particular group or society. These

norms guide behaviour by defining acceptable and unacceptable actions, thoughts and feelings within a social context (Elster, 2020; Sunstein, 1996). Social norms have played a key role in some of the most effective public health initiatives (Thorgeirsson and Kawachi, 2013). For example, they are seen as the main reason why many tobacco control laws, like clean indoor air regulations, are mostly self-enforcing (Jacobson and Wasserman, 1999).

Peer effects: People are strongly influenced by what others around them – their peers - do and think. Peer effects can shape a person's behaviour by either reinforcing social norms or creating a context where those norms are challenged. There is a lot of research on peer effects and risky behaviours, including health behaviours (Luoto and Carman, 2014). For example, a well-known study by Christakis and Fowler (2007) found that a person's chances of becoming obese increases by 57% if a friend became obese within a specific period. Likewise, when it comes to health screening, if people believe that most of their peers do not participate or approve of participation, they will be less likely to participate.

Social networks: People seek company and form social networks. Social networks facilitate the spread and reinforcement of social norms by providing a structure for communication and interaction, influencing how norms are perceived and practiced within a community. Research has shown that social networks can help encourage health screenings, especially for women who feel they have strong support, positive role models, and the ability to talk about screening with others—they are more likely to go for screenings (Knops-Dullens et al., 2007). On the flip side, studies show that social perceptions can also hold people back. For example, some women who skip cervical screenings think that men would not want them to be screened, which serves as a barrier to attendance (Marvan et al., 2013).

3.2.4 Individual differences

We now apply individual differences to health decisions and screening in particular. The literature distinguishes different types of individual difference, although the boundaries between them are fuzzy and contentious.

Self-efficacy: This is the belief in one's ability to successfully complete tasks or achieve goals. Research has shown this motivation to be strongly correlated with range of health behaviours (e.g., medication adherence and healthy lifestyles) that typically demand perseverance and effort to succeed (Tan et al., 2021). Belief in one's ability are a motivator to adopt these behaviours. For this reason, interventions aimed at raising self-efficacy can improve health outcomes.

Optimism: While optimism bias leads to unrealistic health risk assessments, an optimistic disposition at a more general level is related to positive health outcomes (Tomljenovic and Bubić, 2019). Optimistic people adopt healthier lifestyles and behaviours and adapt better to changing health conditions (Tindle et al., 2009; O'Brien and Moorey, 2010; Mäntyselkä et al., 2019).

Personality: All of the Big 5 personality dimensions (agreeableness, extraversion, openness, neuroticism and conscientiousness) are associated with a variety of health outcomes, including substance abuse and longevity (Strickhouser et al., 2017; Huang et al., 2017). There is some speculation over the mechanisms, which are hard to observe and still debated (Friedman, 2000; Murray and Booth, 2015). For example, heart disease may be negatively associated with agreeableness because hostility increases stress, blood pressure and inflammation. Conscientiousness is associated with health outcomes because it promotes medication adherence, medical awareness, exercise and healthy food choices. Even though personality characteristics are enduring, evidence is

emerging that they change over time. Personality may be targeted by health-related interventions because it lies at the root of behaviour (Murray and Booth, 2015).

Values: These are subjective evaluations of people, situations or ideas. They are sometimes seen as individual differences because they are stable, predict a person's behaviour and distinguish them from others (Parks and Guay, 2009). Some cultural values directly relate to health – individualistic and self-expressive values lead people to take better care of themselves (Mackenbach, 2014). Some people value health for its own sake and act accordingly (Dobewall et al., 2018). Values are, to an extent, socially transmitted and change over time, and may therefore be targeted by intervention.

Risk attitudes: These refer to a person's tendency to take or avoid risks when making decisions or evaluating potential outcomes. A person's risk attitudes may differ according to context (e.g., sports, finances, health). The evidence here is strong: Risk-loving people may take part in risky or unhealthy behaviours such as substance abuse or extreme sports. Risk-averseness on the other hand may lead people to self-care, adhere to medication or follow public health guidelines (Cerami et al., 2021; Lutter et al., 2019).

Table 1: Behavioural insights into screening decisions

Insight	Behaviour	Description	Application to screening	Expected effect
Rational, slow thinking	Maximising behaviour	Identifying the best solution based on accurate information gathering and analysis.	Greater awareness of disease, screening options and their availability, but also of screening benefits, costs and effort.	Mainly positive
	Belief updating	Adjusting expectations of likelihood of events or other people or factual beliefs with learning new information.	Learning increases screening activity as screening technology improves or disease risk rises.	Mainly positive
Fast thinking	Over-confidence	Believing one's decisions, skills and abilities are better than they are.	Decision accuracy (not) to screen is overestimated.	Mainly negative
	Optimism bias	Overestimating the likelihood of receiving positive outcomes.	Systematically underestimating one's susceptibility to disease.	Negative
	Availability bias	Estimating an event's likelihood biased by how easily it can be imagined (personal experience, social or media exposure).	Observed disease or health outcomes of others biases own perceived susceptibility.	Depends
	Loss aversion	Weighing losses more than gains of the same value.	Entitlements sustain regular screening. Insignificant screening costs act as barrier.	Depends
	Status quo bias	Tendency to stick to current choices or behaviour patterns.	Initial screening decision (for or against) becomes routine	Depends

			even when conditions change.	
	Present bias	Preference for instant over delayed gratification.	Present cost and inconvenience of screening loom larger than long-term health benefits.	Negative
	Emotions and affect	Arousal experienced as positive or negative in response to perception.	Anxiety of disease, of screening intervention or positive diagnosis influences screening decision.	Ambiguous
	Cognitive overload	Being overwhelmed by amount and complexity of information that cannot be correctly processed.	Disease and screening information overwhelms rational decision process and leads to decision fatigue and procrastination.	Mainly negative
Social thinking	Social norms	Decisions guided by standards of acceptable behaviour.	Individuals follow social norms (not) to screen irrespective of personal circumstances.	Ambiguous
	Peer effects	Decisions guided by influence of others.	Individuals follow peer pressure (not) to screen irrespective of personal circumstances.	Ambiguous
	Social networks	Receiving and sending information through social connections.	Socially connected individuals have better awareness of medical knowledge and social norms.	Ambiguous
	Pro-social preferences	Making decisions that benefit others at cost to oneself.	Screening decision considers concern by loved ones.	Positive
Individual differences	Self-efficacy	Believing in one's ability to perform tasks successfully.	High self-efficacy promotes screening that requires continuous effort and perseverance.	Ambiguous
	Optimistic disposition	Having positive expectations of future outcomes.	Optimistic disposition promotes belief that screening helps early diagnosis and successful treatment.	Positive
	Personality	Persistent ways of thinking and behaving in response to situations.	Conscientiousness increases medical awareness and perseverance with screening. Neuroticism raises medical anxiety. Agreeableness causes influence susceptibility.	Ambiguous

	Values and attitudes	Subjective evaluations of objects, people, situations or ideas.	Positive (negative) attitudes towards health, medical science and profession increase (decrease) screening uptake.	Ambiguous
	Risk averseness	Preference for trading off greater uncertain gains for smaller certain ones.	Risk averse attitudes promote screening behaviour to manage large health risks.	Positive

4 Health screening interventions

4.1 Behaviour change interventions

Policy interventions frequently (but not always) target individual behaviour. They are actions by a policymaker to change a target behaviour in a desired direction in order to bring about better outcomes for that individual and society. Behavioural economists distinguish four kinds of intervention:

- Mandates and prohibitions are legal obligations that compel people to perform or abstain from certain actions (e.g., a ban on smoking);
- Incentivisation attaches financial costs or benefits to these behaviours (e.g., cigarette taxes);
- Information provision induces behaviour change by educating or presenting facts that change how different actions are evaluated (e.g., smoking causes cancer campaigns); and
- Behavioural interventions such as nudges (Thaler and Sunstein, 2008) which involve presenting the same choice in a different way to steer behaviour towards the desired direction (e.g., replacing attractive cigarette pack features with images of diseased lungs).

Nudges are designed based on behavioural insights, i.e. how individuals typically respond to aspects of the choice architecture (the way the choice is presented). Note that in contrast, rational decision making is not affected by choice architecture changes – the same choice elicits the same decisions. Unlike legal obligations or incentives, nudges can be ignored by a rational decision maker, so they preserve the freedom to choose. Nudges also do not involve incentive costs and may be cheaper and simpler to implement than traditional policies.

All these policies are behaviour change interventions – they intend to shift the decision an individual makes when faced with alternative courses of action. Mandates, prohibitions and incentives change behaviour by adding or changing the consequences of the behaviour for the decision maker. Informational and behavioural interventions do not change the consequences, but make it easier or more attractive for the decision maker to adopt the behaviour.

In the following, we summarise the findings of our systematic literature review of interventions to promote screening uptake. In line with the aims of this project, we focus in particular on the latter two types of interventions which are more cognitive or behavioural in nature.

4.2 Literature review approach

A systematic search of three online databases was conducted to identify English-language, peer-reviewed journal articles that quantitatively assess the efficacy of person-centric interventions aimed at increasing non-communicable disease screening among adults without a prior diagnosis. We broadened the focus beyond CVD screening to identify interventions in related screening types as these may apply to the CVD context.

We identified 63 qualifying studies from 23 countries, covering over 407,000 observations. Screening outcomes were examined for breast cancer (n = 14), bowel/colorectal cancer (n=30), cardiovascular disease (n = 1), cervical cancer (n=14), heart health checks [diabetes/hypertension] (n=1), general health checks (n=2), lung cancer (n=2), and melanoma (n=1).

These studies reported different types of intervention encompassing 23 distinct approaches. They were delivered using different types of media. A more detailed and technical version of this literature review is attached as appendix 3.

4.3 Interventions to promote health screening uptake

We now provide an overview of the empirical evidence in this literature.

Health decisions that people make follow a sequential and logical progression.

- First, individuals acquire (or possess) sufficient knowledge about the health issue in question and the available interventions, encompassing disease awareness, understanding of screening benefits, costs and risks, and personal risk perceptions.
- Second, this knowledge informs the formation of an intention to act, influenced by attitudes toward the behaviour, perceived social pressures, behavioural preferences and self-efficacy.
- Finally, the intention is translated into action, contingent on constraining factors such as access to services, available resources, incentives and boundedness in attention.

There are important interplays between the three stages of the decision-making process. For instance, if people face resource-related or behavioural constraints that they anticipate will prevent them from acting in the third stage, they may be less likely to seek out information (first stage) or engage in the decision-making process to form intentions (second stage).

Our review uncovered a variety of interventions implemented to increase screening uptake of non-communicable diseases. We categorise the interventions we reviewed into three main groups: (i) informational interventions, (ii) behavioural interventions, and (iii) incentive-based interventions. A summary of these interventions and their impact on screening uptake is provided in Table 2.

4.3.1 Informational interventions

These interventions provide information to raise awareness and improve understanding of the disease, the benefits of screening, the risks, and the access to screening services. Information is provided utilising various dissemination methods including targeted communication (letters, emails, text messages), educational materials (pamphlets, brochures, videos), community or workplace outreach programs and organised media campaigns. Informational interventions fall into two types:

Awareness: The first assumes that some people are either not aware of screening or not actively thinking about screening. The hypothesis is that informing such people will increase awareness which will flow onto increased screening uptake. To test this assertion, four studies investigated the efficacy of direct correspondence with participants via letters or text messages (de Walque et al., 2022; Erwin et al., 2019; Tavasoli et al., 2016; Tinmouth et al., 2022). These correspondences made participants aware of screening, the health benefits of screening and provided information on where to access screening. In some cases, they also reminded the participant that their screening is due. All four studies showed a positive association between having received such correspondence and screening uptake.

The effect of media campaigns on screening behaviour was examined in three studies (Durkin et al., 2019; Durkin et al., 2020; Risi et al., 2004). Large scale, multi-week media campaigns were observed to be associated with greater colorectal cancer screening uptake. Comparatively, the mass distribution of a photo-comic and radio-drama to increase screening uptake had mixed results.

Knowledge: The second takes a more educational approach -- going beyond just building awareness to providing more comprehensive knowledge of the benefits and costs of screening. Seven studies used brochures and leaflets, and six studies used video materials for information provision (Basch et al., 2015; Champion et al., 2022; Gimeno-Garcia et al., 2009; Kurt et al., 2019; Lopez-Torres, 2016; Melvin et al., 2019; Montero-Moraga et al., 2021; Ruparel et al., 2019; Seven et al. 2015; Thompson et al., 2017; Vachon et al., 2024; Yoshida et al., 2012). Only two of these studies showed positive effects on screening uptake (Gimeno-Garcia et al., 2009; Seven et al., 2015). However, when the information was delivered individually and face-to-face, the effects were positive (Chigbu et al., 2017; Dhoj Shreshta et al., 2022; Thompson et al., 2017).

A similar pattern was observed when information was delivered through group educational sessions. Out of the four studies that investigated the impact of these sessions on screening (Altinel et al., 2022; Ghaffari et al., 2018; Rosser et al., 2015; Wong et al., 2019), only one showed a positive impact. The intervention that led to the positive impact was more extensive in scope (14 weeks of activities) than the ones that did not (typically one or two 30-minute video sessions). The impact of educational programs in workplaces was investigated in three studies (Janda et al., 2006; Ma et al., 2012; Tilley et al., 1999), all of which found a positive impact. Note, that in all these studies, the education intervention was also coupled with additional support in terms of screening navigation.

4.3.2 Behavioural interventions

The efficacy of information-based interventions is highly dependent on their ability to address the psychological (or behavioural) barriers that hinder behaviour change. For example, if information is presented poorly, leading to confusion and increased mental load, then the information is not helpful in changing behaviour. Similarly, the source of the information matters. People are more likely to be swayed if the messenger is a trusted expert, for example a doctor. Finally, in the context of health, people often actively avoid information out of anxiety and fear. If they perceive that the information is going to lead to discomfort or not beneficial, they will not engage. Our review uncovered several interventions that address these and similar behavioural issues.

Personalisation: The first set of studies varied the level of personalisation by either making the language more accessible (Bell et al., 1999; Braun et al., 2005; Del Mar et al., 1998; Roh et al., 2023) or presenting information more specific to one's personal circumstances (Myers et al., 2007; Sallis et al., 2016; Tilley et al., 1999; Tinmouth et al., 2022). Personalisation through language translation makes it easier for those from non-native speaking backgrounds to comprehend. Similarly, people are more likely to take information that corresponds to their personal circumstances more seriously. Results from these studies mostly showed that personalisation through these two channels positively influenced screening uptake, particularly in hard-to-reach populations.

Trusted messengers: The second set of studies investigated whether endorsements from trusted health authorities (like primary physicians and insurance companies) impacted screening behaviour (Barthe et al., 2015; Bell et al., 1999; Goldzahl et al., 2018; Hug et al., 2020; Lewis et al., 2008; Metha et al., 2024). Contrary to prediction, the evidence is mixed. Half of the studies showed that endorsement had a positive impact on screening, while the other half found no impact.

Easing cognitive load: The third set of studies investigated whether screening uptake can be improved by (i) making information easier to comprehend with simpler and clearer language (Bakr et al., 2020; Gold et al., 2019; Goldzahl et al., 2018; Sallis et al., 2016) and (ii) providing active help to make navigation of the screening process easier (Champion et al., 2022; de Ramirez et al., 2022; Ma et al., 2012; Schliemann et al., 2023; Tilley et al., 1999; Vachon et al., 2024; Wong et al., 2019). With regards to (i) the effect was mixed: two studies found a positive

effect, whereas two others found no effects. With regards to (ii), support in terms of patient navigation was found to be positively associated with screening uptake in majority of the studies.

Limited cognitive capacity to follow through on intentions, couple with time poverty, can hinder people from converting their intention to screen into action. To address this issue, behavioural interventions have been implemented in the form of reminders. We found eight studies that used reminders (via message, text or phone calls) to increase screening uptake (Altinel et al., 2022; Eaker et al., 2004; Hirko et al., 2020; Huf et al., 2020; Mehta et al., 2017; Myers et al., 2007; Tavasoli et al., 2016; Wilding et al., 2020). In seven out of the eight studies, the reminders successfully increased screening uptake. It is important to note however that the success of reminders is not surprising because of the nature of the interventions in these studies (run concurrently with other types of interventions) and the cohort on whom it was administered (people who are generally already amenable to screening).

Social norms: The fourth set of studies used social norm information as the intervention. Social norm information was either descriptive, presenting actual screening rates within the population (de Walque et al., 2016; Goldzahl et al., 2018; Gorini et al., 2023; Huf et al., 2020; Stoffel et al., 2019; Wilding et al., 2020) or prescriptive, consisting of normative statements that advocate for screening (Gorini et al., 2023). Overall, most interventions in this category did not change screening behaviour, with only one study using descriptive norms showing a positive effect.

Gain or loss framing: Gain and loss-framed message interventions were investigated in three studies (Gold et al., 2019; Huf et al., 2020; Schneider et al., 2001). Gain-framed messages highlighted the benefits of undertaking screening (number of lives saved) while loss-framed messages highlighted the costs of not undertaking screening (number of lives lost). In two of the three studies, no effect was found. In one study, the loss-framed message performed better than the gain framed message in increasing uptake.

Self-affirmation: There was one study which investigated the impact of self-affirmation to address the issue of health information avoidance. The hypothesis is that self-affirmation improves self-efficacy, which in turn reduces the need to avoid information. However, the study found no effects.

4.3.3 Incentive-based interventions

The previous sections discussed interventions to address informational and psychological barriers that hinder screening. In some cases, people have the intention to screen, yet fail to follow through due to various practical barriers, most of which are financial.

If screening centers are far away and require substantial transport costs, some people will not attend screening. Similarly, those with caregiving responsibilities often need to pay for childcare and self-employed individuals might miss out on earnings if they take time off for the screening. The provision of financial resources should alleviate such barriers.

Our review uncovered seven studies that used financial interventions such as travel vouchers, cash and lottery rewards to promote screening uptake (Bell et al., 1999; de Walque et al., 2016; Erwin et al., 2019; Green et al., 2019; Mehta et al., 2017; Mehta et al., 2020; Mehta et al., 2021). Overall, these studies suggest that the provision of financial resources can increase screening uptake. In five of the studies, a positive relationship was observed. In the other two, no association was found.

Table 2: Summary of relationships between different types of interventions and the uptake of NCD screening

Type	Intervention	Positive effect, n	Negative effect, n	No effect, n	Overall impact
Informational interventions	Awareness				
	- Correspondence	4	-	-	++
	- Media campaigns	2	-	1	+
	Education				
	- Written material	1	-	6	Nil
	- Phone/Video material	1	-	5	Nil
	- Face-to-face	3	-	-	++
	- Group sessions	1	-	4	Nil
	- Workplace/Community	4	-	1	++
Behavioural interventions	Personalisation				
	- Language translations	2	-	2	+
	- Making personal context salient	3	-	1	++
	Endorsement by trusted messengers	3	-	3	+
	Easing cognitive load				
	- Clear information presentation	2	-	2	+
	- Navigation help	6	-	1	++
	- Reminders	7	-	1	++
	Social norms	1	-	6	Nil
	Gain or loss framing	2	-	1	+
	Self-affirmation, or other motivational interventions	2	-	2	+
Incentive-based Interventions	Financial incentives	3		2	+
	Transport vouchers	2	-	-	++

5 Conclusions

The main objectives of this report were to survey existing research on (1) the factors behind health screening decisions and (2) the interventions that can affect these decisions. The rationale for these objectives is the design of an intervention to raise CVD screening in older Tasmanians. This will be the subject of the next phase of the project.

Based on these reviews, the design process will identify one or more factors behind screening decisions to be targeted by the intervention.¹ It will also determine the intervention delivery medium or channel. Finally, the intervention content be designed based on chosen factor and intervention delivery.

While this is the work of the next project stage, this final section will draw some preliminary learnings from our literature reviews towards the design. We begin by learnings from the survey of screening decision factors before turning to screening interventions.

5.1 Health screening decisions

Section 3 outlined the factors that drive individuals' decision to screen. We now assess this literature with a view to identifying factors that may be targeted through intervention. The final column of Table 1 summarises this assessment, which reflects the judgment of the research team based on the evidence we examined in the reviews.

5.1.1 Promoting rational screening decisions

Because health screening generally benefits the individual as well as society, decision factors based on cost-benefit analysis tend to increase screening uptake. We have seen that individuals and groups with poor information or limited ability to process engage less in screening. Lower SES groups and migrant communities are examples identified in the literature. As a result, successful interventions include promoting awareness of diseases and screening options can increase screening in these groups.

There are two qualifications to this approach. One relates to the substance of the information intervention and the other to the way it is presented. Greater awareness of inconvenience, cost or discomfort of screening can have the opposite effect on uptake – in this sense the effect of providing information may not always be positive (see Table 1). The other consideration is that providing information must be done in a way to avoid overwhelming the decision maker with detail that is hard to digest, may lead to decision fatigue or may be ignored. We examine these effects of cognitive limitations next.

5.1.2 Leveraging fast screening decisions

Fast decision making is associated with systematic reasoning error and biased information processing that can reduce screening. An example is the human tendency to overestimate one's own abilities. Applied to the screening context, this relates most readily to overconfidence in one's decision whether to screen. It may stop an individual who rejects screening from changing their mind in the face of evidence or persuasion. It should be noted that overconfidence is a common human trait with evolutionary roots. It may be addressed by policy but interventions are involved and require providing feedback and opportunities for learning to the individual

¹ Note that for this reason, many articles straddle both insights and interventions areas because of a fuzzy boundary between them: A successful intervention to screen is also a factor that influences the screening choice.

(Speirs-Bridge et al. 2010). Also, in some rare cases, overconfidence may support screening, e.g. if the decision to screen may inoculate an individual to social pressure not to.

Optimism bias is more univocally a barrier to screening. The difference to overconfidence is that this expectation relates to outcomes caused by factors outside the self. Optimism may reduce screening when one's own health outcomes are subject to the bias. Again, policy interventions exist to reduce this bias (and these can be tied to specific outcomes like contracting the coronavirus (e.g. Doliński et al. 2021).

Several other decision biases caused by fast thinking have an ambiguous effect on screening as they depend on factors external to the decision maker. For example, whether availability biases an individual to or away from screening depends on the type of information that is highly available to them: A grandfather who smoked and lived, or a young smoker who died. Loss aversion's effect depends on whether an individual is entitled to screening (e.g. from insurance) or not. The decision-preserving effect of the status quo bias depends on whether the initial decision was in favour or against screening. In all these cases, an intervention would have to be tailored to groups who share this external condition.

The nature of screening, i.e. trading off current inconvenience and cost to manage long-term adverse consequences, means that present bias is an inhibitor. Individuals tend to favour immediate gratification at the expense of future ones. Behavioural training interventions to delay immediate gratification exist and have shown effectiveness (e.g. Scholten, et al. 2019). However as before, these go beyond simple, one-shot interventions.

Similarly, behavioural intervention to overcome medical procedure phobias and anxiety exist, using different media and approaches. Some are effective and can increase screening uptake, but they also tend to be involved (Abdel-Jalil et al. 2024).

Cognitive overload is a barrier to health screening because of the information involved in the choice. Further, information-based interventions need to be designed with overload in mind: Information needs to be internalised to shift behaviour. Behavioural scientists and user experience designers have developed easy to impart and tailor information to enhance comprehension (e.g. Wendel 2020). Again, in principle cognitive overload can lock in pro-screening decisions, but the opposite effect is likely to be more common.

5.1.3 Making screening choice more social

Social effects of screening mean that others' opinions and directions affect decision irrespective of individual costs and benefits. It stands to reason that the effect on screening depends what side of the decision these others are on. Social norms for or against health interventions are common in different segments of society (the anti-vax movement is an example - see Adamus et al. 2024; Hornsey et al. 2018). As in other areas, interventions could leverage different sources of social influence in the direction of screening, from family members to friend networks or appeals to social norms. More targeted interventions based on family status could mobilise care for partners or children as a motivator to screen.

Social networks provide powerful conduits for transmitting information and have been used in context where information sharing improves outcomes (such as filling job vacancies, see Rajkumar et al. 2022). As in the other cases. The effect of social networks on screening depends on views and norms of network members. Networks are highly effective in the health context and can be created through interventions using mobile technologies such as smartphone apps (Hunter et al. 2019).

5.1.4 Managing individual differences in screening

Individual differences have a pronounced impact on screening decisions. The effect differs for the Big 5 personality traits, for different motivations and values. They also depend on context: High self-efficacy can relate both to one's ability to deal with the screening process, or with any illness should it occur.

An optimistic disposition as a personality trait is conceptually different to optimism bias: The latter is a general human trait regarding specific events while the former is a tendency to look at the bright side in a more general way. It generates a positive outlook towards the screening process and its efficacy.

There are also specific values and attitudes, towards medicine, technology, science and the medical profession, which have a similar positive impact on screening. Of course, values in the opposite direction, as in the case of anti-vax (Adamus et al. 2024; Hornsey et al. 2018).

Risk tolerance (seeking risk or risk averseness) is among the most-studied individual traits as it affects behaviour in a host of social and economic situations. Risk is everywhere, and health is a potent example. Risk seekers are more likely to run the gauntlet regarding future poor health outcomes; risk avoiders are more likely to invest in insurance (proverbially or literally) against these.

Personality-related individual differences are relatively stable and do not seem, at first blush they, to be candidates for behaviour intervention. There are several reasons why they are important for policy. The first is that they vary in predictable patterns with individual demographics including age and gender, and to some extent, ethnicity (Foldes et al. 2008). We saw also that personality traits can change through learning and experience. Ones that reduce screening take up, like low conscientiousness, are potential targets. They are also important to consider as moderators of the other effects discussed so far: The extent to which screening is affected by information or social pressure depends on the individual's personality. These considerations need to inform intervention design.

Values and attitudes are socially transmitted and may be changed through information or the social channels mentioned above. A large literature in social psychology, stretching back more than 75 years, has developed a deep understanding of the attitude change process (e.g. Crano and Prislin 2006). These include information and social pressure as two routes appealing to slow and fast thinking respectively.

5.2 Health screening interventions

Section 4 outlined the empirical evidence relating to interventions to promote the uptake of uptake of non-communicable disease screening. We now assess this literature in terms of promising interventions. The final column of Table 2 summarises this assessment.

5.2.1 Informational interventions

These interventions involve providing information via different channels to raise awareness, educate and improve understanding of the disease, the benefits of screening, the risks, and the access to screening services.

The empirical evidence suggests that raising awareness of screening through correspondences and media campaigns are generally successful. However, when trying to build more comprehensive knowledge, simply providing information has limited impact. Informational interventions that employ more active delivery methods (e.g., individual, face-to-face delivery) are more successful to increase screening uptake compared to passive ones (e.g., brochures, leaflets, video material). Educational programs in workplaces have also been shown to be

successful, but evidence suggests that the main driver of their success is the availability of help in navigating the screening process. In other words, higher levels of knowledge about the costs and benefits of screening do not *per se* translate to higher uptake. Other supports are required.

5.2.2 Behavioural interventions

These interventions address the psychological (or behavioural) barriers that hinder screening uptake. These barriers include cognitive load constraints, loss aversion, social influence, as well as the lack of engagement, trust and self-efficacy.

The empirical evidence relating to such interventions highlight the importance of reducing cognitive effort and friction, and increasing relevance via personalisation. Making the navigation easy with active help, timely reminders and making the personal context of the participant salient had the most positive impacts on screening uptake. Trusted messenger, loss vs gain framing and motivational nudges had mixed results, while surprisingly, social norm nudges had limited impact on screening behaviour.

5.2.3 Incentive-based interventions

These interventions tackle the more practical barriers to screening, such as financial constraints. Overall, empirical evidence suggests that the provision of financial resources, particularly transport vouchers, can increase screening uptake.

While the interventions assessed above provide useful insights into what has worked or not in the past, they represent somewhat piecemeal efforts to increase screening uptake. The opportunity is ripe for the application of behavioural insights frameworks such as the Behavioural Insight Team's EAST framework (2014) to design future interventions. EAST sets out four principles for behavioural intervention design: To encourage a behaviour, make it Easy, Attractive, Social and Timely. We have seen elements of EAST in navigation help (Easy), personalisation (Attractive), descriptive social norms (Social) and reminders (Timely). The hugely rich insights summarised in section 5.1 provide fertile and promising avenues for more sophisticated interventions which are grounded in theory.

References

- Abdel-Jalil, A., Baldwin, J., & Leaf, J. (2024). Exposure-based treatments for fear and reactivity to medical procedures: A systematic review of the literature with implications for research and practice. *Behavioral Interventions*. <https://doi.org/10.1002/bin.2010>.
- Adamus, M., Mikušková, E., & Kohut, M. (2024). Conspire to one's own detriment: Strengthening HPV Program Support Through Debunking Epistemically Suspect Beliefs. *Applied psychology. Health and well-being*.
- Albada, A., Ausems, M. G., Bensing, J. M., & van Dulmen, S. (2009). Tailored information about cancer risk and screening: a systematic review. *Patient Education and Counseling*, 77(2), 155–171.
- Altinel, B., & Akin, B. (2022). The effect of multiple interventions for women at risk for cervical cancer on their health responsibility, beliefs regarding cervical cancer, and having screening: A randomized controlled trial. *Health Education Research*, 37(2), 94-103.
- Agostinho Silva, S., & Santos Fugas, C. (2015). The influence of peer norms. In M. J. Zohar (Ed.), *The Wiley Blackwell handbook of the psychology of occupational safety and workplace health* (pp. 61–82). Wiley-Blackwell.
- Allgood, P. C., Maroni, R., Hudson, S., Offman, J., Turnbull, A. E., Peacock, L., et al. (2017). Effect of second timed appointments for non-attenders of breast cancer screening in England: a randomised controlled trial. *Lancet Oncology*.
- Allison, P. (2012). When can you safely ignore multicollinearity? Retrieved from [Insert URL or source if available].
- Andreoni, J. (1989). Giving with impure altruism: Applications to charity and Ricardian equivalence. *Journal of Political Economy*, 97(6), 1447–1458.
- Angner, E., Ray, M. N., Saag, K. G., & Allison, J. J. (2009). Health and happiness among older adults: a community-based study. *Journal of Health Psychology*, 14(4), 503–512.
- Arcas, M. M., Burón, A., Ramis, O., Esturi, M., Hernández, C., & Macià, F. (2014). Can a mobile phone short message increase participation in breast cancer screening programmes?. *Revista Española de Salud Pública*, 29(4), 188-196.
- Arbyn, M., Anttila, A., Jordan, J., Ronco, G., Schenck, U., Segnan, N., et al. (2010). European guidelines for quality assurance in cervical cancer screening. Second edition—summary document. *Annals of Oncology*, 21(3), 448–458.
- Aro, A. R., de Koning, H. J., Absetz, P., & Schreck, M. (1999). Psychosocial predictors of first attendance for organised mammography screening. *Journal of Medical Screening*, 6(2), 82–88.
- Barnes, A. J., Groskaufmanis, L., & Thomson, N. B. (2016). Promising approaches from behavioral economics to improve patient lung cancer screening decisions. *Journal of the American College of Radiology*, 13(12 Pt B), 1566–1570.
- Bakr, O., Afsar-Manesh, N., Raja, N., Dermenchyan, A., Goldstein, N. J., & Shu, S. B. (2020). Application of behavioral economics principles improves participation in mailed outreach for colorectal cancer screening. *Clinical and Translational Gastroenterology*, 11(1), e00115.
- Barthe, J., Perrodeau, E., Gilberg, S., Ravaud, P., Ghasarossian, C., Marchand-Buttin, F., et al. (2015). Impact of a doctor's invitation on participation in colorectal cancer screening: A cluster randomized trial. *American Journal of Medicine*, 128(9), 1024.e1-7.

- Basch, C. E., Zybert, P., Wolf, R. L., Basch, C. H., Ullman, R., Shmukler, C., et al. (2015). A randomized trial to compare alternative educational interventions to increase colorectal cancer screening in a hard-to-reach urban minority population with health insurance. *Journal of Community Health*, 40(5), 975-983.
- Baum, A., Garofalo, J. P., & Yali, A. M. (1999). Socioeconomic status and chronic stress. *Annals of the New York Academy of Sciences*, 896, 131-144.
- Benthin, A., Slovic, P., Moran, P., Severson, H., Mertz, C. K., & Gerrard, M. (1995). Adolescent health-threatening and health-enhancing behaviors: A study of word association and imagery. *Journal of Adolescent Health*, 17(3), 143-152.
- Berens, E. M., Reder, M., Razum, O., Kolip, P., & Spallek, J. (2015). Informed choice in the German Mammography Screening Program by education and migrant status: Survey among first-time invitees. *PLoS ONE*, 10(11), e0142316.
- Binder, M., & Coad, A. (2013). "I'm afraid I have bad news for you..." Estimating the impact of different health impairments on subjective well-being. *Social Science & Medicine*, 87, 155-167.
- Boell, S. K., & Cecez-Kecmanovic, D. (2015). On being systematic in literature reviews in IS. *Journal of Information Technology*, 30(2), 161-173.
- Bongaerts, T. H., Büchner, F. L., Middelkoop, B. J., Guicherit, O. R., & Numans, M. E. (2020). Determinants of (non-)attendance at the Dutch cancer screening programmes: A systematic review. *Journal of Medical Screening*, 27(3), 121-129.
- Box, G. E., & Cox, D. R. (1964). An analysis of transformations. *Journal of the Royal Statistical Society. Series B (Methodological)*, 26(2), 211-252.
- Braun, K. L., Fong, M., Kaanoi, M. E., Kamaka, M. L., & Gotay, C. C. (2005). Testing a culturally appropriate, theory-based intervention to improve colorectal cancer screening among Native Hawaiians. *Preventive Medicine*, 40(6), 619-627.
- Brown, S. B., Gibney, T. M., & Tarling, R. (2013). Busy lifestyles and mammography screening: time pressure and women's reattendance likelihood. *Psychology & Health*, 28(8), 928-938.
- Brown, S. B., Hole, D. J., & Cooke, T. G. (2007). Breast cancer incidence trends in deprived and affluent Scottish women. *Breast Cancer Research and Treatment*, 103(2), 233-238.
- Bulliard, J.-L., De Landtsheer, J.-P., & Levi, F. (2004). Reattendance in the Swiss mammography screening pilot programme. *Journal of Medical Screening*, 11(2), 59-64.
- Caplan, L. S., Helzlsouer, K. J., Shapiro, S., Wesley, M. N., & Edwards, B. K. (1996). Reasons for delay in breast cancer diagnosis. *Preventive Medicine*, 25(2), 218-224.
- Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science*, 7(1), 37.
- Champion, V. L., Monahan, P. O., Stump, T. E., Biederman, E. B., Vachon, E., Katz, M. L., et al. (2022). The effect of two interventions to increase breast cancer screening in rural women. *Cancers (Basel)*, 14(18).
- Champion, V. L., & Skinner, C. S. (2008). The health belief model. *Health behavior and health education: Theory, research, and practice*, 4, 45-65.
- Chapman, G. B., & Elstein, A. S. (1995). Valuing the future: temporal discounting of health and money. *Medical Decision Making*, 15(4), 373-386.
- Chernev, A., Böckenholt, U., & Goodman, J. (2015). Choice overload: A conceptual review and meta-analysis. *Journal of Consumer Psychology*, 25(2), 333-358.
- Chigbu, C. O., Onyebuchi, A. K., Onyeka, T. C., Odugu, B. U., & Dim, C. C. (2017). The impact of community health educators on uptake of cervical and breast cancer prevention services in Nigeria. *International Journal of Gynaecology and Obstetrics*, 137(3), 319-324.

- Chin, M. H., Walters, A. E., Cook, S. C., & Huang, E. S. (2007). Interventions to reduce racial and ethnic disparities in health care. *Medical Care Research and Review*, 64(5 Suppl), 7S–28S.
- Choudhry, N. K., Avorn, J., Glynn, R. J., Antman, E. M., Schneeweiss, S., Toscano, M., Reisman, L., Fernandes, J., Spettell, C., Lee, J. L., & Levin, R. (2011). Full coverage for preventive medications after myocardial infarction. *New England Journal of Medicine*, 364(24), 2307–2317.
- Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *The New England Journal of Medicine*, 357(4), 370–379.
- Chuah, J., & Hoffmann, K. (2025, January 2). Why your spin bike has become a clothes rack – and what you can do about it, according to behavioural science. *The Conversation*.
- Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Influence: Compliance and Conformity. *Annual Review of Psychology*, 59, 601–621.
- Clark, D. O., Patrick, D. L., Grembowski, D., & Durham, M. L. (1995). Socioeconomic status and exercise self-efficacy in late life. *Journal of Behavioral Medicine*, 18(4), 355–376.
- Clouston, K., Katz, A., Martens, P. J., Sisler, J., Turner, D., Lobchuk, M., et al. (2014). Does access to a colorectal cancer screening website and/or a nurse-managed telephone help line provided to patients by their family physician increase fecal occult blood test uptake?: Results from a pragmatic cluster randomized controlled trial. *BMC Cancer*, 14, 263.
- Cole, S. R., Young, G. P., Byrne, D., Guy, J. R., & Morcom, L. M. (2002). Participation in screening for colorectal cancer based on a faecal occult blood test is improved by endorsement by the primary care practitioner. *Journal of Medical Screening*, 9(4), 147–152.
- Consedine, N. S., Horton, D., Magai, C., & Kukafka, R. (2007). Breast screening in response to gain, loss, and empowerment-framed messages among diverse, low-income women. *Journal of Health Care for the Poor and Underserved*, 18(3), 550–566.
- Crano, W. D., & Prislin, R. (2006). Attitudes and persuasion. *Annual Review of Psychology*, 57(1), 345–374.
- Crump, S. R., Mayberry, R. M., Taylor, B. D., Barefield, K. P., & Thomas, P. E. (2000). Factors related to noncompliance with screening mammogram appointments among low-income African-American women. *Journal of the National Medical Association*, 92(5), 237–246.
- Danner, U. N., Aarts, H., & de Vries, N. K. (2008). Habit vs. intention in the prediction of future behaviour: the role of frequency, context stability and mental accessibility of past behaviour. *British Journal of Social Psychology*, 47(Pt 2), 245–265.
- Deck, C., & Jahedi, S. (2015). The effect of cognitive load on economic decision making: A survey and new experiments. *European Economic Review*, 78, 97–119.
- De Nooijer, D. P., de Waart, F. G., van Leeuwen, A. W., & Spijker, W. W. (2005). Participatie aan het Nederlandse bevolkingsonderzoek naar baarmoederhalskanker hoger na uitnodiging door huisarts, vooral in traditioneel laag-opnamegroepen. *Nederlands Tijdschrift voor Geneeskunde*, 149(42), 2339–2343.
- Del Mar, C., Glasziou, P., Adkins, P., Hua, T., Brown, M. (1998). Do personalized letters in Vietnamese increase cervical cancer screening among Vietnamese women? *Australian and New Zealand Journal of Public Health*, 22(7), 824–825.
- de Ramirez, S., McGarvey, J., Lotz, A., McGee, M., Oderwald, T., Floess, K., et al. (2022). Closing the gap: A comparison of engagement interventions to achieve equitable breast cancer screening in rural Illinois. *Population Health Management*, 25(2), 244–253.
- DeSantis, C. E., Siegel, R. L., Sauer, A. G., Miller, K. D., Fedewa, S. A., Alcaraz, K. I., et al. (2016). Cancer statistics for African Americans, 2016: Progress and opportunities in reducing racial disparities. *CA: A Cancer Journal for Clinicians*, 66(4), 290–308.

- de Walque, D., Chukwuma, A., Ayivi-Guedehoussou, N., & Koshkakaryan, M. (2022). Invitations, incentives, and conditions: A randomized evaluation of demand-side interventions for health screenings. *Social Science & Medicine*, 296, 114763.
- Detweiler, J. B., Bedell, B. T., Salovey, P., Pronin, E., & Rothman, A. J. (1999). Message framing and sunscreen use: Gain-framed messages motivate beach-goers. *Health Psychology*, 18(2), 189–196.
- Dobewall, H., Tark, R., & Aavik, T. (2018). Health as a value and its association with health-related quality of life, mental health, physical health, and subjective well-being. *Applied Research in Quality of Life*, 13, 859–872.
- Doliński, D., Kulesza, W., Muniak, P., Dolińska, B., Węgrzyn, R., & Izydorczak, K. (2021). Media intervention program for reducing unrealistic optimism bias: The link between unrealistic optimism, well-being, and health. *Applied Psychology. Health and Well-Being*, 14, 499 - 518.
- Downs, L. S., Smith, J. S., Scarinci, I., Flowers, L., & Parham, G. (2008). The disparity of cervical cancer in diverse populations. *Gynecologic Oncology*, 109(2 Suppl), S22–S30.
- Duffy, S. W., Myles, J. P., Maroni, R., & Mohammad, A. (2016). Rapid review of evaluation of interventions to improve participation in cancer screening services. *Journal of Medical Screening*.
- Durkin, S., Broun, K., Guerin, N., Morley, B., & Wakefield, M. (2020). Impact of a mass media campaign on participation in the Australian bowel cancer screening program. *Journal of Medical Screening*, 27(1), 18-24.
- Durkin, S. J., Broun, K., Spittal, M. J., & Wakefield, M. A. (2019). Impact of a mass media campaign on participation rates in a National Bowel Cancer Screening Program: A field experiment. *BMJ Open*, 9(1), e024267
- Foldes, H., Duehr, E., & Ones, D. (2008). Group differences in personality: Meta-analyses comparing five U.S. racial groups. *Personnel Psychology*, 61, 579-616.
- Eaker, S., Adami, H. O., Granath, F., Wilander, E., & Sparen, P. (2004). A large population-based randomized controlled trial to increase attendance at screening for cervical cancer. *Cancer Epidemiology, Biomarkers & Prevention*, 13(3), 346–354.
- Ekechi, C., Olaitan, A., Ellis, R., Koris, J., Amajuoyi, A., & Marlow, L. A. (2014). Knowledge of cervical cancer and attendance at cervical cancer screening: A survey of Black women in London. *BMC Public Health*, 14, 1096.
- Elster, J. (2020). Social norms and economic theory. In *Handbook of monetary policy* (pp. 117–133). Routledge.
- Erwin, E., Aronson, K. J., Day, A., Ginsburg, O., Macheku, G., Feksi, A., et al. (2019). SMS behaviour change communication and eVoucher interventions to increase uptake of cervical cancer screening in the Kilimanjaro and Arusha regions of Tanzania: A randomized, double-blind, controlled trial of effectiveness. *BMJ Innovations*, 5(1), 28-34.
- Falk, A., & Fischbacher, U. (2006). A theory of reciprocity. *Games and Economic Behavior*, 54(2), 293–315.
- Fallowfield, L. J., Rodway, A., & Baum, M. (1990). What are the psychological factors influencing attendance, non-attendance and re-attendance at a breast screening centre? *Journal of the Royal Society of Medicine*, 83(9), 547–551.
- Feldstein, A. C., Perrin, N., Rosales, A. G., Schneider, J., Rix, M. M., & Glasgow, R. E. (2011). Patient barriers to mammography identified during a reminder program. *Journal of Women's Health*, 20(11), 1717–1722.
- Fehr, E., & Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *The Quarterly Journal of Economics*, 114(3), 817–868.
- Feldstein, A. C., Perrin, N., Rosales, A. G., Schneider, J., Rix, M. M., & Glasgow, R. E. (2011). Patient barriers to mammography identified during a reminder program. *Journal of Women's Health*, 20(11), 1717–1722.

- Gallagher, K. M., & Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: A meta-analytic review. *Annals of Behavioral Medicine*, 43(1), 101–116.
- Gallagher, K. M., Updegraff, J. A., Rothman, A. J., & Sims, L. (2011). Perceived susceptibility to breast cancer moderates the effect of gain- and loss-framed messages on use of screening mammography. *Health Psychology*, 30(2), 145–152.
- Gerber, A. S., & Green, D. P. (2009). Descriptive social norms and motivation to vote: Everybody's voting and so should you. *The Journal of Politics*, 71(1), 178–191.
- Ghaffari, M., Rad, T. N., Mohammadi, S., & Rakhshanderou, S. (2018). Effect of an intervention on the breast cancer screening behavior in women: Application of the integrated behavioral model. *International Journal of Preventive Medicine*, 9, 99.
- Gimeno-Garcia, A. Z., Quintero, E., Nicolas-Perez, D., Parra-Blanco, A., & Jimenez-Sosa, A. (2009). Impact of an educational video-based strategy on the behavior process associated with colorectal cancer screening: A randomized controlled study. *Cancer Epidemiology*, 33(3-4), 216–222.
- Giorgi Rossi, P., Grazzini, G., Anti, M., Baiocchi, D., Barca, A., Bellardini, P., et al. (2011). Direct mailing of faecal occult blood tests for colorectal cancer screening: A randomized population study from Central Italy. *Journal of Medical Screening*, 18(3), 121–127.
- Glanz, K., Rimer, B. K., Lerman, C., & McGovern Gorchov, P. (1992). Factors influencing acceptance of mammography: Implications for enhancing worksite cancer control. *American Journal of Health Promotion*, 7(1), 28–36.
- Gold, N., Durlak, C., Sanders, J. G., Thompson, K., & Chadborn, T. (2019). Applying behavioral science to increase uptake of the NHS Health Check: A randomized controlled trial of gain- and loss-framed messaging in the national patient information leaflet. *BMC Public Health*, 19(1), 1519.
- Goldstein, D. G., & Johnson, E. J. (2003). Defaults save lives. *Science*, 302(5649), 1338–1339.
- Goldzahl, L., Hollard, G., & Jusot, F. (2018). Increasing breast-cancer screening uptake: A randomized controlled experiment. *Journal of Health Economics*, 58, 228–252.
- Gorini, G., Betti, E., Stoffel, S., Falini, P., Iossa, A., Senore, C., et al. (2023). Testing behavioral economics messages to increase non-responders' participation in organized colorectal cancer screening programs: A randomized controlled trial. *Preventive Medicine*, 174, 107615.
- Gotzsche, P. C., & Nielsen, M. (2011). Screening for breast cancer with mammography. *The Cochrane Database of Systematic Reviews*, 1, CD001877.
- Grimm, P. (2010). Social desirability bias. John Wiley & Sons.
- Grol, R., Hermens, R. P., Tacken, M. A., & Hulscher, M. E. (2000). Attendance to cervical cancer screening in family practices in the Netherlands. *Preventive Medicine*, 30(1), 35–42.
- Hallsworth, M., Berry, D., Sanders, M., Sallis, A., King, D., & Vlaev, I. (2015). Stating appointment costs in SMS reminders reduces missed hospital appointments: Findings from two randomised controlled trials. *PLoS ONE*, 10(9), e0137306.
- Hallsworth, M., Chadborn, T., Sallis, A., Sanders, M., Berry, D., Greaves, F., et al. (2016). Provision of social norm feedback to high prescribers of antibiotics in general practice: a pragmatic national randomised controlled trial. *The Lancet*, 387(10029), 1743–1752.
- Hawkes, N. (2012). Poor health does not preclude a happy life, though it does increase the odds against it. *BMJ: British Medical Journal (Online)*, 345.
- Henderson, L., Clements, A., Damery, S., Wilkinson, C., Austoker, J., Wilson, S., et al. (2011). 'A false sense of security'? Understanding the role of the HPV vaccine on future cervical screening behaviour: a qualitative study of UK parents and girls of vaccination age. *Journal of Medical Screening*, 18(1), 41–5.

- Hermens, R. P., Tacken, M. A., Hulscher, M. E., Braspenning, J. C., & Grol, R. P. (2000). Attendance to cervical cancer screening in family practices in the Netherlands. *Preventive Medicine*, 30(1), 35–42.
- Hersch, J., Barratt, A., Jansen, J., Irwig, L., McGeechan, K., Jacklyn, G., et al. (2015). Use of a decision aid including information on overdetected to support informed choice about breast cancer screening: A randomised controlled trial. *The Lancet*, 385(9978), 1642–1652.
- Hestbech, M. S., Gyrd-Hansen, D., Kragstrup, J., Siersma, V., & Brodersen, J. (2016). How does HPV vaccination status relate to risk perceptions and intention to participate in cervical screening? A survey study. *BMC Public Health*, 16, 708.
- Hewitson, P., Ward, A. M., Heneghan, C., Halloran, S. P., & Mant, D. (2011). Primary care endorsement letter and a patient leaflet to improve participation in colorectal cancer screening: Results of a factorial randomised trial. *British Journal of Cancer*, 105(4), 475–480.
- Hirko, K. A., Lennon, S. A., Lucas, T., Miller, D. C., Jimbo, M., Leibfritz, S. J., et al. (2020). Improving colorectal cancer screening in a rural setting: A randomized study. *American Journal of Preventive Medicine*, 59(3), 404–411.
- Hole, D. J., Baker, D., & Middleton, E. (2003). Cervical screening and health inequality in England in the 1990s. *Journal of Epidemiology and Community Health*, 57(6), 417–423.
- Hoque, M. E. (2013). Awareness of cervical cancer, Papanicolaou's smear and its utilization among female, final year undergraduates in Durban, South Africa. *Journal of Cancer Research and Therapeutics*, 9(1), 25–28.
- Hornsey, M., Harris, E., & Fielding, K. (2018). The Psychological Roots of Anti-Vaccination Attitudes: A 24-Nation Investigation. *Health Psychology*, 37, 307–315.
- Huang, I., Lee, J. L., Ketheeswaran, P., Jones, C. M., Revicki, D., & Wu, A. (2017, March 29). Does personality affect health-related quality of life? A systematic review. *PLoS ONE*.
- Huf, S., Kerrison, R. S., King, D., Chadborn, T., Richmond, A., Cunningham, D., et al. (2020). Behavioral economics informed message content in text message reminders to improve cervical screening participation: Two pragmatic randomized controlled trials. *Preventive Medicine*, 139, 106170.
- Humphreys, L. G., & Ilgen, E. R. (1976). Latent roots of random data correlation matrices with squared multiple correlations on the diagonal: A Monte Carlo study. *Psychometrika*, 41, 341–348.
- Hunter, R., De La Haye, K., Murray, J., Badham, J., Valente, T., Clarke, M., & Kee, F. (2019). Social network interventions for health behaviours and outcomes: A systematic review and meta-analysis. *PLoS Medicine*, 16.
- Ishikawa, Y., Zheng, Y. F., Nishiuchi, H., Suda, T., Hasumi, T., & Saito, H. (2013). Classification tree analysis to enhance targeting for follow-up exam of colorectal cancer screening. *BMC Cancer*, 13, 470.
- Jacobson, P. D., & Wasserman, J. (1999). The implementation and enforcement of tobacco control laws: Policy implications for activists and the industry. *Journal of Health Politics, Policy and Law*, 24(3), 567–598.
- Janda, M., Youl, P. H., Lowe, J. B., Baade, P. D., Elwood, M., Ring, I. T., et al. (2006). What motivates men aged 50 years and older to participate in a screening program for melanoma? *Cancer*, 107(4), 815–823.
- Jepson, R., Clegg, A., Forbes, C., Lewis, R., Sowden, A., & Kleijnen, J. (2000). The determinants of screening uptake and interventions for increasing uptake: A systematic review. *Health Technology Assessment*, 4(14), i-vii, 1–133.
- Johnson, E. J., & Goldstein, D. G. (2004). Defaults and donation decisions. *Transplantation*, 78(12), 1713–1716.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica*, 47, 263–291.

- Kang, J., Wang, S., Yi, J., & Zhang, Q. (2024). Effects of health education on screening rate of first-degree relatives of cancer patients: A systematic review and meta-analysis. *Journal of Medical Screening*, 31(3), 121–133.
- Katapodi, M. C., Lee, K. A., Facione, N. C., & Dodd, M. J. (2004). Predictors of perceived breast cancer risk and the relation between perceived risk and breast cancer screening: A meta-analytic review. *Preventive Medicine*, 38(4), 388–402.
- Khwaja, A., Silverman, D., Sloan, F., & Wang, Y. (2009). Are mature smokers misinformed? *Journal of Health Economics*, 28(2), 385–397.
- Knops-Dullens, T., de Vries, N., & de Vries, H. (2007). Reasons for non-attendance in cervical cancer screening programmes: An application of the Integrated Model for Behavioural Change. *European Journal of Cancer Prevention*, 16(5), 436–445.
- Kurt, G., & Akyuz, A. (2019). Evaluating the effectiveness of interventions on increasing participation in cervical cancer screening. *Journal of Nursing Research*, 27(5), e40.
- Laibson, D. (1997). Golden eggs and hyperbolic discounting. *The Quarterly Journal of Economics*, 112(2), 443–478.
- Lechner, L., de Vries, H., & Offermans, N. (1997). Participation in a breast cancer screening program: Influence of past behavior and determinants on future screening participation. *Preventive Medicine*, 26(4), 473–482.
- Lewis, C. L., Brenner, A. T., Griffith, J. M., & Pignone, M. P. (2008). The uptake and effect of a mailed multi-modal colon cancer screening intervention: A pilot controlled trial. *Implementation Science*, 3, 32.
- Lopez-Torres Hidalgo, J., Rabanales Sotos, J., Simarro Herraiz, M. J., Lopez-Torres Lopez, J., Campos Rosa, M., & Lopez Verdejo, M. A. (2016). Effectiveness of three interventions to improve participation in colorectal cancer screening. *Revista Española de Enfermedades Digestivas*, 108(6), 315–322.
- Luoto, J., & Carman, K. G. (2014). Behavioral economics guidelines with applications for health interventions. Inter-American Development Bank. Social Protection and Health Division. IDB Technical Note: 665.
- Lutter, J., Szentes, B., Wacker, M., Winter, J., Wichert, S., Peters, A., Holle, R., & Leidl, R. (2019). Are health risk attitude and general risk attitude associated with healthcare utilization, costs and working ability? Results from the German KORA FF4 cohort study. *Health Economics Review*, 9.
- Ma, G. X., Yin, L., Gao, W., Tan, Y., Liu, R., Fang, C., et al. (2012). Workplace-based breast cancer screening intervention in China. *Cancer Epidemiology, Biomarkers & Prevention*, 21(2), 358–367.
- McGregor, L. M., Bonello, B., Kerrison, R. S., et al. (2016). Uptake of Bowel Scope (Flexible Sigmoidoscopy) Screening in the English National Programme: The first 14 months. *Journal of Medical Screening*, 23(2), 77–82.
- McKay, E., Wong, J., Ward, S., Ruwende, J., & Kerrison, R. (2025). Barriers and facilitators of abdominal aortic aneurysm screening in London: A cross-sectional survey. *Journal of Medical Screening*, 32(1), 53–56
- MacLure, M. (2005). ‘Clarity bordering on stupidity’: Where’s the quality in systematic review? *Journal of Education Policy*, 20(4), 393–416.
- Mackenbach, J. P. (2014). Cultural values and population health: A quantitative analysis of variations in cultural values, health behaviours and health outcomes among 42 European countries. *Health & Place*, 28, 116–132.
- Maheswaran, R., Pearson, T., Jordan, H., & Black, D. (2006). Socioeconomic deprivation, travel distance, location of service, and uptake of breast cancer screening in North Derbyshire, UK. *Journal of Epidemiology and Community Health*, 60(3), 208–212.

- Mandrik, O., Tolma, E., Zielonke, N., et al. (2021). Systematic reviews as a “lens of evidence”: Determinants of participation in breast cancer screening. *Journal of Medical Screening*, 28(2), 70–79.
- Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science*, 341(6149), 976–980.
- Mäntyselkä, P., Kautiainen, H., & Miettola, J. (2019, August 5). Beliefs and attitudes towards lifestyle change and risks in primary care – a community-based study. *BMC Public Health*.
- Marlow, L. A., Wardle, J., & Waller, J. (2015). Understanding cervical screening non-attendance among ethnic minority women in England. *British Journal of Cancer*, 113(5), 833–839.
- Marvan, M. L., Ehrenzweig, Y., & Catillo-Lopez, R. L. (2013). Knowledge about cervical cancer prevention and psychosocial barriers to screening among Mexican women. *Journal of Psychosomatic Obstetrics & Gynaecology*, 34(4), 163–169.
- Mehta, S. J., Feingold, J., Vandertuyn, M., Niewood, T., Cox, C., Doubeni, C. A., et al. (2017). Active choice and financial incentives to increase rates of screening colonoscopy: A randomized controlled trial. *Gastroenterology*, 153(5), 1227-1229.e2.
- Mehta, S. J., Oyalowo, A., Reitz, C., Dean, O., McAuliffe, T., Asch, D. A., et al. (2020). Text messaging and lottery incentive to improve colorectal cancer screening outreach at a community health center: A randomized controlled trial. *Preventive Medicine Reports*, 19, 101114.
- Mehta, S. J., Reitz, C., Niewood, T., Volpp, K. G., & Asch, D. A. (2021). Effect of behavioral economic incentives for colorectal cancer screening in a randomized trial. *Clinical Gastroenterology and Hepatology*, 19(8), 1635-1641.e1.
- Montero-Moraga, J. M., Posso, M., Roman, M., Buron, A., Sala, M., Castells, X., et al. (2021). Effect of an information leaflet on breast cancer screening participation: A cluster randomized controlled trial. *BMC Public Health*, 21(1), 1301.
- Moore, D. A., & Healy, P. J. (2008). The trouble with overconfidence. *Psychological Review*, 115(2), 502.
- Moses, J. (2013). Get action instead of indifference: Using behavioral economics insights to deliver benefits messages. *Benefits Quarterly*, 29(3).
- Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science*, 341(6149), 976–980.
- Murray, A. L., & Booth, T. (2015). Personality and physical health. *Current Opinion in Psychology*, 5, 50–55.
- Myers, R. E., Sifri, R., Hyslop, T., Rosenthal, M., Vernon, S. W., Cocroft, J., et al. (2007). A randomized controlled trial of the impact of targeted and tailored interventions on colorectal cancer screening. *Cancer*, 110(9), 2083-2091.
- Mynttinen, S., Sundström, A., Koivukoski, M., Hakuli, K., Keskinen, E., & Henriksson, W. (2009). Are novice drivers overconfident? A comparison of self-assessed and examiner-assessed driver competences in a Finnish and Swedish sample. *Transportation Research Part F: Traffic Psychology and Behaviour*, 12(2), 120–130.
- O’Brien, C. W., & Moorey, S. (2010). Outlook and adaptation in advanced cancer: A systematic review. *PsychoOncology*, 19, 1239–1249.
- O’Donoghue, T., & Rabin, M. (1999). Doing it now or later. *American Economic Review*, 89(1), 103–124.
- O’Donoghue, T., & Rabin, M. (2000). The economics of immediate gratification. *Journal of Behavioral Decision Making*, 13(2), 233–250.
- Ogedegbe, G., Cassells, A. N., Robinson, C. M., DuHamel, K., Tobin, J. N., Sox, C. H., ... et al. (2005). Perceptions of barriers and facilitators of cancer early detection among low-income minority women in community health centers. *Journal of the National Medical Association*, 97(2), 162–170.

- Plumb, A. A., Ghanouni, A., Rainbow, S., et al. (2017). Patient factors associated with non-attendance at colonoscopy after a positive screening faecal occult blood test. *Journal of Medical Screening*, 24(1), 12–19.
- Purnell, J. Q., Thompson, T., Kreuter, M. W., & McBride, T. D. (2015). Behavioral economics: "Nudging" underserved populations to be screened for cancer. *Preventing Chronic Disease*, 12, E06.
- Rajkumar, K., Saint-Jacques, G., Bojinov, I., Brynjolfsson, E., & Aral, S. (2022). A causal test of the strength of weak ties. *Science*, 377(6612), 1304–1310.
- Risi, L., Bindman, J. P., Campbell, O. M., Imrie, J., Everett, K., Bradley, J., et al. (2004). Media interventions to increase cervical screening uptake in South Africa: An evaluation study of effectiveness. *Health Education Research*, 19(4), 457–468.
- Roh, S., & Lee, Y. S. (2023). Developing culturally tailored mobile web app education to promote breast cancer screening: Knowledge, barriers, and needs among American Indian women. *Journal of Cancer Education*, 38(4), 1224–1233.
- Ruparel, M., Quaife, S. L., Ghimire, B., Dickson, J. L., Bhowmik, A., Navani, N., et al. (2019). Impact of a lung cancer screening information film on informed decision-making: A randomized trial. *Annals of the American Thoracic Society*, 16(6), 744–751.
- Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty*, 1, 7–59.
- Sallis, A., Buntin, A., Bonus, A., James, A., Chadborn, T., & Berry, D. (2016). The effectiveness of an enhanced invitation letter on uptake of National Health Service Health Checks in primary care: A pragmatic quasi-randomized controlled trial. *BMC Family Practice*, 17, 35.
- Schliemann, D., Jamil, A. S. A., Mohan, D., Tan, M. M., Cardwell, C. R., & Ismail, R. (2023). The development and evaluation of a mHealth, community education and navigation intervention to improve clinical breast examination uptake in Segamat, Malaysia: A randomized controlled trial. *PLOS ONE*, 18(10), e0288437.
- Schneider, T. R., Salovey, P., Apanovitch, A. M., Pizarro, J., McCarthy, D., Zullo, J., et al. (2001). The effects of message framing and ethnic targeting on mammography use among low-income women. *Health Psychology*, 20(4), 256–266.
- Scholten, H., Scheres, A., De Water, E., Graf, U., Granic, I., & Luijten, M. (2019). Behavioral trainings and manipulations to reduce delay discounting: A systematic review. *Psychonomic Bulletin & Review*, 26, 1803 – 1849.
- Schueler, K. M., Chu, P. W., & Smith-Bindman, R. (2008). Factors associated with mammography utilization: A systematic quantitative review of the literature. *Journal of Women's Health*, 17(9), 1477–1498.
- Seven, M., Akyuz, A., & Robertson, L. B. (2015). Interventional education methods for increasing women's participation in breast cancer screening programs. *Journal of Cancer Education*, 30(2), 244–252.
- Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science*, 338(6107), 682–685.
- Sharot, T. (2012). *The optimism bias: Why we're wired to look on the bright side*. Constable & Robinson.
- Shiv, B., & Fedorikhin, A. (1999). Heart and mind in conflict: The interplay of affect and cognition in consumer decision making. *Journal of Consumer Research*, 26(3), 278–292.
- Simon, H. A. (1972). Theories of bounded rationality. *Decision and Organization*, 1(1), 161–176.
- Slovic, P. (1987). Perception of risk. *Science*, 236(4799), 280–285.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, 177(3), 1333–1352.

- Speirs-Bridge, A., Fidler, F., McBride, M., Flander, L., Cumming, G., & Burgman, M. (2010). Reducing Overconfidence in the Interval Judgments of Experts. *Risk Analysis*, 30.
- Stoffel, S., Benito, L., Mila, N., Travier, N., Binefa, G., Vidal, C., et al. (2019). Testing behavioral interventions to optimize participation in a population-based colorectal cancer screening program in Catalonia, Spain. *Preventive Medicine*, 119, 58-62.
- Strickhouser, J. E., Zell, E., & Krizan, Z. (2017). Does personality predict health and well-being? A Metasynthesis. *Journal of Personality*.
- Sunstein, C. R. (1996). Social norms and social roles. *Columbia Law Review*, 96, 903.
- Tan, F., Oka, P., Dambha-Miller, H., & Tan, N. (2021). The association between self-efficacy and self-care in essential hypertension: A systematic review. *BMC Family Practice*, 22.
- Tavasoli, S. M., Pefoyo, A. J., Hader, J., Lee, A., & Kupets, R. (2016). Impact of invitation and reminder letters on cervical cancer screening participation rates in an organized screening program. *Preventive Medicine*, 88, 230-236.
- Teo, C., Ng, C., Booth, A., & White, A. (2016). Barriers and facilitators to health screening in men: A systematic review. *Social science & medicine*, 165, 168-176 .
- Thompson, B., Carosso, E. A., Jhingan, E., Wang, L., Holte, S. E., Byrd, T. L., et al. (2017). Results of a randomized controlled trial to increase cervical cancer screening among rural Latinas. *Cancer*, 123(4), 666-674.
- Tindle, H. A., Chang, Y. F., Kuller, L. H., Manson, J. E., Robinson, J. G., Rosal, M. C., ... et al. (2009). Optimism, cynical hostility, and incident coronary heart disease and mortality in the Women's health initiative. *Circulation*, 120, 656–662.
- Timmouth, J., Llovet, D., Sutradhar, R., Tsiplova, K., Roushani, J., Lee, A., et al. (2022). Two randomized controlled trials for colorectal cancer screening invitations developed using a behavioral science approach. *Preventive Medicine*, 155, 106918
- Timmouth, J., Patel, J., Austin, P. C., Baxter, N. N., Brouwers, M. C., Earle, C., ... et al. (2015). Increasing participation in colorectal cancer screening: Results from a cluster randomized trial of directly mailed gFOBT kits to previous nonresponders. *International Journal of Cancer*, 136(6), E697–E703.
- Tomljenovic, H., & Bubić, A. (2019). Cognitive and emotional factors in health behaviour: Dual-process reasoning, cognitive styles and optimism as predictors of healthy lifestyle, healthy behaviours and medical adherence. *Current Psychology*.
- Trigoni, M., Griffiths, F., Tsiftsis, D., Koumantakis, E., Green, E., & Lionis, C. (2008). Mammography screening: Views from women and primary care physicians in Crete. *BMC Women's Health*, 8, 20.
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5(2), 207–232.
- Vachon, E. A., Katz, M. L., Rawl, S. M., Stump, T. E., Emerson, B., Baltic, R. D., et al. (2024). Comparative effectiveness of two interventions to increase colorectal cancer screening among females living in the rural Midwest. *Journal of Rural Health*, 40(4), 610-622.
- Vernon, S. W., Lavelle, E. A., & Jackson, G. L. (1990). Participation in breast screening programs: A review. *Social Science & Medicine*, 30(10), 1107–1118.
- Volpp, K. G., & Asch, D. A. (2017). Make the healthy choice the easy choice: Using behavioral economics to advance a culture of health. *Quarterly Journal of Medicine*, 110(5), 271–275.
- Waller, J., Bartoszek, M., Marlow, L., & Wardle, J. (2009). Barriers to cervical cancer screening attendance in England: A population-based survey. *Journal of Medical Screening*, 16(4), 199–204.

- Weinstein, N. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 39(5), 806–820.
- Weinstein, N. D., Marcus, S. E., & Moser, R. P. (2005). Smokers' unrealistic optimism about their risk. *Tobacco Control*, 14(1), 55–59.
- Wendel, S. (2020). Designing for behavior change: Applying psychology and behavioral economics. O'Reilly Media.
- Wilding, S., Tsipa, A., Branley-Bell, D., Greenwood, D. C., Vargas-Palacios, A., Yaziji, N., et al. (2020). Cluster randomized controlled trial of volitional and motivational interventions to improve bowel cancer screening uptake: A population-level study. *Social Science & Medicine*, 265, 113496.
- Wong, C. L., Choi, K. C., Law, B. M. H., Chan, D. N. S., & So, W. K. W. (2019). Effects of a community health worker-led multimedia intervention on the uptake of cervical cancer screening among South Asian women: A pilot randomized controlled trial. *International Journal of Environmental Research and Public Health*, 16(17).
- Yoshida, M., Kondo, K., Nakanishi, C., & Tada, T. (2012). Interventional study for improvement of lung cancer screening rate. *Journal of Medical Investigation*, 59(1-2), 127-135.