Thinking Style and Health Behaviour:

A Dual-Process Approach to the Prediction of Preventive Health Behaviours.

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Abstract

Dual-process theories propose that cognition involves two different forms of processing: rapid, autonomous, associative type 1 processing, and slower, resource-intensive, more deliberative type 2 processing. Individual differences have been identified in the degree to which people rely on each type of processing, and a measure called the Rational-Experiential Inventory has been used to quantify these preferences — known as thinking style — as two independent variables. People who are high in *experientiality* tend to listen to their gut feelings and intuitions (i.e. type 1 processing) whereas those high in *rationality* are more likely to enjoy and value thinking hard (i.e. type 2 processing). Given the differing strengths of both types of thinking and the robust associations between some personality variables and health behaviour, it is worthwhile investigating the implications of thinking style for health behaviour. The aims of this project were to determine whether self-reported health behaviour was predicted by thinking style, whether it was better predicted by health-specific thinking style, and whether the influence of attitudes over behaviour is moderated by thinking style.

The first study made use of a subset of participants from a previous project (n = 585, all males, mean age 61.4 years) to explore the effect of thinking style on male-specific cancer screening behaviour. Rationality explained a small amount of variance in self-reported participation in digital rectal examinations (r = .11, p = .016). In the second study, N = 992 adults (54.1% female; mean age 46.5 years) completed an online survey, n = 510 of whom took part in a follow-up survey. A short form of the Rational-Experiential Multimodal Inventory was devised and validated, with acceptable results. Next, the short form thinking style items were translated to pertain to the health context, and this measure of health thinking

style demonstrated incremental validity over trait thinking style in the prediction of self-reported health behaviour: health rationality predicted variance in diet quality (ß = .17, $p < .001$), faecal occult blood test participation (ß = .20, $p = .001$), and pap smear participation (ß = .14, $p = .008$), while health intuition predicted variance in faecal occult blood test participation (ß = .20, $p = .001$). Finally, limited evidence was found to support the proposal that health rationality moderates the influence of explicit attitudes — and health intuition moderates the influence of implicit attitudes — over health behaviour. However, results diverged from expectations: moderations operated in an unexpected manner and both health rationality and health intuition moderated the prediction of diet quality by explicit attitudes.

This suite of results suggests that thinking style can explain some variance in health behaviour, and aligns with previous suggestions that people alter their thinking style depending on the domain. Health thinking style shows promise as a health psychological measure that can enable better understanding of health behaviour. The results also show that the interaction between thinking styles and attitudes in regards to health behaviour may be more complicated than previously thought.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Chapter 4.

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Clare McGuiness

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Finally, my thanks to my husband Dan: for your endless love and warmth, for the irrepressible fun and creativity you bring to our lives, for being there for me when I need it, and for the good humour with which you will presumably take the lovely dedication page I have prepared (see page xxiv). Our cat Natalie also deserves a mention: if you could comprehend my words, Natalie, I would thank you for your companionship and affection, the pre-dawn wake-ups, your long lists of indecipherable demands, the occasional minor flesh wound, and importantly, for your steadying influence. Nothing is more grounding than scooping cat turds out of a litter box, and such was your dedication to my welfare that you sometimes even demanded I took this self-care moment for myself more than once a day. Thank you.

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Overview

The thesis begins with a review of the literature and a thorough description of the concepts and variables around which the research revolves. The Introduction chapter concludes with statements of the aims of the research. Following this, the methodology of the research is described in more detail than could be included in the papers for publication. Next, four research papers are presented with preambles situating them with regards to the overall aims. I begin by testing for a link between thinking style and cancer screening behaviour in Chapter 3, and in Chapter 4 I prepare for subsequent work by creating a brief form of a recent thinking style measure. In Chapter 5 I use this short measure as a basis for the development of a scale to measure health thinking style, and I investigate its incremental validity in predicting health behaviour. Finally, in Chapter 6 I bring attitudes about health behaviour into the picture, and explore the ways in which they interact with health thinking style in predicting behaviour. The Discussion chapter summarises and integrates the findings, acknowledges the studies' limitations, discusses their implications and provides suggestions for future research.

References for all chapters are collected at the end of the thesis. Likewise, all Appendices are to be found at the end. Table and figure numbering are continuous throughout the document.

Dedication

For Dan and Natalie.

CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW.

1.1. Preamble

This thesis considers thinking style (preferences for using rapid, intuitive processing and more effortful deliberative processing; Epstein, Pacini, Denes-Raj, & Heier, 1996) in the context of primary and secondary preventive health behaviour. To set the scene for research on the relationship of thinking style to health behaviour, it is necessary to first introduce dual-process models of cognition, paying particular attention to the trait conceptualisation of processing preference. Second, attempts to predict health behaviours using dual-process variables will be briefly reviewed, finishing with work to date utilising thinking style variables. To conclude, the importance of the chosen health behaviours to health outcomes will be outlined.

1.2. Literature Review

1.2.1. Dual-process models of cognition

Research delineating feelings, instincts, and intuitions from deliberative, reflective, and analytic cognitions has been accumulating for several decades (e.g. Shiffrin & Schneider, 1977) but has arguably been characterised by inconsistency. In an attempt to clarify matters, Evans and Stanovich (2013) reviewed evidence, highlighted inconsistencies, and responded to criticisms of dual-process theories. The paper has spurred considerable debate, and in it the authors argued that while several theories had advanced a *dual systems* approach, it is more defensible to propose a *dual process* approach because while cognitive processes can be broadly categorised into two types, multiple systems may underlie each type. They also argued for the use of the terminology *type 1* and *type 2* to replace existing terms, such as those used at the beginning of this paragraph, that are more descriptive but potentially limiting or judgemental.

1.2.1.1. Type 1 processes.

The defining features of type 1 processes are that they operate autonomously (i.e. occurring in response to stimuli) and place few demands on working memory. A range of other features attributed to type 1 processes, including being associative, non-conscious and fast, are common but not universal characteristics. It is generally agreed that these kinds of processes resemble those governing the behaviour of animals, and that they are likely to be evolutionarily older than type 2 processes (Evans & Stanovich, 2013).

Examples of type 1 processes include the experience-based judgements that spring to mind for experts engaged in their practice; but also, on the other hand, the simplistic heuristics learned from experience and patterns in the environment that can lead to biased responding when incorrectly applied (Kahneman & Klein, 2009). Also falling within the type 1 category are cognitive modules devoted to a particular purpose (such as object identification), that are strung together to guide more complex behaviours (such as reading) (Barrett & Kurzban, 2006). Conditioning, implicit learning, overlearned associations, emotion-based behavioural control, and cognitive tasks automatized through repetition are all proposed to be type 1 processes (Evans & Stanovich, 2013). Recent findings even indicate the existence of a rudimentary form of logic processing that is rapid (Bago & De Neys, 2017). From the perspective of the individual, type 1 processes can be experienced as instincts, basic emotions such as fear (Evans, 2014), gut feelings or “knowing without knowing why” (Burton, Heintzelman, & King, 2013, p. 752).

1.2.1.2. Type 2 processes.

The ability for type 2 processing appears to be uniquely developed in humans. While semblances of such processes have been detected in some non-human animals, these animals' processing capacity is orders of magnitude below that of humans (Penn, Holyoak, & Povinelli, 2008). Type 2 processes are characterised by their demands on working memory, and a fundamental feature is *cognitive decoupling*: the ability to operate upon symbols and mental representations without confusing them with reality (Stanovich, West, & Toplak, 2011). They may also be comparatively slow, consciously controlled, and tend to be closely linked to cognitive ability. Functions include logical or hypothetical thinking, rule-based reasoning, complex emotions and mental simulation (Evans & Stanovich, 2013). In everyday life, it is type 2 processing that enables numeracy, language processing, prediction of future consequences, learning via analogy, the comprehension of other people's mental states, and the conceptual understanding of unseen biological and physical processes (Evans & Stanovich, 2013; Penn et al., 2008).

1.2.1.3. Mode of operation.

As findings to support the existence of two types of processing have accumulated, researchers have debated the way in which the two interact. Most dual-process theories describe either a *parallel-competitive* or a *default-interventionist* manner of interaction (Evans, 2008). Theories that use a parallel-competitive framework assume that both types of process operate simultaneously and interactively, with either a type 1 or a type 2 response predominating (e.g. Epstein, 1994; Sloman, 1996; E. R. Smith & DeCoster, 2000). Default-interventionist theories differ insofar as they propose that type 1 processes are generated rapidly in response to stimuli, but can be overridden or augmented by type 2 processing (e.g. Evans, 2007; Klein, 2008; Morewedge & Kahneman, 2010; Pennycook, Fugelsang, &

Koehler, 2015; Stanovich, 2009). The latter model resolves conceptual issues inherent to parallel-competitive models; not least of which is that it makes little sense for slow and resource-intensive type 2 processes to be initiated in response to every task (Evans & Stanovich, 2013). The capacity for type 2 processes to override type 1 processes, therefore, is a central feature of default-interventionist models, but the antecedents of type 2 processing require explanation. A number of factors (sometimes called boundary conditions; Hofmann, Friese, & Wiers) affecting this process have been identified, including individual differences (discussed in Section 1.2.1.4), and situational factors.

Aspects of the situation can affect the type of processing that is used; for instance, the presence of cognitive load (i.e. being required to carry out one or more processes such that high demands are placed on cognitive resources). Cognitive load can prevent type 2 responses from overriding type 1 responses (Johnson, Tubau, & De Neys, 2016), as can alcohol (Hofmann & Friese, 2008). If a behaviour or other process is habitual, then type 1 processes are more likely to remain in control, and relatedly, as expertise in a domain grows, behaviour that was once highly controlled may become more automatic (Evans, 2014; Shiffrin & Schneider, 1977). Influence over the processing type used may also occur via cues in the environment; time pressure can lead to type 1 processing (Evans & Curtis-Holmes, 2005) while fonts that are difficult to read appear to prime type 2 processing by indicating high task difficulty (Alter, Oppenheimer, Epley, & Eyre, 2007). In fact, one explanation for the selection of processing type is that problems sharing characteristics with either type 1 or 2 processing are likely to be approached using those processes. Specifically, type 2 processing may occur in relation to precisely defined problems, high (but comprehensible) complexity, the appearance of sequentiality (but see also Rusou, Zakay, & Usher, 2017), and problems that can be evaluated based on clear criteria. On the other hand, vaguely described problems, low complexity, positive affect, problems that seem holistic or non-sequential, and those that cannot be clearly evaluated trigger type 1 processing (Inbar, Cone, & Gilovich, 2010; King, Burton, Hicks, & Drigotas, 2007). Finally, the temporal aspects of the task appear to be relevant. Processing type has successfully been primed experimentally using elaboration: elaborating on a past decision primed type 1 processing and elaboration on a future decision primed type 2 processing (Godek & Murray, 2008).

The factors mentioned above influence the likelihood that type 1 or type 2 processing will be relied upon in a given situation but some mechanism must perform the role of initiating (or not initiating) type 2 processes. Recent theory suggests that the rapid type 1 responses are accompanied by meta-cognitive evaluations such as feelings of rightness (Thompson, Turner, & Pennycook, 2011) or doubt (Johnson et al., 2016) or are followed by a conflict-detection process (Pennycook, Fugelsang, et al., 2015) that indicates whether deeper processing is necessary. In cases where confidence in the type 1 response is low (or conflict between type 1 responses is detected), type 2 processing may be initiated. Another meta-cognitive account posits that an immediate meta-decision determines the appropriate cognitive resources to devote to a given task — in large part based on the estimated costs and benefits of engaging more intensive deliberation versus type 1 processing or a habitual response (Boureau, Sokol-Hessner, & Daw, 2015). Indeed, recent work with Rhesus monkeys has lent support to the existence of such meta-decisions (the monkeys' considerably lower type 2 capacity notwithstanding; Kowaguchi, Patel, Bunnell, & Kralik, 2016), indicating that the monkeys used the cognitive strategies most likely to yield success. Meta-decisions may incorporate some of the situational factors discussed above (for instance, a rapid assessment that limited time is available and that a quick type 1 response is required) and may also be influenced by preferences for one type of processing over the other.

1.2.1.4. The dual-process view of attitudes.

Attitudes are commonly defined as a tendency to evaluate stimuli positively or negatively (Eagly & Chaiken, 1993). Dual-process theorists argue that these tendencies — the cognitive processes that lead to an evaluation, and the evaluation itself — can occur as type 1 or type 2 processes (Gawronski & Bodenhausen, 2006). Evaluations instantiated in and based on automatic type 1 processes such as affective reactions or associative links with other concepts (and which people may experience as a ‘gut reaction’) are referred to as *implicit* attitudes (Gawronski & Bodenhausen, 2006; Ranganath, Smith, & Nosek, 2008). *Explicit* attitudes, on the other hand, are formed via deliberative type 2 processing involving reason, logic, hypothetical thinking, and judgements about truth (Gawronski & Bodenhausen, 2006). In common with the default-interventionist operation of type 1 and 2 processes in general, implicit attitudes are generated quickly, may be evaluated by type 2 processes, and can be incorporated into or repressed in favour of an explicit attitude (Gawronski & Bodenhausen, 2006). Therefore, agreement between explicit and implicit attitudes can range from their being identical, to inconsistent, to entirely opposed (Nosek, 2007; Wilson, Lindsey, & Schooler, 2000).

1.2.1.5. Individual differences in processing preferences.

Theorists have suggested that individuals differ in their tendency to utilise type 1 and type 2 processing, and that these tendencies are relatively stable over time (Betsch, 2008; Epstein et al., 1996). This pair of preferences will be referred to as *thinking style* (although the terms cognitive style or decision style are sometimes used, e.g. Brown & Bond, 2015; Pachur & Spaar, 2015). Before discussing the measurement of thinking style, it must be noted that although individual differences in using the two types of processing will be measured, most people actually differ little in their amount of type 1 activity; the true source of individual differences is the degree to which a person intervenes upon type 1 processes and overrides them with type 2 processes (Evans & Stanovich, 2013). Some conceptualisations of thinking style (e.g. Pacini & Epstein, 1999) are based on the parallel-competitive model of processing (which has arguably been superseded by the default-interventionist model; Evans & Stanovich, 2013). In addition, thinking styles (e.g. Epstein, 2003) may be described in terms of dual systems, invoking precisely two discrete systems, each exclusively involved in one form of processing (a concept that is also somewhat outdated; Evans & Stanovich, 2013) rather than the more flexible notion of dual processes: i.e. the multitude of processes of human cognition, operating within numerous systems, can be classified as either type 1 or type 2. However, for practical purposes this is not important, because in asking participants about their thinking style it is expedient simply to ask about *using* each type of processing (rather than to explain in detail the operation of the two). In effect, high reported use of type 2 thinking represents a strong tendency to override type 1 thinking, and high reported use of type 1 thinking represents a low tendency to override these processes. Moreover, prominent measures of thinking style tend to perform as would be suggested by the default-interventionist dual-process model. In decision-making studies, high preference for Type 2 processing is associated with better decision performance when no time limit is set, but loses its positive influence when time pressure is applied, suggesting it is linked to slower type 2 processing. The presence of a time limit does not alter the relationship between preference for type 1 processing and decision accuracy (Phillips, Fletcher, Marks, & Hine, 2016).

The Need for Cognition scale (Cacioppo & Petty, 1982) was developed more than three decades ago to measure the contribution of individual differences to central, effortful (versus peripheral) processing in the Elaboration Likelihood Model (Petty & Briñol, 2012). It has been argued that the processing differences in this model represent modes of operation rather than the types of processing that are central to dual-process models (Evans, 2011), but the Need for Cognition scale has nonetheless stood the test of time as a measure of dispositional reliance on type 2 processing (Cacioppo, Petty, Feinstein, Blair, & Jarvis, 1996). Using Likert scales, participants rate their agreement with a series of items, such as, “I usually end up deliberating about issues even when they do not affect me personally”.

Meanwhile, Seymour Epstein had already embarked upon the research program through which he would develop Cognitive-Experiential Self-Theory (e.g. Epstein, 1973), a theory of personality integrating work from several prominent personality, learning, phenomenological psychology, object-relations and psychodynamic theories (Epstein, 2003). There are two main elements to Cognitive-Experiential Self-Theory, one being the importance of four basic needs (relatedness, maximising pleasure or avoiding pain, stable conceptualisation of the world, and self-esteem) and the networks of beliefs associated with them. It is the other aspect of the theory that is relevant to the present research: a dual-systems conceptualisation of human cognitive functioning (not dual-*process*, although as mentioned above, for our purposes this distinction is not critical) that aligns with the broadly accepted tenets of dual-process theory (Evans & Stanovich, 2013). According to Cognitive-Experiential Self-Theory, the *rational system* (i.e. type 2 processing) is analytic, able to process abstract symbols including language, is slower to operate but quicker to change stored beliefs, and is a newer evolutionary development. The *experiential system* (i.e. type 1 processing) is associationistic, emotion-focused, deals in images, metaphors, recalled experience and narratives, and operates rapidly but requires repeated exposures or extreme experiences in order to change stored information. A defining feature of Cognitive-Experiential Self-Theory, according to its author, is its acknowledgement that the experiential system can be adaptive, and indeed enabled humans to reach the evolutionary point where the rational system could develop — rather than solely being a source of maladaptive functioning, error or bias (Epstein, 2003). While earlier work suggested parallel-competitive operation (Pacini & Epstein, 1999), more recent writings discuss rapid experiential processing as potentially being intervened upon by rational processes, suggesting a default-interventionist model (Epstein, 2003).[1]

The delineation of two types of cognitive process was intrinsic to the Cognitive-Experiential Self-Theory model of personality. Therefore, it was reasoned, the degree to which people tend to use each type of process must also be a fundamental aspect of personality, and variables measuring preferences for each type of process must relate meaningfully to people's behaviour and outcomes (Epstein, 2003). The Rational-Experiential Inventory (REI) was developed for this purpose, with scales measuring *experientiality* (the preference for using type 1 processes, e.g. "I believe in trusting my hunches") and *rationality* (the preference for using type 2 processes, e.g. "I prefer complex to simple problems") (Epstein et al., 1996). The rationality scale was based closely on the Need for Cognition scale (Cacioppo & Petty, 1982) which had demonstrated validity in measuring type 2 processing in a format that was compatible with Cognitive-Experiential Self-Theory — particularly, one which allowed for the possibility that the two preference scales may be either inversely related or unrelated (Epstein et al., 1996). The items for the experientiality scale were developed to measure the preference for intuitive thinking in a similar manner.

Two major revisions of the REI have been made. A 1999 version introduced subscales measuring ability and engagement in each type of thinking; rational ability and engagement correlated strongly but not perfectly, as did experiential ability and engagement, suggesting that people perceive differences in how good they are at each type of processing as well as

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[1] A note regarding terminology: Having described Cognitive-Experiential Self-Theory's proposed systems, discussion herein will revert to the terminology (and assumption) of Type 1 and Type 2 processes. However when discussing the individual difference variables that capture the use of these types of processing, Cognitive-Experiential Self-Theory's terminology of rationality and experientiality (Pacini & Epstein, 1999) will be retained, given the theory's pivotal role in establishing individual differences research in this area. In the earliest REI (Epstein et al., 1996) these scales were titled Faith in Intuition and Need for Cognition, respectively, but the names arrived at in later versions have been adopted.

how much they use them (Pacini & Epstein). This distinction has been argued to be of limited usefulness (Akinci & Sadler-Smith, 2013). A third version published in 2011 aimed to measure experientiality in a more nuanced way, based on the observation that compared to rationality, more links had been found between experientiality and problematic reasoning (e.g. heuristic or non-optimal judgements) and fewer links to positive characteristics (e.g. rationality is related to self-reported ability to delay gratification and behave responsibly, but experientiality is unrelated) or protective effects against contentious attitudes (rationality, but not experientiality, was negatively related to conservative views such as endorsement of capital punishment and literal interpretation of the bible in a US sample) had been found (Epstein et al., 1996; Pacini & Epstein, 1999). The Cognitive-Experiential Self-Theory view of type 1 processing suggests that it makes a positive contribution to cognitive functioning and behaviour; thus Norris and Epstein (2011) reasoned that the experiential scale's content validity might be improved by expanding its focus. In the Rational-Experiential Multimodal Inventory (REIm) the experiential scale contains three subscales: intuition (e.g. "I often go by my instincts when deciding on a course of action", and into which the previous items were incorporated), emotionality ("Everyday experiences often evoke strong feelings in me") and imagination ("I tend to describe things by using images or metaphors, or creative comparisons"). These changes bore fruit, with the REIm's expanded experiential scale being positively associated with indicators of creativity, aesthetic judgement, sense of humour, intuition skills, empathy, and social popularity, all of which were unrelated to rationality (Norris & Epstein, 2011). This most recent version has not been used to a large degree, and the two earlier versions of the REI are in much more widespread use. That said, the different versions are quite comparable (with the caveat that the experientiality scales of the 1996 and 1999 REI are equivalent to the experiential-intuition subscale in the REIm, rather than the full REIm experiential scale).

Thinking style, as measured by the REI, has shown consistent relationships with Big Five personality factors. Across a number of studies, both rationality and experientiality have been positively associated with openness to experience and conscientiousness, whereas rationality is negatively related to neuroticism, and experientiality is positively related to extraversion (Alós-Ferrer, Garagnani, & Hügelschäfer, 2016; Epstein et al., 1996; Heintzelman & King, 2015; King & Hicks, 2009; Pacini & Epstein, 1999). Other links between Big Five and REI variables have been detected, but less consistently (Freeman, Evans, & Lister, 2012; Pacini & Epstein, 1999). Both variables are positively correlated with emotional intelligence, more so for experientiality (Schutte et al., 2010), and both are negatively related to trait anxiety (Leikas, Lindeman, Roininen, & Lahteenmaki, 2007). Rationality is associated with higher self-control capacity — which in turn appears to bolster positive adjustment, leading to higher self-esteem and lower depressive mood (Bertrams & Dickhauser, 2012) — as well as being linked to higher numeracy (De Bruin, McNair, Taylor, Summers, & Strough, 2015) and general intelligence (Furnham & Thorne, 2013).

Thinking style has also been linked to individual differences in ways of understanding the world. Experientiality is associated with superstitious thinking (J. M. Fletcher, Marks, & Hine, 2011), belief in conspiracy theories (but trait rationality reduced belief, Swami, Voracek, Stieger, Tran, & Furnham, 2014), spiritual beliefs (Koteles, Simor, Czeto, Sarog, & Szemerszky, 2016), authoritarianism (Kemmelmeier, 2010) and persecutory ideation (Freeman et al., 2012). On a more positive note, it is positively associated with experiencing meaning in life (Heintzelman & King, 2015) and having higher life satisfaction (Schutte et al., 2010) and shows stronger associations with well-being than does rationality (Koteles et al., 2016). In behavioural experiments, experientiality predicted repeating decisions that had previously been successful, even when conditions suggested that a change in approach was required (demonstrating reliance on the reinforcement heuristic; Alos-Ferrer & Hugelschafer,

2012) and appears to have implications for moral behaviour, although these are as yet poorly understood (Ward & King, 2015).

There appears to be a genetic component to thinking style, with up to 34% of variance in rationality and 44% of variance in experientiality related to genetic factors (J. M. Fletcher, Marks, Hine, & Coventry, 2014). An individual's preference for rational processing is moderately correlated with their working memory capacity and it has been suggested that the experience of success or failure on working memory capacity-intensive tasks leads to the formation of a preference for (or against) this type of thinking (J. M. Fletcher et al., 2011; J. M. Fletcher et al., 2014). The parallel operation of the experientiality and rationality subscales allows for participants to present themselves as high (or low) on one or both scales. A typology of thinking styles developed using latent profile analysis comprised four thinking style profiles dubbed experiential (high experientiality, low rationality), rational (high rationality, low experientiality), dual preference (high on both) and disengaged (low on both). Working memory capacity was lowest in the disengaged group and highest in the rational group (J. M. Fletcher, Marks, & Hine, 2012).

Rationality and experientiality are proposed to be uncorrelated (Pacini & Epstein, 1999). Although at first appearances the basic dual-process model might suggest that they should be negatively correlated (because if a person does not utilise one form of processing on a task, they must surely be using the other), there are two reasons that this need not be the case for thinking style. One reason is that it is possible to draw on both forms of processing at once in a complementary fashion: for example, to build on a type 1 response with type 2 elaboration. The other reason is that participants can truthfully report strong preferences for both processing types, if they tend sometimes to trust their intuitions and sometimes prefer to deliberate, or are aware they use them together. These preferences may in truth be related to different tasks or different domains of life, but the REI does not differentiate (a topic that will be returned to later).

Some studies have reported negative relationships between the two scales in their samples (Thoma, White, Panigrahi, Strowger, & Anderson, 2015) whereas others have detected small positive relationships (Alós-Ferrer et al., 2016). The relationship between processing preferences may alter with age. When one study investigated the age-related change in the correlation between the two variables, the initially negligible correlations between the two increased to become slightly positive, peaking in the thirties and forties, before becoming increasingly negative in the sixties and beyond (Sladek, Bond, & Phillips, 2010). Elsewhere, it has been reported that when adult and adolescent participants were grouped into one of four thinking style profiles (reflecting high or low rationality and experientiality), a higher proportion of adolescents than adults had no strong preference, being high on both or low on both (J. M. Fletcher et al., 2012). Taken together, these findings about the temporal change in rationality and experientiality relative to one another suggest that with time, and through experience, people become more comfortable with one form of processing than the other. Additional findings from these studies were that with increasing age comes an overall decrease in both rationality and experientiality (Sladek et al., 2010); and that compared to adolescents, a higher proportion of adults were *experientially dominant* (being high in experientiality and low in rationality) (J. M. Fletcher et al., 2012). Given the self-report nature of the REI and the lack of longitudinal data, the lifespan development of thinking style is unclear and the effects of decreased confidence or cultural influences cannot be ruled out.

As outlined above, thinking style represents a self-reported pattern of use for each processing type. Therefore, on any given task, thinking style cannot directly reveal the processing type used, but is one of a number of predictors (along with situational factors).

With this in mind, the association of thinking style to the actual reported use of type 1 or 2 processing on a specific task has been compared (by asking participants, immediately after a task, what processes were just used). Rationality was positively correlated with reported use of type 2 processing, but not type 1 processing, across eight tasks (and the equivalent pattern of effects largely held for experientiality and type 1 processing), suggesting that the REI does tap self-perceptions of processing preferences (Novak & Hoffman, 2009).

Due to the REI's prominence and the large body of research using its variants (Phillips et al., 2016) compared to similar measures (such as Betsch, 2008), as well as its grounding in a comprehensive theory of personality (Epstein, 2003) this measure has been applied in the current research. An important feature of the REI is that it addresses *thinking* generally, rather than focusing many or all of its items on the narrower class of *deciding* as some measures do (e.g. Leykin & DeRubeis, 2010; Scott & Bruce, 1995). This is important because the processing that relates to health behaviour may not be viewed by participants as "deciding". Although the well-known Myers-Briggs Type Indicator contains an intuition scale, it is based on a definition of experientiality that conflicts with dual-process theory (for example, trusting experience more than words is positioned as being opposite to intuition; The Myers & Briggs Foundation, 2016). Meanwhile, work on measuring thinking styles has continued since the present research was commenced. A scale measuring holistic, inferential and affective forms of intuitive processing has been recently published (Pretz et al., 2014) and a scale that combines items from many prominent thinking style measures is in development, and may prove useful for future research (see Pachur & Spaar, 2015).

1.2.1.6. Domain-specificity of processing.

When people respond to items on the REI, they may be answering by formulating a general view of their processing across many situations, or they may be thinking of the same task each time, or they may be recalling their processing in a different context for each item. Therefore, an important question relates to whether people are roughly consistent across different situations, contexts, or domains of life – or whether they vary systematically. Although the REI is general in nature, the possibility that different situations cue different levels of type 1 or 2 processing has been acknowledged from the outset (Epstein et al., 1996). Research has continued to support the notion that people utilise the type of processing they see as most effective for a given task (Novak & Hoffman, 2009; Phillips et al., 2016; Rusou, Zakay, & Usher, 2013).

Research supports the idea that people might switch processing style at times. For instance, one study asked participants (who had completed the REI) to perform several cognitive tasks that were better-suited to either type 1 or type 2 processes, and then asked them to report what type of processing they had just used. Thinking style predicted task success to some extent (more so for rationality than for experientiality); people higher in experientiality did better on a measure of associational fluency, and rationality was unrelated to performance on this task. However, the processing type participants reported using on each task was a better predictor of task success, fully mediating the effect of thinking style — and suggesting people switch adaptively from their preferred thinking style to the other if it seems a better fit for the task (Novak & Hoffman, 2009). This aligns with suggestions, noted earlier, that meta-cognitions or meta-decisions guide processing, and are influenced by thinking style and attributes of the task or situation.

Furthermore, Pachur and Spaar (2015) found that the preference for type 1 and type 2 processing when making a decision differed across the domains of mate choice, clothing, restaurants, medical, electronics and vacations. The highest preference for type 1 processing was for decisions about mate choice, and the highest preference for type 2 processing was for decisions about electronics. Of particular interest for this research, preference for type 1 or 2 processing when making decisions in the medical domain correlated only moderately (r = .31 and r = .27, respectively, $p < .05$), with people's general thinking styles. Across the six domains, these were the second-lowest (type 1) and equal-lowest (type 2) correlations, indicating that when making medical decisions, people often depart from (or perhaps have less confidence in) the processing type they usually prefer. Findings such as these provide evidence that thinking styles may vary predictably across domains, and provide support for the notion of domain-specific thinking style measurement. The possibility that people may alter their thinking style when it comes to health matters is a major hypothesis of this thesis and will be addressed in Chapter 5 (page 153).

1.2.1.7. Implications of processing type.

The foregoing discussion of the two kinds of processing, and the patterns with which people engage them, would have little practical significance if the outcomes of processing were identical regardless of the type used. Although both forms of processing are theoretically adaptive (Epstein, 2003), many examples exist that demonstrate the different strengths and weaknesses of type 1 and type 2 processing. For instance, type 2 processing is generally posited as the main driver of mathematical thinking (Attridge & Inglis, 2015), but when tasks involve high information load (e.g. reporting the average of a set of 18 numbers) type 1 processes may generate more accurate responses (Rusou et al., 2017).

Heuristic processing involves substituting a simple or familiar attribute into a problem rather than processing more difficult or unfamiliar information (Kahneman, 2003). This form of type 1 processing can be highly efficient, but can lead to errors and biases, as in base rate neglect, where probabilities or ratios are compared by focusing on the numerators (e.g. the number of male deaths from lung cancer versus from prostate cancer) without incorporating the critical base rates (e.g. the number of men diagnosed with lung cancer and prostate cancer). Commission of base rate neglect when comparing the mortality rates of lung and prostate cancer (i.e. just comparing the death figures as a simpler proxy for the mortality rate) will lead a person to think prostate cancer and lung cancer are similarly lethal, because the numbers of deaths are in the same league; however, many fewer men are diagnosed with lung cancer, meaning its mortality rate is far higher (Australian Institute of Health and Welfare, 2014b). Another problematic effect of type 1 processing is anchoring, in which judgements (e.g. numerical estimates or belief in the existence of a phenomena) are affected by previous judgements (Mussweiler & Strack, 2000). Even when type 2 processes intervene at later stages of processing, they may fail to correct for the bias in type 1 processing (Kahneman & Klein, 2009). On the other hand a type 1 strength is that goals may be activated as type 1 processes (for instance, the intention to behave co-operatively may be made salient through priming) and then persistently guide behaviour with minimal demands on working memory capacity (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trotschel, 2001).

Being predictors of processing type selection on any given task, thinking style variables also have a bearing on the outcomes of processing. For instance, individuals scoring lower on the rationality scale are more likely to demonstrate base rate neglect. In an experiment using probabilities represented visually as jelly beans in trays, low-rationality participants tended to ignore base rates, and interpreted probabilities of 10/100, 9/100 and 7/100 as greater than 1/10. Individuals high on rationality were able to suppress this bias when the stakes were high, and there was little effect of experientiality on score (Epstein et al., 1996). The degree to which base rate interpretation is only managed by type 2 processes has, however, been disputed (Pennycook, Trippas, Handley, & Thompson, 2014). However, in general, higher experientiality appears to lead to poorer performance or non-normative responses on reasoning tasks, whereas rationality is related to normative responding (Phillips et al., 2016).

The interpretation of information is especially liable to influence by the processing type used. For instance, high experientiality is related to a tendency to interpret vague and meaningless statements as profound (Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2015, Study 2), and, in the presence of positive affect, to believing questionable information as true (King et al., 2007). Individuals lower in rationality may prefer to deal with smaller, concrete numbers and concepts that can be easily visualised, and may respond better to information presented as a narrative grounded in real life than to abstract concepts (Epstein, 1994; Epstein et al., 1996). When performing tasks where short- and long-term consequences must be weighed up, low-rationality individuals perform better when information about the long-term consequences of their choices is explicitly provided — information that those higher in rationality appear to consider without assistance (Mueller, Schiebener, Stöckigt, & Brand, 2016).

Messages about health or other topics can be constructed such that they are gain-framed (focusing on the benefits of a behaviour) or loss-framed (focusing on the negative consequences of a behaviour) and some studies report differential impacts of different framing (Covey, 2014). Although framing effects have to some extent been discredited (O'Keefe, 2012), mixed results have been reported regarding the interaction between thinking style and framing. High-rationality individuals have been found to be more susceptible to loss-framed messages, while an advantage for gain-framed messages was seen in low-rationality individuals (Covey, 2014) whereas in another study, highly experiential individuals were more susceptible to framing effects whereas rationality made no difference (Stark, Baldwin, Hertel, & Rothman, 2016). As a result of the many effects of thinking style on information processing, targeting of persuasive messages for people who prefer type 1 processing (i.e. affect-based messages) and type 2 processing (i.e. factual messages) has been explored with success (Haddock, Maio, Arnold, & Huskinson, 2008).

Finally, an important ramification of relying on type 1 or type 2 processing is that each type may draw upon different content. Focusing on the health domain, this research will be discussed in Section 1.2.2.4.

1.2.2. Dual-process explanations for health behaviour

To gain some idea of the relevance of dual-process models to health psychology, one only needs to imagine the internal tug-of-war experienced when offered a decadent dessert after having intended to eat healthily. In general terms, type 2 processing is suited to "choices that are determined by reasoning about or simulation of future consequences of anticipated actions" (predicting the dessert's contribution to weight gain or longer-term health outcomes) whereas type 1 processes are adapted to govern "choices driven by experiential learning and associative strength" (the anticipation of delicious flavour) (Evans & Stanovich, 2013, p. 238).

The usual implications of processing type can, of course, relate to health behaviour. For instance, in the process of obtaining health information: narratives about vaccination side effects (presumed to be processed in a type 1 manner) may decrease vaccination intentions more than statistical information about side effects (Betsch, Ulshofer, Renkewitz, & Betsch, 2011). Base rate neglect has been shown to influence health-related risk judgements, with participants judging a cancer as riskier when it had a mortality rate of 1,286 in every 10,000 people, compared to a rate of 24.14 people in every 100 (Yamagishi, 1997). Or in terms of behavioural control: the role of type 2 processing in healthy eating is suggested by the finding that under low cognitive load (i.e. ability to use type 2 processes) people have greater approach tendencies towards healthy foods than unhealthy foods, while approach tendencies for both kinds of food are similar under cognitive load, when type 2 processing is restricted (Cheung, Gillebaart, Kroese, & de Ridder, 2016).

It has also been proposed that the use of heuristics in type 1 processing has implications for health decision-making. For instance, the availability heuristic (the cognitive rule of thumb that an event is more likely to occur if information about it is more easily retrieved from memory) may be at play in the spike in screening rates that happens when a celebrity is diagnosed with a particular cancer (Peters, McCaul, Stefanek, & Nelson, 2006) or, when choosing food to buy, focusing on the presence of a nutrient recently discussed in the media, rather than a more exhaustive reading of nutritional information (Gomez, 2013). The representativeness heuristic (the finding that the perceived likelihood of an event is indicated by the likelihood of similar events), could underlie the finding that women's perceived susceptibility to breast cancer, heart disease, and osteoporosis rises with their perceived likeness to 'stereotypical' sufferers of those diseases (Gerend, Aiken, West, & Erchull, 2004). Finally, the social proof heuristic (if many people make a certain decision it must be correct) has been shown to lead to healthier eating when type 1 processing was employed (Salmon, Fennis, de Ridder, Adriaanse, & de Vet, 2014).

Naturally, for health-related constructs just like for more general ones, the effects of different processing habits accrue such that differences can be detected between individuals with different thinking styles. The acquisition or interpretation of health information can be influenced by a person's thinking style; for example, people higher in rationality tend to seek out more information on food packets prior to making a choice, rather than attending to images (Ares, Mawad, Gimenez, & Maiche, 2014). Several studies have experimented with targeting health information to different cognitive styles. People higher in experientiality may be more effectively communicated with using narrative (vs statistical) information (Dillard & Hisler, 2015) and those higher in rationality may be unaffected by the emotional dimension of health risk messages, leading to a lower overall evaluation of risk (Leikas et al., 2007).

Thinking style may also have an influence on the formation of health-related attitudes or perceptions. Experientiality, for instance, is positively associated with germ aversion (negative responses to situations with a perceived likelihood of pathogen transmission, such as using a public telephone), whereas rationality is unrelated (L. A. Duncan, Schaller, & Park, 2009). Two groups of attitudes that deviate from scientific evidence have been linked positively to experientiality and negatively to rationality: magical beliefs about food and health (e.g. belief in the need to clean toxins from the body) (Saher, Lindeman, & Hursti, 2006) and modern health worries (such as concern about electromagnetic radiation) (Koteles et al., 2016). Given this it is perhaps surprising that experientiality is not associated with rejection of vaccinations (Browne, Thomson, Rockloff, & Pennycook, 2015). In terms of food perceptions, affect intensity, a trait conceptually overlapping with experientiality (Norris & Epstein, 2011), is positively related to pleasure anticipation, number of food cravings, and the extent to which participants are influenced by vivid food advertisements (Moore & Konrath, 2015).

1.2.2.1. A dual-process model applied to health behaviour.

Strack and Deutsch (2004) developed a comprehensive model for understanding social behaviour from a dual-process perspective. The Reflective-Impulsive Model drew together previous research to describe the cognitive processes that influence social behaviour, specifying a type 1 process of spreading activation from stimuli to action-guiding behavioural schemata, and a type 2 process of deliberate decision-making leading to intention formation that activates behavioural schemata. Several propositions follow from the model: type 1 motivation is characterised by approach or avoidance orientations; and links between objects in type 1 processing are associative, but in type 2 processing objects are linked by language-like propositions, giving much greater flexibility (such as the ability to think about the future and that which does not exist).

Dual-process accounts specific to *health* behaviour generally focus on the operation of self-control — and more often than not, on the times when it fails (Cheung et al., 2016). Hofmann et al. (2008) argued that the Reflective-Impulsive Model could add to the understanding and prediction of health behaviour. Conceiving type 1 and type 2 processes as two sides of a self-control conflict, they also brought so-called ‘boundary conditions’ (such as thinking style and alcohol) to the fore as factors shifting behavioural influence in favour of one form of processing or the other. Although it may seem that type 2 processes would be responsible for healthy actions, and type 1 processes for unhealthy behaviour, Hofmann et al. (2008) took the view that the effect of any process upon health behaviour depends upon its *content*, rather than its form. For example, type 1 impulses such as aversions to spoiled food, or attractions to healthy foods, are protective of health. Similarly, type 2 processes can be maladaptive; for instance, where poor health information is obtained from dubious sources, or where personal standards of health lead to excessive dieting or exercising (Friese, Hofmann, & Wiers, 2011).

Nonetheless, there is a case to be made for focusing on a subset of health-related behaviours where, very often, type 1 processes *are* a less positive influence than type 2 processes. These have been dubbed *hard to maintain* behaviours and can be further divided into two main groups (Borland, 2014). The immediate consequences of a behaviour (i.e. pleasure or pain) leads to the acquisition of positive or negative valence in type 1 processes through a process of associative learning. Positive or negative valence in type 2 processes is determined by a behaviour’s more distal consequences; those that are delayed sufficiently to prevent an associative stimulus-response connection being formed, and which may require abstract processing to comprehend. Behaviours for which type 1 valence is positive and type

2 valence is negative ("I want to, but I know I shouldn't") are classed as *hard to reduce* behaviours, and include smoking and consuming unhealthy foods. On the other hand, behaviours such as exercising, eating healthy foods, and cancer screening likely attain a negative type 1 valence and positive type 2 valence ("I know I should, but I don't want to") and are classed as *hard to sustain*. Of course, if an individual dislikes a behaviour as well as understanding its negative consequences, the behaviour is easy to avoid (e.g. smoking, for a non-smoker to whom cigarettes seem disgusting); if they like a behaviour, or do it habitually, as well as believing it is beneficial, it is easy to maintain (e.g. brushing teeth in the morning). But this system of classification highlights the fact that the types of behaviour that occupy much research attention are those that involve a conflict between type 1 and type 2 processes (Borland, 2014). Preventive health behaviours, as a class, often require the evaluation of long-term consequences to be weighed against appealing or aversive immediate consequences, suggesting that dual-process approaches are warranted.

1.2.2.2. Predicting health behaviour from personality.

The ability to predict future behaviour is at the core of personality theories (Cattell, 1950). In the health arena, the relevance of the Big Five personality variables to health behaviour (Bogg & Roberts, 2004), health outcomes (Israel et al., 2014), and health behaviour theories (Conner & Abraham, 2001) is a rich and growing area of research. The striking finding that conscientious individuals tend to live longer than those who are not conscientious (Kern & Friedman, 2008) demonstrates the impact that stable individual differences can have on important health outcomes, by subtly influencing health behaviour over days, years or decades. Thinking style was developed as a central aspect of a personality theory (Epstein et al., 1996), and rationality and experientiality are themselves considered to be personality variables (Epstein, 2003). Explorations of the impact of thinking style on health behaviour have been limited, and therefore it is productive to investigate this area. Furthermore, thinking style encompasses different types of traits — patterns of use of Type 1 and 2 processing — to other personality measures, such as the Big Five which covers patterns of temperament, values, and interpersonal relations (Costa & McCrae, 1992). Therefore if any effects of thinking style on health behaviour were detected, this would not only strengthen the case that personality variables should be accounted for in health behaviour research, but may enhance our ability to do so, by highlighting that different types of traits may be leveraged in prediction or promotion of the same behaviour. Moreover, given the examples of how type 1 and 2 processing (and therefore processing preferences) might affect health behaviour, the prediction of health behaviour using thinking style can shed light on the effects that accumulate from certain patterns of processing.

1.2.2.3. Predicting health behaviour from dual-process personality variables.

A handful of studies have probed the link between thinking style and real-world health behaviour (and because it concerns people's actual daily behaviour rather than that measured in the laboratory, data is usually self-reported), which is the second major aim of this thesis, addressed in Chapter 3 (page 97) and Chapter 5 (page 153). Health behaviours considered previously are as diverse as complementary and alternative medicine practices, consumption of soft drinks and lollies, hand washing, wheat avoidance, and smoking. Specific findings suggest that rationality is negatively related to the use of herbal remedies, prayer, and homeopathy (Thomson, Jones, Browne, & Leslie, 2014) and soft drink consumption (Richetin, Perugini, Adjali, & Hurling, 2007), that neither experientiality nor rationality is directly related to sweets consumption (Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007), and that compliance with hand-washing guidelines amongst doctors was higher amongst more experiential individuals (Sladek, Bond, & Phillips, 2008). Amongst non-coeliac individuals who experienced unpleasant symptoms from wheat products, rationality seemed to predict (i.e. approaching significance) avoiding the consumption of foods including wheat (Golley, Corsini, Topping, Morell, & Mohr, 2015). Finally, for smoking, mixed results have been reported. An association has been found between lower rationality and having smoked previously, whereas no association with experientiality was apparent; however, the combination of low rationality and high experientiality was common amongst smokers (Brown & Bond, 2015). In another study, neither rationality nor experientiality were directly related to the amount smoked (though further results from this study are discussed below; Marks, O'Neill, & Hine, 2008)

There are evidently gaps in knowledge about the relationship of thinking style to important health behavioural variables such as physical activity, cancer screening, diet (measuring diet quality more broadly, given the findings on soft drink, sweets, and wheat product consumption); and the mixed findings relating to smoking beg clarification. Further attempts to predict people’s self-reported health behaviour from their thinking style will add to our understanding of health behaviour, and will also further establish the generalizability of thinking styles to real-world settings.

1.2.2.4. Predicting health behaviour from thinking style and attitudes.

Differing implicit and explicit attitudes and their effect on health behaviour have been seen for food purchasing behaviour (Prestwich, Hurling, & Baker, 2011), exercise behaviour (Conner, Rhodes, Morris, McEachan, & Lawton, 2011; Conroy, Hyde, Doerksen, & Ribeiro, 2010; Forrest, Smith, Fussner, Dodd, & Clerkin, 2016), and prostate cancer screening by PSA test (Consedine, 2012). Following on from the assertion that implicit and explicit attitudes can exist in memory at the same time Wilson et al. (2000), a number of studies have focused on factors that are postulated to increase reliance on one or the other form of processing (such as alcohol, cognitive load, or thinking style) to explore whether the operation of implicit attitudes occurs via type 1 processing and the activation of explicit attitudes via type 2 processing. If this is so, then an attitude about a behaviour may be less able to affect that behaviour if the person does not use the congruent type of processing at the relevant time. In this context, the factors mentioned can be postulated as moderators of the behavioural influence of attitudes, because they affect the likelihood that type 1 processes (and hence implicit attitudes) or type 2 processes (and hence explicit attitudes) will be engaged. Certainly, in terms of alcohol consumption and cognitive load, it seems that implicit attitudes predict health behaviour more strongly after alcohol consumption or under high cognitive load, while explicit attitudes predict behaviour in a sober or no-load control group (Friese, Hofmann, & Wanke, 2008, Study 1; Hofmann & Friese, 2008). The factor of interest for this thesis, however, is thinking style.

A moderation effect of thinking style has been theorised such that rationality (or experientiality) moderates the capacity of explicit (or implicit) attitudes to influence behaviour. It has been further theorised that attitudes should be unaffected by the non-congruent processing preference (i.e. implicit attitudes should not be moderated by rationality) (Richetin et al., 2007). This pattern has been detected for outcomes such as evaluations (Richetin et al., 2007), but has proved elusive for behaviour (Richetin et al., 2007). Rationality has been found to moderate explicit attitudes' prediction of self-reported sweets (vs fruit) consumption, but experientiality did not moderate implicit attitudes (Conner et al., 2007)[2]. In a study predicting self-reported smoking, the influence of implicit attitudes about smoking was moderated by both experientiality and rationality. Implicit attitudes

[2] It should be noted that some studies explore the differential influence of implicit and explicit attitudes on behaviour that is more spontaneous versus more considered (e.g. Conner et al., 2007; see also Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). This is not the question of interest in this thesis — rather, the focus is on how individual differences in processing preference affect the impact of attitudes on health behaviour of various kinds.

predicted smoking behaviour for those with dual-preference, intuitive, and disengaged thinking style profiles, but not those with a rational profile (high rationality and low experientiality) (Marks et al., 2008). The proposed pattern of interactions is far from established for attitudes, thinking styles and health behaviour, and forms the third major focus of this thesis (to be explored in Chapter 6; see page 189).

1.2.3. Health behaviour

Noncommunicable diseases (most notably cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes) account for over two-thirds of deaths globally, many of which are considered to be premature. Modifiable risk factors for noncommunicable disease include lifestyle factors such as poor diet quality, insufficient physical activity, and smoking (World Health Organization, 2014). Primary prevention strategies are targeted at improving these health behaviours in order to reduce the development of noncommunicable diseases. Secondary prevention, which aims to identify and treat disease in its early stages, can be particularly effective in detecting cancer, and this is achieved through organised and opportunistic cancer screening (Australian Institute of Health and Welfare, 2014a).

1.2.3.1. Primary prevention: lifestyle behaviours.

Several dietary behaviours are related to adverse long-term health outcomes. Most Australian adults (92%) do not meet the recommended intake of two serves of fruit and five serves of vegetables per day, which puts them at increased risk of cancer (stomach and colorectal) and cardiovascular disease. Consumption of high fat diets and large amounts of processed meat is a risk factor for breast, colorectal, prostate and other cancers. Alcohol use also has long-term risks including several cancer types, liver damage and brain damage. Australian adults are advised to drink no more than two standard drinks on any one occasion to minimise the long-term risks of consumption, but 20% consume alcohol at higher levels than this. Performing 150 minutes of moderate to vigorous physical activity per week protects against the risk of heart disease, high blood pressure, and stroke, but more than half of Australian adults do not achieve this amount and thus are at higher risk of disease. Higher age and lower socioeconomic status are related to lower levels of physical activity. Furthermore, overweight, which results from poor diet quality and a lack of physical activity, is itself a risk factor for heart disease and cancers (Australian Institute of Health and Welfare, 2014a, 2014b).

Smoking rates have been decreasing in Australia as a result of successive health promotion campaigns, taxation increases and point of sale and packaging restrictions. In 2012 daily smoking was reported by 16% of adults, compared to half a century earlier when 43% of adults smoked every day. Yet rates of decline have been slower amongst people over 45, and people with the lowest socioeconomic status are twice as likely to smoke daily as those with the highest socioeconomic status. Smoking remains a source of substantial health burden, increasing the likelihood of developing emphysema, heart disease, stroke, and many forms of cancer (Australian Institute of Health and Welfare, 2014a, 2014b).

1.2.3.2. Secondary prevention: cancer screening.

The most commonly diagnosed forms of cancer in Australia are prostate, breast, and colorectal cancer. Australian males have a 1 in 2 risk of being diagnosed with some form of cancer by age 85, whereas for women, the risk is 1 in 3 (Australian Institute of Health and Welfare, 2014b). However, a large number of deaths can be avoided by screening, which involves testing asymptomatic individuals in a target population group (often defined by age or gender) for risk factors, markers or early symptoms of a disease. Screening programs facilitate early disease detection and thereby enable more effective treatment as well as reducing the burden on health care systems (Australian Health Ministers' Advisory Council, 2008; World Health Organization, 2015). In Australia, organised screening is provided for colorectal cancer, breast cancer and cervical cancer, while prostate cancer screening is offered opportunistically.

Over 16,000 people are diagnosed with colorectal cancer every year in Australia, making it the third most commonly diagnosed cancer after skin cancer and prostate cancer (both of which have substantially higher survival rates) (Australian Institute of Health and Welfare, 2014b). Screening for colorectal cancer is via faecal occult blood test (also known as a home stool test), a test that detects blood in stool which may be a sign of cancer or pre-cancerous growths. Currently, Australians aged are invited to complete a mailed faecal occult blood test every five years from age 50, with a final invitation the year they turn 74. The invitation frequency will be increased to achieve biennial screening by 2020 (Australian Institute of Health and Welfare, 2016a). In 2012-13, more than 1,100 participants with positive home stool test results underwent follow-up colonoscopies that detected cancerous, suspected-cancerous or pre-cancerous growths (Australian Institute of Health and Welfare, 2014c). Despite its effectiveness, the participation rate is less then optimal at 36% (lower for men than women, even though men are more likely to have a bowel cancer detected) (Australian Institute of Health and Welfare, 2016a).

Breast cancer is the most common cancer diagnosed in Australian women. Screening of the breast by x-ray (known as a mammogram) is able to detect abnormalities, and is provided as a population screening methodology in Australia. Women aged between 50 and 74 are invited to screen biannually, and women over 40 can access free mammograms upon request. Overall participation stands at 55%, but this rate has not increased in close to two decades, and participation is lower amongst Aboriginal and Torres Strait Islander women, those living in very remote areas, and women whose first language is not English (Australian Institute of Health and Welfare, 2016a).

Cervical cancer is not as common as breast, colorectal or prostate cancer; it is in fact the fourteenth most commonly diagnosed type of cancer amongst Australian women (Australian Institute of Health and Welfare, 2014b). However, the progression of the disease, in most cases, is such that there is a drawn out precancerous stage in which detection and early treatment can occur, making it appropriate for population-based screening (Australian Institute of Health and Welfare, 2016b). Unlike the other cancers discussed, younger women are also at risk, making biannual screening a viable option from ages 20 to 69. Women are encouraged to visit their doctor for a Pap test, which detects abnormal cells indicative of possible cancer or precancerous growths. The participation rate is the highest amongst the organised screening programs, at 58%, but has not risen over the past decade and participation is lower in very remote and lower socioeconomic status areas. Like with the other screening programs discussed, participation must be increased to capitalise on the test's potential to save lives (Australian Institute of Health and Welfare, 2016a).

Prostate cancer is a major cause of male death from cancer, second only to lung cancer (Australian Institute of Health and Welfare, 2014b). The two main screening tests available are the prostate-specific antigen (PSA, which is an indicator of possible prostate cancer) test, or digital rectal examination (in which a practitioner uses a gloved finger inserted into a man's rectum to detect abnormal prostate growth). However, although it can be life-threatening, some prostate cancers are slow-growing and many cases diagnosed by PSA testing or digital rectal examinations never impact upon the man's health. This is reflected in the fact that prostate cancer has one of the highest five-year survival rates of all cancers: 92% of men receiving this diagnosis are alive five years later (AIHW Prostate Cancer in Australia). Australian Government guidelines state that due to insufficient evidence of reductions in prostate cancer-specific and all-cause mortality, issues of overdiagnosis, and potential harms of testing and treatment, screening at a population level is inappropriate (National Health and Medical Research Council, 2013b). Asymptomatic men seeking prostate cancer screening tests are advised to weigh up the benefits and risks of testing with their General Pratitioner (GP) (Screening Subcommittee of the Australian Population Health Development Principal Committee & Cancer Council Australia, 2010). This is a change from previous guidelines, such as those of the U.S. Preventive Services Task Force (2008), which had recommended against screening at older ages but been agnostic on screening for men under 75 years of age.

1.2.3.3. Influencing health behaviour.

Historically, health psychology models and theories have placed a far greater emphasis on type 2 processes than on type 1 processes (Hofmann, Friese, & Wiers, 2011). As outlined above, there is still a great deal of headway to be made in reducing noncommunicable disease risk (by improving diet, increasing physical activity, and reducing smoking) and increasing early detection (by increasing screening participation in appropriate groups). Therefore, new ideas are needed, and the promise of approaches based on dual-process theory has been increasingly acknowledged (e.g. Sheeran & Webb, 2016). In particular, the possibility that thinking style and dual forms of attitudes can explain some variance in health behaviour is an idea that should be pursued further. Investigating these variables in relation to behaviours of importance to primary and secondary prevention should provide a useful contribution to strategies that can aid disease prevention efforts in future.

1.3. Aims of this research

1.3.1. Chapter 3.

Previous work has revealed small and mixed effects of thinking style on health behaviour variables. Study 1 extends knowledge of the impact of thinking style on health behaviour by testing whether the preference for type 1 or type 2 processing is related to the likelihood of participating in cancer screening via FOBT, PSA test or DRE.

1.3.2. Chapter 4.

As there is no short form of the REIm, a brief version of this measure is developed and psychometrically tested in Study 2. Due to having 13 items, the short form is named the REIm-13. Data are used to assess the factor structure in terms of its reliability, validity, and its association with criterion variables in order to ascertain its usefulness for future research.

1.3.3. Chapter 5.

Following on from findings that people deviate from their usual thinking style when engaging in processing related to different domains of life, Study 3 will explore the degree to which people have a particular *health thinking style*. This will be achieved by transposing the REIm-13 to specifically relate to health, and then assessing its ability to predict self-reported health behaviour. It is hypothesised that if *trait* thinking style (REIm) can predict variance in health behaviour, then health thinking style should be able to predict more variance. The incremental validity of health thinking style over trait thinking style in predicting health behaviour will be tested.

1.3.4. Chapter 6.

The link between health thinking style and health behaviour may be partially explained by the types of content being processed. In order to test this possibility, Study 4 will focus on attitudes about health behaviour that are accessed by type 1 processes and those that are used in type 2 processes. The aim will be to detect a moderation effect: health rationality should moderate the influence of type 2 attitudes over behaviour, and health intuition should moderate the influence of type 1 attitudes over health behaviour. In line with previous research, the study will test for three-way interactions whereby each attitude type is moderated by both health thinking style variables.

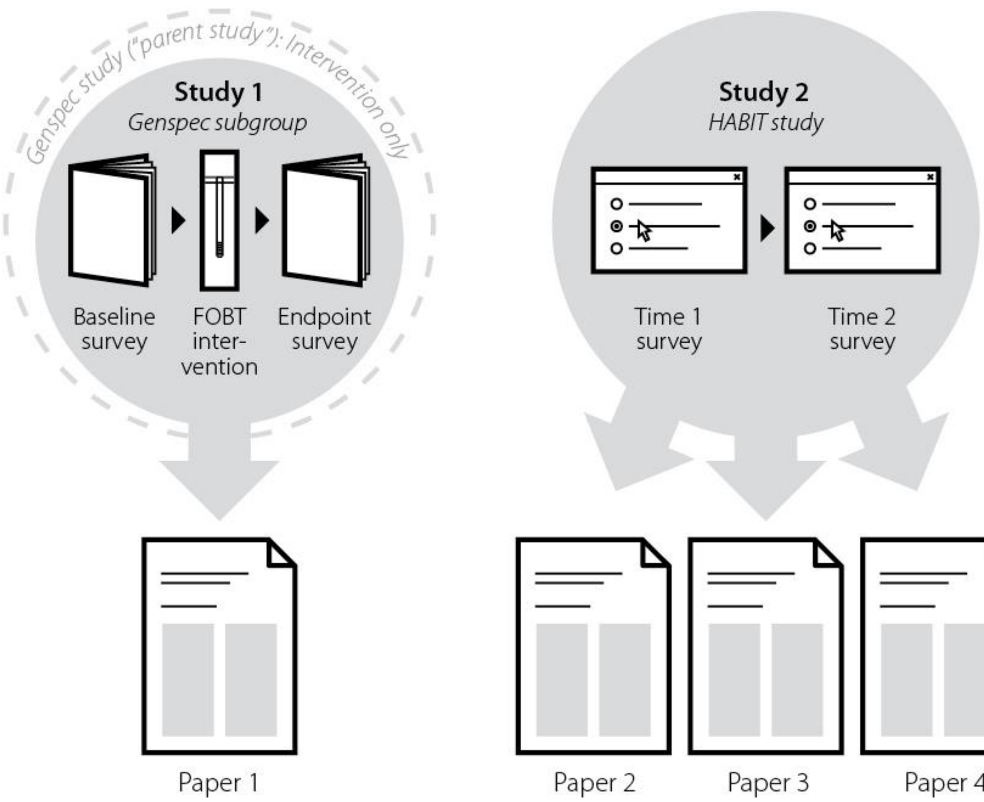
Over the coming chapters, the relationship between thinking style and health behaviour will be explored. In addition, the possible domain-specificity of thinking style will be considered, as will its role in affecting whether attitudes influence health behaviour. In the following chapter, the samples, methodology, measures and some analyses will be decribed in detail for the two studies that provided data for this thesis. Following that, the four published or publication-ready articles will be presented, and their findings reviewed and synthesised in a final discussion chapter.

CHAPTER 2. OVERVIEW OF RESEARCH METHODOLOGY, SAMPLES, AND MEASURES.

The aim of this chapter is to document the methods used in the four research papers, and in particular, to introduce the major variables and explain the processes by which they were created. The inclusion of a separate chapter dedicated to methods allows this to be done more thoroughly than is possible in the confines of a journal-length article.

Two studies provided data that were analysed in this thesis. Study 1 was a pre-existing dataset from previous research whereas Study 2 was newly conceived and implemented during the course of the PhD. For orientation, an overview is shown in Figure 1.

Figure 1. Overview of studies providing data for this thesis.



2.1. Research design

For all papers, correlational methods were used. Data collection was cross-sectional and rather than performing experimental manipulations on the variables of interest, I assessed relationships between them. Correlational methods are useful for hypothesis testing where the focus is exploring relationships between variables, rather than determining causality (Pelham & Blanton, 2007). The ability to conduct surveys using online platforms has enhanced the ease with which this research can be carried out, allowing for larger sample sizes, which has positive ramifications for statistical power. Furthermore, the opportunity to participate at a convenient time and place (rather than attending a university laboratory, for instance) lessens participant burden and thereby facilitates recruitment — both in terms of quantity, and in terms of sample diversity.

Through the rest of this chapter I will describe the procedures, measures, and samples employed in the four papers in this thesis. For coherence, the two separate studies that were carried out will be described independently: first Study 1 (immediately below), and then Study 2 (beginning in section 2.3 on page 42).

2.2. Study 1 (data for Chapter 3)

Data on which the analyses in Chapter 3 (page 97) were based originated from an earlier study (known as Genspec[3]), which will be referred to as the *parent study*. The parent study was a randomised controlled trial assessing the efficacy of gender-specific, targeted letters in improving faecal occult blood test uptake in a population-based probability sample of Australian men. The sample used herein was the survey subgroup of the parent study, and the description of study method below focuses on this group.

[3] NHMRC Project Grant number 1026510: Optimising men’s uptake of FIT screening for bowel cancer: a population based randomised controlled. 2012. Turnbull D., Wilson, C., Flight, I., Zajac, I.

2.2.1. Parent study method

2.2.1.1. Procedure.

A random selection of 10,000 names from the Roll maintained by the Australian Electoral Commission, stratified to reflect state population densities, formed the initial invitee sample. Participants were drawn from South Australia, Western Australia, New South Wales, Victoria and Queensland. Inclusion criteria were that participants be male, aged 50 to 74 years (inclusive), and living at a standard residential address; individuals not meeting these criteria were removed from the sample, along with duplicates, leaving a final eligible total sample of N = 9,216[4].

The sample was divided into four trial arms. This was achieved by assigning random integers to participants, sorting according to these integers, and by using random allocation software to designate the trial arm (Saghaei, 2004). To assign participants to the survey subgroup, random integers were once assigned within each trial arm, with participants receiving numbers 1 to 600 in each arm forming this group (N = 2,400 in total).

Two surveys were administered; one before the intervention (the baseline survey) and one following it (the endpoint survey) — see Table 1. The surveys were paper-based, and were mailed to participants using the addresses recorded for them on the Electoral Commission Roll. The pages of each survey pertinent to this research are included as Appendix A (page 245) and Appendix B (page 251). The baseline survey was mailed in mid-October 2012 and was preceded, two weeks earlier, by an invitation letter explaining that the survey would soon be sent. Reminder letters were sent to non-responders three and seven weeks after the survey. The endpoint survey was mailed in mid-June, 2013, followed by reminders to non-responders at three and seven weeks.

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[4] Power analyses were carried out to determine the necessary sample size to carry out the analyses required for the parent study. However, as they do not pertain to the analyses comprising Study 1, they are not reported here.

Table 1

Sources of data from parent study

	Baseline survey N = 926 October 2012	Intervention March 2013	Endpoint survey N = 585 June 2013
Demographics	✓		
Self-reported prostate-specific antigen test participation	✓		
Self-reported digital rectal examination participation	✓		
Self-reported faecal occult blood test participation	✓		
GP visit frequency	✓		
Observed faecal occult blood test participation (return of kit)		✓	
REI			✓

REI = Rational-Experiential Inventory

The screening offer was made to all participants, including those in the survey subgroup, in early March 2013. The primary manipulation of the parent study involved a 2 x 2 factorial design comprising modifications to an advance notification letter that was mailed two weeks before the screening offer, and to an invitation letter accompanying the kit. The screening kit included a two-sample Faecal Immunochemical Test (OC-Sensor, manufactured by Eiken Chemical Co, Tokyo), screening information and instructions, a participant details form, and a postage-paid padded envelope addressed to a pathology laboratory in South Australia.

The screening kit was mailed approximately 20 weeks after the baseline survey and 15 weeks before the endpoint survey. In order not to harass participants, those who either opted out from, or did not respond to, the baseline survey were removed from the survey subgroup prior to the screening offer and received no further contact (see Figure 2 on page 109, for participant flow). Those who completed the baseline survey but did not participate in the faecal occult blood test offer were retained in the subgroup regardless, and were mailed the endpoint survey.

2.2.1.2. Measures.

Demographics and GP attendance Self-reported participation in the cancer screening modalities was obtained by asking participants whether they had ever completed the screening test in question. Participants were mailed faecal occult blood test kits, and the observed faecal occult blood test participation variable indicated whether or not the participant had completed their kit and returned it to the processing laboratory within twelve weeks of it being mailed to them. The staging of data collection (see Table 1) may have had some impact on the make-up of the final sample in Study 1, given that in order to provide the all-important thinking style data (via the Rational Experiential Inventory, discussed on page 9), participants must have completed and mailed back two surveys without incentive, and not been deterred from further participation by receiving a faecal occult blood test kit from the same study.

2.2.1.3. Sample.

Descriptive statistics for the baseline and endpoint samples are shown in Table 2, as well as tests for differences between those who participated at endpoint and those who dropped out. Those who participated at baseline but not at endpoint (i.e. who were lost to follow-up) were slightly older and were less likely to report having done a faecal occult blood test before. However, the most pronounced difference between endpoint participants and endpoint non-participants was in their rates of uptake of the screening intervention. Threequarters of endpoint participants had completed the mailed faecal occult blood test kit, while just one-fifth of endpoint non-participants had done so. Thus, the endpoint sample — who formed the final sample for Study 1 — may not be representative of the general Australian male population when it comes to faecal occult blood test screening.

Table 2

Study 1 sample descriptive statistics at Baseline and Endpoint.

		Baseline participants	Endpoint		
			Participants	Non-participants	Difference[3]
N		926	585	341	
Age	M (*SD*)	61.08 (6.93)	61.44 (6.72)	60.46 (7.26)	$t(905) = 2.05$, $p = .041$
Language[1]	Yes	18%	17.1%	19.4%	*ns*
	No	78%	82.9%	80.6%	
SES[2]	1st decile	5.3%	3.8%	7.9%	*ns*
	2nd decile	2.4%	1.7%	3.5%	
	3rd decile	2.4%	2.6%	2.1%	
	4th decile	5.2%	5.3%	5.0%	
	5th decile	5.4%	5.1%	5.9%	
	6th decile	7.2%	7.0%	7.6%	
	7th decile	8.2%	7.7%	9.1%	
	8th decile	12.3%	13.5%	10.3%	
	9th decile	20.1%	21.9%	10.3%	
	10th decile	31.5%	31.5%	31.7%	
Education	Year 12 or less	34.1%	31.9%	37.9%	*ns*
	TAFE/Trade	19.3%	19.7%	18.6%	
	Dipl./Assoc.	11.9%	12.2%	11.5%	
	Bachelor	13.4%	14.2%	12.1%	
	Postgraduate	21.2%	22.0%	19.9%	

		Baseline participants	Endpoint		
			Participants	Non-participants	Difference[3]
Thinking style M (*SD*)	Rationality	-	3.61 (.74)	-	-
	Experientiality	-	3.63 (.69)	-	
FOBT uptake[4]	Returned kit	54.6%	74.4%	20.1%	$\chi^2(1) = 252.91$, $p < .001$
	Did not return	45.4%	25.6%	79.9%	
Self-reported FOBT[5]	Screened before	65.3%	71.3%	54.2%	$\chi^2(2) = 26.16$, $p < .001$
	Never screened	33.6%	27.3%	45.4%	

Notes. SES = socioeconomic status. FOBT = faecal occult blood test. 1. Speaking a language other than English at home.

2. 1st decile = most disadvantaged, 10th decile = most advantaged.

3. Test of difference between participants and non-participants at Endpoint.

4. Completion of mailed FOBT kit provided as part of RCT.

5. Excluding ‘don’t know’ responses, hence percentages do not sum to 100.

Compared to males aged 50 to 74 from the general Australian population, the final sample (N = 585 who participated at both baseline and endpoint) had a much higher rate of postgraduate education (Australian Bureau of Statistics, 2011a). The sample was also more socioeconomically advantaged. To reflect the Australian population, 10% of the sample should fall in each socioeconomic status (SES) decile, but as Table 2 shows, the most affluent deciles — 8, 9 and 10 — are over-represented while the lower deciles are under-represented. In addition, participants in the sample used for Study 1 (i.e. those who completed the Endpoint survey) appeared more willing to participate in faecal occult blood test screening than the rest of the parent study’s sample; 74.4% of the Study 1 sample participated, while in the remainder of the parent study’s sample, participation did not exceed 35%.

2.2.1.4. Trial results

As mentioned earlier, the purpose of Study 1's parent study was to test the effectiveness of different notification and invitation letters mailed prior to a faecal occult blood test, and this was done through a randomised controlled trial. In the rest of the parent study's sample (i.e. those *not* included in Study 1 of this thesis), the modified advance notification letters produced a statistically significant increase in uptake of the mailed faecal occult blood test. In the subgroup used as the sample for Study 1, no such effect was detected, and this may have been related to their having received the survey in the months preceding the screening offer. Answering questions about perceived faecal occult blood test screening barriers, benefits and self-efficacy, and susceptibility to colorectal cancer, may have moved some participants in the survey group to a more advanced stage of readiness to screen (Prochaska & Velicer, 1997), negating the effect of the targeted letters. Additionally, self-selection bias may have been present given that only those who responded to the baseline survey were sent the screening offer, and people who respond to health surveys may be more positively disposed towards a faecal occult blood test screening offer.

2.3. Study 2 (data for Chapters 4, 5, and 6)

The data collected in Study 2 provided the data for the remaining three papers presented in this thesis. This study was developed after completion of Study 1, with the aim of replicating and extending Study 1's findings, while compensating for limitations (by updating the measurement of thinking style and attempting to improve the representativeness of the sample). To provide data for the three papers, Study 2 would be required to obtain data on participant demographics and a few simple health-related indicators, as well as thinking style and a new construct, health thinking style. Also, in relation to eight health behaviours (healthy eating, physical activity, smoking cessation; and participation in faecal occult blood tests, Pap smears, mammograms, PSA tests and digital rectal examinations), participants would need to complete items indicating their implicit attitudes, their explicit attitudes, and their recent behaviour. The specific aims will not be relayed here but are detailed in Chapter 4 (page 129), Chapter 5 (page 153), and Chapter 6 (page 189). This study was dubbed the HABIT Study (Health Attitudes, Behaviours, Intuitions and Thoughts).

2.3.1. Study 2 method

2.3.1.1. Power considerations.

Because the analyses likely to require the greatest power were those aimed at detecting moderation effects, it was appropriate to use a similar study as an indicator of expected effect size, and refer to guidelines regarding sample sizes required to detect such an effect with a power level of .80. A study carried out by Conner et al. (2007; see second study) that attempted to detect moderation of attitudes' influence by individual difference variables had formed the original inspiration for my moderation study. Because essentially the same kind of moderation was the focus in Chapter 6 (page 189), the earlier study provided a useful guide to effect size. The authors had reported the R^2 of two linear regression models to be .13 and .17 for main effects and .23 and .25 when interaction terms were included. A table published in Warner (2013) indicated that with effects of this magnitude, a sample of N = 127 or greater was anticipated to provide statistical power of .80 with an alpha level of .05.

This sample size would, of course, be required for *each* of the moderation analyses, which required different demographic samples. Therefore it was imperative to attract at least 127 male participants aged 50 or over and 127 female participants aged 50 or over, in order to run moderation models for digital rectal examination, prostate-specific antigen (PSA) test, and Mammography participation. To produce a sample balanced in age, the same amount of males and females aged under 50 were sought. As a result of these requirements, the models for behaviours with more inclusive demographic requirements (such as faecal occult blood test, which included all people aged over 50, and Pap smear, which included all females) and the models that included the whole sample (healthy eating, physical activity, and smoking cessation) would end up with larger samples than strictly necessary, but would not be negatively impacted by this. Consequently, with the aim of ensuring adequate power for the three most demographically specific analyses, as well as to account for missing data, attrition through the survey, and the fact that my implicit attitude measures were untested (and were potentially less precise than the implicit attitude measures used by the exemplar study), I aimed to recruit a minimum of 150 participants of each gender in both the under- and over-50 age groups.

2.3.1.2. Procedure.

Surveys in Study 2 were built using the SurveyGizmo online survey platform. This included a pilot survey and the main data collection. Test-retest reliability data was necessary for Chapters 4 and 5, therefore the main data collection phase comprised two surveys: time 1 (T1) and time 2 (T2).

2.3.1.2.1. Pilot study

Before promoting the survey widely, a pilot study was conducted. The survey was promoted to the researchers' own social networks, and 51 people took part between 19 August and 8 September 2015 by completing the survey and providing feedback. The primary aims were to identify any usability issues across computer and mobile device platforms, to ensure that participants could understand and use the visual analogue sliding scales (the scales participants used to respond to the implicit attitude items) without difficulty, and to seek general feedback about the survey. Changes made based on pilot feedback included:

- improving the representativeness of demographic response options for marital status
- clarifying scenario wording
- emphasising that ratings of the scenario characters required only first impressions based on the limited information provided
- including the word describing the attitude type (benefits, barriers, health-consciousness) in the visual analogue sliding scale instruction to prevent misunderstanding
- relabelling the visual analogue sliding scale endpoints (from ‘not determined’ and ‘extremely determined’ to ‘low’ and ‘high’) due to confusion about what the midpoint meant
- re-writing self-referential explicit attitude items about smoking so that a non-smoker could answer them (i.e. from ‘If I quit smoking…’ to ‘If a person quits smoking…’)
- simplifying a dietary question about liquids consumed (which originally asked participants to estimate what percentage of their fluid intake was water, and which was replaced by two separate fields for number of glasses of water and number of glasses of other drinks)
- eliminating usability issues on certain mobile devices
- fixing survey logic that was not functioning properly
- implementing additional survey logic (hiding a question about trimming the fat from meat from people who report not eating meat, for example)

- adding an instruction that if no response option quite reflected the participant's views, they should just choose the closest.

2.3.1.2.2. Promotion and recruitment

During the main data collection phase of the study, the survey was promoted widely using email and social media. A number of organisations agreed to include a notice about the study in email newsletters (the University of Adelaide, the Freemasons SA/NT fraternal organisation) or to send a dedicated email to members (Foundation 49, a men's health organisation). Additionally, social media and website posting were made available by an Australian national scientific organisation, CSIRO, and by six state offices of Council on the Ageing, a group representing the interests of people over 50 years of age.

The Study 1 sample had been dominated by people residing in the most advantaged postcodes in Australia (refer back to Table 2, page 40). In order to attract participants from areas with lower SES, and improve the representativeness of the sample, a leaflet drop was carried out to 770 homes in suburbs assigned the lowest SES decile (in Adelaide's north-western suburbs). Promotional posters with tear-off tags were also placed in these areas. Examples of the promotional materials are shown in Appendix C (page 253).

Recruitment materials for the general public emphasised the offer of a prize (a graphics tablet at T1 and a AU$100 shopping voucher at T2). To avoid attracting an overly health-conscious sample, they did not mention the health focus of the study. Social media and email promotion, however, did provide some background to the study topic. At T1, potential participants who viewed printed promotional materials could access the surveys by typing in the web address or scanning the QR code (using a QR reader on their mobile device which would then open the survey web page in a browser). In the case of those who received email promotion, the survey was accessed by clicking on a link. At T2, people who had participated at T1 and agreed to be contacted about the follow-up survey were emailed a personalised link which they could click to access the survey.

2.3.1.2.3. Data collection

All participants completed their surveys online. Although a paper version was available, no participants took up the offer of having a copy mailed to them. On average, participants took 25 minutes to complete the T1 survey and 10 minutes to complete the T2 survey. The order of variable collection is shown in Table 3 and the surveys themselves are provided as Appendices D and E (pages 257 and 307, respectively).

Table 3

Sources of data from Study 2

	T1 survey N = 920 August 2015	T2 survey N = 510 February 2016
Demographics	✓	
Implicit attitudes about health behaviours[2]	✓	Partial[2]
Explicit attitudes about health behaviours[2]	✓	
Self-reported health behaviour[2]	✓	
Health importance	✓	
GP visit frequency	✓	
REIm (full 42-item scale)		✓
REIm-13 (13-item short form)	✓	✓
REI-Health	✓	✓

1. The health behaviours in question are: healthy eating, physical activity, smoking cessation, and participation in faecal occult blood tests, Pap smears, mammograms, PSA tests and digital rectal examinations.

2. Implicit attitudes about healthy eating, physical activity and smoking cessation were measured again at T2.

2.3.1.3. Measures.

2.3.1.3.1. Thinking style

Study 1 had used a brief version of the 1996 REI (Epstein et al.). Small positive associations between rationality and digital rectal examination participation were found, with no relationship evident between intuition (a core aspect of Experientiality) and any of the screening behaviours. However, a newer version of the REI had been produced subsequently that offered more detailed measurement of Experientiality: the REIm (see page 9). The new measure offered the promise that with better measurement of experientiality, links with health behaviour could be found, and was consequently selected for use in Study 2.

As detailed in Chapter 4 (page 129), I firstly set about producing a brief version of the REIm. This was done partly as a step toward developing a short measure of health-specific cognitive style (see Chapter 5, page 153), but also to address a perceived need for a short form. The short form of the previous REI (1999) is a commonly used tool. For example, in 2015, 4 of 11 published studies using this measure used shortened forms. However, no shortened form of the REIm has been published, and the full 42-item scale may not be practical in some projects. It was likely that a validated brief form of the REIm would facilitate the use of this measure — and better measurement of preferences for experiential processing — in future studies.

Given the existing literature supporting both a four-factor (Rationality, Emotionality, Imagination, Intuition) and a two-factor (Rationality, Experientiality) solution for the REIm (Norris & Epstein, 2011), I performed a confirmatory factor analysis of the 13-item shortened scale, which is reported in Chapter 5 (Figure 6, page 145). However, exploratory factor analyses for the full and short scales were also run to ensure the items loaded as intended when structure was determined by eigenvalues, and to check for problematic cross loadings. These analyses were not presented in the final article, and are therefore presented below.

Given the non-normal distributions of all items, Weighted Least Squares Means and Variance (WLSMV) adjusted estimation was used for ordinal variables, as recommended by Li (2015). To guide the extraction of factors, eigenvalues were generated for T1 and T2. These values confirmed the presence of four first-order factors. Table 4 shows the item loadings for the varimax-rotated four factor solutions for each time point. As can be seen, all items loaded strongly onto their theorized factor. The cross-loading of one Rational item onto the Imagination subscale is consistent with previous findings (Norris & Epstein, 2011) and was disregarded given its substantially higher loading on the intended factor.

Table 4

Factor structure of the REIm-13 at T1 and T2

	Four-factor				Two-factor	
Item	Rat.	Ima.	Int.	Emo.	Rat.	Exp.
I am not very good in solving problems that require careful logical analysis[1]	**.65** *.82*				**.59** *.76*	
Reasoning things out carefully is not one of my strong points[1]	**.64** *.71*				**.60** *.70*	
I enjoy intellectual challenges	**.75** *.68*	**.42** *.30*			**.84** *.75*	
I enjoy problems that require hard thinking	**.70** *.73*				**.77** *.78*	
I enjoy reading things that evoke visual images		**.65** *.70*				**.54** *.52*

	Four-factor				Two-factor	
Item	Rat.	Ima.	Int.	Emo.	Rat.	Exp.
I can clearly picture or remember some sculpture or natural object (not alive) that I think is very beautiful		**.43** *.54*				**.41** *.44*
I enjoy imagining things		**.64** *.63*				**.55** *.50*
I don't think it is a good idea to rely on one's intuition for important decisions[1]			**.63** *.76*			**.55** *.64*
I often go by my instincts when deciding on a course of action			**.85** *.82*			**.58** *.67*
I trust my initial feelings about people			**.47** *.48*			**.40** *.36*
Emotions don't really mean much: they come and go[1]				**.43** *.47*		**.34** *.42*
When I have a strong emotional experience, the effect stays with me for a long time				**.66** *.74*		**.41** *.51*
When I'm sad, it's often a very strong feeling				**.56** *.55*		**.34** *.40*

Note. EFA with varimax rotation and WLSMV estimation. **Bold** = T1 (N = 920); *Italic* = T2 (N = 510). Loadings <.3 not shown. 1. Items have been reverse coded.

An exploratory factor analysis was also conducted for the full REIm at T2, and is reported in Table 5. As can be seen, most items loaded on the theorized construct, although cross loadings, and some statistically non-significant loadings, were evident. Despite this, and given the focus on the REIm-13 herein, I proceeded with the theoretically-supported structure.

Table 5

Factor structure of the REIm at T2.

	Four-factor				Two-factor	
Item	Rat.	Ima.	Int.	Emo.	Rat.	Exp.
I am not very good in solving problems that require careful logical analysis[1]	.78				.77	
Reasoning things out carefully is not one of my strong points[1]	.71				.70	
I enjoy intellectual challenges	.69	.32			.73	
I enjoy problems that require hard thinking	.75				.78	
I prefer complex to simple problems	.58				.60	
I don't like to have to do a lot of thinking[1]	.66	.32			.70	
I am not a very analytical thinker[1]	.77				.75	
I try to avoid situations that require thinking in depth about something[1]	.72				.75	
I am much better at figuring things out logically than most people	.75				.74	
I have a logical mind	.73				.71	
Using logic usually works well for me in figuring out problems in my life	.60				.59	
Knowing the answer without understanding the reasoning behind it is good enough for me[1]	.38				.37	
I enjoy reading things that evoke visual images		.60				.54
I can clearly picture or remember some sculpture or natural object (not alive) that I think is very beautiful		.64				.53
I enjoy imagining things		.61				.52
I identify strongly with characters in movies or books I read		.39		.46		.52
I tend to describe things by using images or metaphors, or creative comparisons		.51				.57
Art is really important to me		.72				.50

	Four-factor				Two-factor	
Item	Rat.	Ima.	Int.	Emo.	Rat.	Exp.
Sometimes I like to just sit back and watch things happen		.04				
I have favorite poems and paintings that mean a lot to me		.74				.55
When I travel or drive anywhere, I always watch the landscape and scenery		.37				.38
I almost never think in visual images[1]		.47				.44
I don't think it is a good idea to rely on ones intuition for important decisions[1,]			.68			.58
I often go by my instincts when deciding on a course of action			.80			.66
I trust my initial feelings about people			.60			.38
I like to rely on my intuitive impressions			.84			.67
I tend to use my heart as a guide for my actions			.61			.57
I enjoy learning by doing something, instead of figuring it out first			.30			
I can often tell how people feel without them having to say anything			.46			.48
I generally don't depend on my feelings to help me make decisions[1]			.53	.49		.64
For me, descriptions of actual people's experiences are more convincing than discussions about "facts"			.47			.42
I'm not a very spontaneous person[1]			.32			.31
Emotions don't really mean much: they come and go[1,]				.63		.49
When I have a strong emotional experience, the effect stays with me for a long time				.61		.50
When I'm sad, it's often a very strong feeling				.58		.40
My emotions don't make much difference in my life[1]				.71		.53
Things that make me feel emotional don't seem to affect other people as much				.49		.32

Item	Four-factor Rat.	Ima.	Int.	Emo.	Two-factor Rat.	Exp.
Everyday experiences often evoke strong feelings in me				.41		.43
I'd rather be upset sometimes and happy sometimes, than always feel calm						.37
I don't react emotionally to scary movies or books as much as most people do[1]				.45		.38
My anger is often very intense				.32		
When I'm happy, the feeling is usually more like contentment than like exhilaration or excitement[1]						

Note. EFA with varimax rotation and WLSMV estimation. N = 510. Loadings <.3 not shown.

1. Items have been reverse coded.

2.3.1.3.2. Health thinking style

The creation of the REI-Health is detailed in Chapter 5 (page 153). However, some additional information is provided below.

The REIm largely focuses on *thinking*, but several items reference *deciding*. To our knowledge this has not been found to influence the scale's factor structure or validity, and indeed need for cognition and faith in intuition have been found to correlate predictably with measures of deliberative and intuitive decision making (Richetin et al., 2007). A side-effect of converting the scale wording so as to be specifically relevant to thinking relevant to health behaviours was that the proportion of items focused on deciding increased (i.e. making a choice about, as opposed to simply thinking about, a health matter), but I ensured that no subscale became entirely focused on deciding; aiming, in the spirit of the REIm, to address both thinking and deciding.

2.3.1.3.3. Implicit and explicit attitudes

In the study 2 survey I focused on two commonly-used markers of attitude to health behaviour: perceived benefits of, and perceived barriers to, engagement. Barrier and benefit attitudes, specifically, were chosen for their long history of use (for instance they are included in the prominent social cognition model the Health Belief Model; Rosenstock, 1966) and due to the range of existing measures available for the behaviours of interest (refer to Appendix F, page 319). An additional consideration was that these two types of attitudes, which have consistently shown opposing relationships to health behaviour (i.e. perceived benefits are positively related to participation while perceived barriers are negatively related; Carpenter, 2010), provided sufficient scope on which to base the implicit attitude scenarios described in section 2.3.1.3.5. A character could be presented as either endorsing or rejecting a behaviour's benefits, and as either succumbing to, or overcoming, barriers to the behaviour. For explicit attitudes, three benefit items and three barriers items were administered. The measurement of implicit attitudes was more laborious and, consequently, only one benefit and one barrier item were utilised, along with a third item measuring the more general attitude, health-consciousness, which is discussed further in section 2.3.1.3.5. Composite attitudinal measures for explicit attitudes (benefits minus barriers) and implicit attitudes (benefits plus health-consciousness minus barriers) were produced for use in Chapter 7 (page 189).

2.3.1.3.4. Measurement of explicit attitudes

Explicit attitude items were in the form of short statements that participants were required to rate their agreement with on a five-point Likert scale from 'strongly disagree' to 'strongly agree'. For example, a healthy eating benefits item was 'Eating healthy foods and snacks helps me look good'. Items were obtained (and sometimes modified) from existing measures, and in the case of digital rectal examination attitudes, created using the other measures as a guide. The sources of the explicit attitude items (and, if applicable, notes on their creation or revision) are provided in Appendix F (page 319).

2.3.1.3.5. Measurement of implicit attitudes

Implicit attitudes have traditionally been measured using procedures such as the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998), in which the strength of the association between different concepts (for instance, 'flower' and 'pleasant') is inferred using response times on a computer program. Average criterion prediction by the Implicit Association Test has been reported to be as high as r = .27 (Greenwald, Poehlman, Uhlmann, & Banaji, 2009) while other authors question its construct validity (Oswald, Mitchell, Blanton, Jaccard, & Tetlock, 2013). However, interest in other ways of capturing implicit attitudes stretches back half a century to the suggestion by Cook and Selltiz (1964) that *partially structured* measures (so called because they provide certain details but are open to interpretation) could achieve this by having participants describe the behaviour of a third person. The assumption underlying the method is that while participants are not asked to directly report their attitudes, their perceptions and judgements are affected by their attitudes, just as in an Implicit Association Test participants' response time is affected by their attitudes. Importantly, the attitudes captured by partially structured measures are proposed to be implicit attitudes (Vargas, von Hippel, & Petty, 2004). The use of partially structured measures has been revived recently by Vargas et al. (2004), and moreover, such measures can be administered in a paper-based or online survey, without the need for purpose-designed software (Vargas, Sekaquaptewa, & von Hippel, 2007).

Using this method, implicit attitudes can be measured in a survey format by asking participants to read a scenario in which a person behaves in an ambivalent manner relative to a certain attitude object. For instance, the authors measured religiosity, and presented the following scenario in which a woman behaved in religious and non-religious ways:

> *Mary didn't go to church once the whole time she was in college but she claimed that she was still a very religious person. She said that she prayed occasionally and that she believed in Christian ideals. Sometimes she watched religious programs on TV like the 700 Club or the Billy Graham Crusade.*

Participants were allowed the time to deliberate in their judgement of the character's attitudes and behaviour but were never explicitly asked for their attitudes about religion (Vargas et al., 2007). It is assumed that participants' judgements about the other person are made in relation to their own implicit attitudes, and that they may capture attitudinal orientations not expressed in responses to explicit measures. As a result, these measures may be less affected by concerns about social desirability. Significantly, because participants simply read and respond to a scenario without the need for time restrictions, partially structured measures can be implemented in a survey format; whether paper-based or online.

In the example mentioned, people who were highly religious (whose own behaviour might include attending church once or more a week and daily prayer) would judge Mary as being fairly non-religious, whereas a non-religious person (who may never have prayed or set foot inside a church) might view her as being quite religious — therefore a participant's implicit attitude, relative to other participants, is inferred to be the inverse of the judgement they made of the character in the scenario. For instance, a person who judged Mary to be quite non-religious receives a high score indicating the strength of their own implicit attitudes. (The same person may not have explicitly reported a high level of religiosity if asked directly, for any number of reasons.)

In the original study, participants also completed explicit measures of their attitudes about religion and reported on a range of religious behaviours. A multiple regression was run predicting the religious behaviour variable, and after controlling for explicit attitudes, the partially-structured implicit attitude measure predicted variance in religious behaviour (ß = .17, p = .02). When the study was repeated with participants also completing an Implicit Association Test aimed at capturing the positivity of implicit attitudes about religion, the Implicit Association Test predicted no variance in religious behaviour after controlling for explicit attitudes, whereas the partially structured measure did (ß = .09, p = .05) (Vargas et al., 2004). In other studies from the same paper, implicit attitudes about dishonesty predicted self-reported dishonest behaviour (ß = .21, p = .004) and cheating on a test during the experiment (ß = .20, p = .022), while implicit political orientation attitudes predicted requests for information from the corresponding political groups (ß = .25, p = .007).

In the study for this thesis, three types of implicit attitudes were measured for each behaviour (i.e. for healthy eating, physical activity, smoking cessation; and participation in faecal occult blood tests, Pap smears, mammograms, PSA tests and digital rectal examinations). The first two implicit attitudes, perceived barriers and perceived benefits, were designed to align with the explicit attitude measures. A third attitude variable was also measured: health-consciousness in relation to that behaviour. The first reason for this addition was that it was unknown whether attitudes as specific as perceived barriers and perceived benefits could successfully be measured using partially structured attitude measures. The attitudes measured in the original paper related to quite broad concepts such as dishonesty, political conservatism, and religiosity. Therefore, the more general health-consciousness rating was included in case the other two provided no useable data. Secondly, a third variable was included so that, like several studies in the original article (Vargas et al., 2004), I could produce a three-variable summed composite of implicit attitudes.

2.3.1.3.5.1. Partially-structured attitude measure item creation

A short scenario was written for each of the eight behaviours following the example of Vargas et al. (2004). To align the implicit and explicit attitude measures as much as possible, the same three benefits and three barriers used in explicit attitude items formed the basis for each scenario. These were necessarily reworded so the explicit measures (which appeared later in the survey) would not seem repetitive, including one of the six being negatively phrased relative to the explicit measures (e.g. a benefit perceived as being absent rather than present). As per the original measure, the characters in the scenarios needed to express an ambivalent position in regard to the behaviour, and thus needed to endorse some barriers and benefits, while at the same time rejecting others. To ensure consistency across scenarios, the alterations made in the adaptation process were carefully calibrated: for each scenario, one benefit or barrier would be ignored by the character, one would be rejected (or overcome, in the case of barriers) and the remaining four would be endorsed.

Along with consistency, readability and comprehension were a focus. Each scenario was edited to 80 words, and was revised until its Flesch Reading Ease score was below 85 (or lower if possible), and its Flesch-Kincaid Grade Level was below 7. These scores indicate that a piece of writing is easy to read (meeting the recommended level for consumer information), and is readable by a person with a seventh grade education (Flesch, n.d.). For the screening behaviours, a short definition was provided below the scenario. The eight scenarios are presented in the following sections (with definitions if one was provided), along with information about their construction and readability.

2.3.1.3.5.1. Scenario 1: healthy eating.

The healthy eating scenario had a Flesch Reading Ease score of 78.5 and a Flesch-Kincaid Grade Level of 6.2. The scenario is shown below, followed by details of its construction (Table 6).

Jay feels like no matter what he eats, he's always overweight. But when it's so much effort to buy and prepare healthy foods, he often just can't be bothered. He's always so tired by dinner time so he craves something tasty and easy like fast food. He recently found out that he is at higher than average risk of heart disease. Since then he feels he has made an effort, such as starting to order his coffees with skim milk.

Table 6

Scenario construction for healthy eating

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: improve appearance	Eating healthy foods and snacks helps me look good.	+	Jay feels like no matter what he eats, he's always overweight	-
Barrier: don't care	I just do not care about eating fruits and vegetables every day.	+	he often just can't be bothered	+
Benefit: lower disease risk	Eating healthy foods lowers my chance of developing certain diseases.	+	He recently found out that he is at higher than average risk of heart disease. Since then he feels he has made an effort	+
Barrier: crave unhealthy foods	I never crave unhealthy foods.	-	he craves something tasty and easy like fast food	+

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: energy	Eating healthy foods gives me energy and helps me to be physically active.	+	He’s always so tired by dinner time	/
Barrier: difficult	Fresh healthy foods are not easily available.	+	it’s so much effort to buy and prepare healthy foods	+

1. Implicit version phrasing relative to explicit measure.

2. Character’s response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.2. Scenario 2: Smoking cessation.

The smoking cessation scenario had a Flesch Reading Ease score of 84.8 and a Flesch-Kincaid Grade Level of 5.4. The scenario is shown below, followed by details of its construction (Table 7).

James knows that his wife and kids would be really pleased if he quit smoking for good. But he doesn’t think they understand how hard it is to quit, because they’ve never been addicted. He’s cut down a bit over the past couple of years. He says he *doesn’t think that it makes a difference to his health. He hates wasting money and is known to be thrifty, but his cigarettes feel like something he can’t live without, just now.*

Table 7

Scenario construction for smoking cessation

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: feel healthier	Quitting smoking makes a person feel healthier.	+	says he doesn't think that it makes a difference to his health	-
Barrier: addiction prevents quitting	Addiction makes it hard to quit smoking.	+	how hard it is to quit … addicted	+
Benefit: save money	Quitting smoking saves a person money.	+	hates wasting money and is known to be thrifty, but	/
Barrier: difficulty	Non-smokers can easily understand what it's like to quit smoking.	-	doesn't think they understand how hard it is to quit	+
Benefit: others happy	If I quit smoking it would make people I care about happy.	+	knows that his wife and kids would be really pleased if he quit smoking for good	+
Barrier: lost without cigarettes	I'd feel lost without cigarettes.	+	cigarettes feel like something he can't live without	+

1. Implicit version phrasing relative to explicit measure.

2. Character's response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.3. Scenario 3: Physical activity.

The physical activity scenario had a Flesch Reading Ease score of 76.9 and a Flesch-Kincaid Grade Level of 5.8. The scenario is shown below, followed by details of its construction (Table 8).

Mary says she has nowhere she can do exercise. But really, she has never enjoyed exercising at all. Her doctor said she should get more active to lower her risk of disease, so she signed up at a nearby gym. But Mary dislikes exercising in public. Her weight troubles her and because of this she hates to wear gym clothes. She often finds herself at home watching TV rather than going to the aerobics classes that she signed up for.

Table 8

Scenario construction for physical activity

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: improve appearance	Being active makes me attractive to others.	+	Her weight troubles her	/
Barrier: prefer other activity	I would rather watch TV or read than do something active.	+	She often finds herself at home watching TV rather than going to the aerobics classes that she signed up for	+
Benefit: lower disease risk	Exercising regularly lowers my chance of developing certain diseases.	+	Her doctor said she should get more active to lower her risk of disease, so she signed up at a nearby gym	+
Barrier: no suitable equipment/environment	I have all the equipment I need to be able to exercise and an appropriate area in which to do it.	-	she has nowhere she can do exercise	+
Benefit: enjoy physical activity	I think being active is something fun and enjoyable to do	+	she has never enjoyed exercising	-
Barrier: dislike exercising in public	I feel embarrassed when I exercise around other people.	+	dislikes exercising in public … she hates to wear gym clothes	+

1. Implicit version phrasing relative to explicit measure.

2. Character's response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.4. Scenario 4: Faecal occult blood test.

The faecal occult blood test scenario had a Flesch Reading Ease score of 78 and a Flesch-Kincaid Grade Level of 5.6. The scenario and definition are shown below, followed by details of scenario construction (Table 9).

Months ago, the government mailed Terry a home stool test. He thought this was a good program that would save lives. Ignoring his embarrassment, he put the test in his family's busy kitchen as a reminder. Doing the test would stop him worrying about bowel cancer. He thinks if cancer is found early the treatment won't be as awful. Yet he still can't bring himself to collect his stool samples even on those days when he has plenty of time.

Home stool test (also known as Faecal Occult Blood Test or FOBT): A test to screen for bowel cancer. You collect samples of two or more bowel movements on a stick, brush or card, and mail the samples off for processing.

Table 9

Scenario construction for faecal occult blood test

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: reduce worry	A FOBT will help me not worry as much about bowel cancer.	+	Doing the test would stop him worrying about bowel cancer	+
Barrier: embarrass-ment	A FOBT is embarrassing.	+	Ignoring his embarrassment, he put the test in his family's busy kitchen	/
Benefit: save life	Finding bowel cancer early will save my life.	+	He thought this was a good program that would save lives	+
Barrier: faecal aversion	Collecting a stool sample to do a FOBT does not bother me at all.	-	can't bring himself to collect his stool samples	+
Benefit: early detection aids treatment	Treatment for bowel cancer may not be as bad if it is found early.	+	if cancer is found early the treatment won't be as awful	+
Barrier: time consuming	I do not have the time to do a home stool test	+	even on those days when he has plenty of time	-

1. Implicit version phrasing relative to explicit measure.

2. Character's response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.5. Scenario 5: Pap smear.

The Pap smear scenario had a Flesch Reading Ease score of 72.4 and a Flesch-Kincaid Grade Level of 6.4. The scenario and definition are shown below, followed by details of scenario construction (Table 10).

When Selma's colleague needed large amounts of chemotherapy for cervical cancer that was found late, Selma said she'd begin having Pap smears every two years. But she hasn't been to the doctor yet. Finding time is not a problem. But the Pap smear process sounds pretty embarrassing to Selma. Nonetheless, she tells younger women at work that a Pap smear might save their lives. When a colleague complains that it hurts a little, Selma tells her she's being weak.

Pap smear: A test to screen for cervical cancer. A doctor takes a sample of cells from the cervix.

Table 10

Scenario construction for Pap smear

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: effective early detection	I think that having a regular Pap smear is the best way for cervical cancer to be diagnosed early.	+	When Selma's colleague … Selma said she'd begin having Pap smears every two years	+
Barrier: time consuming	Having a Pap smear takes too much time.	+	Finding time is not a problem	-
Benefit: save life	Having regular Pap smears will decrease my chances of dying from cervical cancer.	+	she tells younger women at work that a Pap smear might save their lives	+
Barrier: uncomfortable	Having a Pap smear causes no discomfort whatsoever.	-	When a colleague complains that it hurts a little, Selma tells her she's being weak	/
Benefit: early detection aids treatment	If cervical cancer was found at a regular Pap Smear Test its treatment would not be so bad	+	When Selma's colleague required extensive chemotherapy and surgery for late-detected cervical cancer, Selma decided	+

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Barrier: embarrassing	It is embarrassing to show my private parts to have a Pap Smear Test	+	the Pap smear process sounds pretty embarrassing	+

1. Implicit version phrasing relative to explicit measure.

2. Character's response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.6. Scenario 6: mammogram.

The mammogram scenario had a Flesch Reading Ease score of 70.6 and a Flesch-Kincaid Grade Level of 6.7. The scenario and definition are shown below, followed by details of scenario construction (Table 11).

Leila has raised money for the Cancer Council before. So she knows about how mammograms can detect lumps and lower the risk of dying from breast cancer. A letter about having a mammogram arrived six months ago. Leila knows the test doesn't take long, but the idea of finding a problem is scary. So is the thought of having treatment for even a small lump. She delays making the booking because the last time she felt ashamed and slightly uncomfortable.

Mammogram: A test to screen for breast cancer. A radiographer uses a machine to take x-rays of each breast.

Table 11

Scenario construction for mammogram

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: effective detection	Having a mammogram is the best way for me to find a very small lump in my breast.	+	she knows about how mammograms can detect lumps	+
Barrier: embarrasing	Having a mammogram is too embarrassing.	+	ashamed	+
Benefit: save life	Having a mammogram will decrease my chances of dying from breast cancer.	+	lower the risk of dying from breast cancer	+
Barrier: uncomfortable	Having a mammogram is too painful.	+	slightly uncomfortable	+
Benefit: early detection aids treatment	If I find a lump through a mammogram, my treatment for breast cancer may not be as bad	+	the idea of finding a problem is scary. So is the thought of about having treatment for even a small lump	/
Barrier: time consuming	Having a mammogram is easy to fit into my schedule.	-	knows that a mammogram doesn’t take long	-

1. Implicit version phrasing relative to explicit measure.

2. Character’s response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.7. Scenario 7: PSA test.

The PSA test scenario had a Flesch Reading Ease score of 76.7 and a Flesch-Kincaid Grade Level of 5.3. The scenario and definition are shown below, followed by details of scenario construction (Table 12).

Huy knows all about prostate cancer. He worries about it sometimes, but thinks being tested might make him worry more. He's heard that PSA tests can detect prostate cancer that has no symptoms. But he's confused about whether it's helpful to detect a prostate cancer that has no symptoms. Plus, he has always hated needles. And his schedule is fuller than ever since he retired. He'd probably visit his GP for a chat about it if he had more time.

PSA test (Prostate Specific Antigen test): A test to screen for prostate cancer. A blood sample is taken using a needle, and then it is sent to a lab.

Table 12

Scenario construction for PSA test

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Benefit: reduce worry	Having a PSA test would mean I won't worry as much about prostate cancer.	+	He worries about it sometimes	/
Barrier: uncomfortable	Giving the blood sample for a PSA test would be uncomfortable.	+	he has always hated needles	+
Benefit: effective early detection	Having a PSA test would allow me to find prostate cancer early.	+	He's heard that PSA tests can detect prostate cancer that has no symptoms	+
Barrier: time consuming	Having a PSA test is quick and convenient.	-	He'd probably visit his GP for a chat about it if he had more time	+
Benefit: early detection aids treatment	Treatment for prostate cancer is more successful if it is detected early by PSA testing.	+	he's confused about whether it's helpful to detect a prostate cancer that has no symptoms	-

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Barrier: cause worry	Having a PSA test will make me worry about prostate cancer.	+	thinks being tested might make him worry more	+

1. Implicit version phrasing relative to explicit measure.

2. Character's response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.8. Scenario 8: Digital rectal examination.

The digital rectal examination scenario had a Flesch Reading Ease score of 74.8 and a Flesch-Kincaid Grade Level of 6.1. The scenario and definition are shown below, followed by details of scenario construction (Table 13).

Marco's doctor said next check-up, he'd give Marco a digital rectal examination. The thought of having prostate cancer and not knowing is a bit of a concern. But Marco reckons he'd still be worried even after the test. He thinks he'll feel ashamed and it might hurt. He tells himself that the hassle is nothing compared to finding prostate cancer late when treatment is so much worse. Still, he's been putting off going to the doctor for two years now.

Digital rectal examination: A test to screen for prostate cancer. A doctor inserts a gloved finger into your rectum to feel the prostate.

Table 13

Scenario construction for digital rectal examination

Barrier or benefit	Explicit measure	Phrasing[1]	Scenario translation	Response[2]
Reduce worry	Having a digital rectal examination would mean I won't worry as much about prostate cancer.	+	Marco reckons he'd still be worried even after a digital rectal exam	-
Embarrassing	A digital rectal examination is embarrassing.	+	thinks he'll feel ashamed	+
Effective early detection	Having a digital rectal examination would allow me to find prostate cancer early.	+	The thought of having prostate cancer and not knowing is a bit of a concern	+
Unpleasant	Having a digital rectal examination is unpleasant.	+	it might hurt	+
Early detection aids treatment	Having a digital rectal examination can help to find prostate cancer early when treatment is not as bad.	+	compared to finding prostate cancer late when treatment is so much worse	+
Inconvenient	Having a digital rectal examination is a convenient way to find prostate cancer	-	the hassle is nothing	/

1. Implicit version phrasing relative to explicit measure.

2. Character's response to benefit or barrier. For benefits, this is whether character endorses (+), rejects (-) or disregards (/) the benefit. For barriers, this is whether the character succumbs to (+), rejects/overcomes (-) or disregards (/) the barrier.

2.3.1.3.5.9. Scenario ratings

Following the example of Vargas et al. (2007), participants were instructed to rate each scenario character based on their behaviour. I used the words determination, wisdom, and health-consciousness to label the characteristics being rated, but to prevent misinterpretation and ensure participants focused their ratings on the dimensions of interest to us, I incorporated the names of the first two variables of interest (barriers, benefits) into the relevant slider directions, and clarified the meaning of health-consciousness. Taking as an example the physical activity sliders, the directions for all behaviours took the following form:

> *Please rate Mary's determination (i.e. overcoming barriers) when it comes to exercising:* [visual analogue sliding scale]
>
> *Please rate Mary's wisdom (i.e. doing what is beneficial) when it comes to exercising:* [visual analogue sliding scale]
>
> *Please rate how health-conscious Mary is (i.e. looking after her health) when it comes to exercising:* [visual analogue sliding scale]

Participants rated each characteristic on a visual analogue sliding scale with possible values ranging from 0 to 100. Because participants were assumed to evaluate characters with reference to their own attitudes, slider ratings provided an *inverse* measure of the participant's implicit attitudes about the health behaviour. For instance, a participant who judged Jay to perceive low benefits of healthy eating was inferred to perceive high benefits, and a participant who rated Mary to have low health-consciousness was assumed to have high health-consciousness. The exceptions were the barriers items, for which the characteristic evaluated was determination, or *overcoming* barriers. This introduced another inversion such that a high rating for determination implies the character was judged to easily overcome barriers (or perceive low barriers), which in turn was taken to mean the participant was deterred by barriers (or perceived high barriers). Therefore, barrier slider scores were actually consistent with implicit attitudes. Table 14 demonstrates the relationship of evaluations to inferred participant ratings.

Table 14

Interpretation of ratings provided in response to partially structured attitude measure scenarios

Characteristic evaluated	*Interpretation of low rating*		*Interpretation of high rating*		Rating is inverse of implicit attitude?
	Character's attitude	Participant's attitude	Character's attitude	Participant's attitude	
Determination	↑ barriers	↓ barriers	↓ barriers	↑ barriers	N
Wisdom	↓ benefits	↑ benefits	↑ benefits	↓ benefits	Y
Health-consciousness	↓ health-conscious	↑ health-conscious	↑ health-conscious	↓ health-conscious	Y

2.3.1.3.5.10. Completion time

Participants were instructed to give their first impressions in response to the scenarios. It was not possible to apply a time limit to the survey pages, but timers recorded the amount of time each participant spent per page (on which they read one scenario and completed three sliders). Durations are shown in Table 15. T-tests (not shown) revealed that time to respond did not significantly differ between those with an intuitive trait thinking style profile (high intuition and low rationality) and those with other trait thinking style profiles; nor did they differ between those high and low on intuition alone. Similarly, neither the intuitive health thinking style profile, nor being high on health intuition, predicted different completion times (also not shown). Three of the implicit attitude measures (physical activity, smoking cessation, and diet quality) were re-administered at time 2, and the difference in completion time was not significantly different from time 1 (Table 15).

Table 15

Descriptive statistics for time spent on implicit attitude pages

	N	Seconds spent on page			
		Min.	Max.	M (*SD*)	T1-T2 difference
Healthy eating	907	9	2043	69.15 (117.65)	
Smoking cessation	907	7	1152	46.81 (48.86)	
Diet quality	907	6	2915	52.19 (134.72)	
Faecal occult blood test	398	16	10104	77.37 (504.63)	
Pap smear	494	10	8906	75.37 (416.18)	
Mammogram	159	8	1354	47.86 (106.41)	
PSA test	238	15	8891	85.55 (574.12)	
Digital rectal examination	238	14	187	42.92 (21.68)	
Healthy eating (T2)	503	11	779	66.82 (86.77)	$t(496) = -.76$, $p=.449$
Smoking cessation (T2)	503	7	822	44.04 (48.077)	$t(497) = .78$, $p=.436$
Diet quality (T2)	503	7	9720	61.00 (433.31)	$t(496) = -.19$, $p=.846$

Participants were not excluded based on very short or long response times. This was because it would be difficult to discern a minimum acceptable time in which a person could read and respond to a short scenario; and because a person providing a valid response might have been called away from the computer for a period of time while on that page. These extreme response times therefore did not necessarily indicate an aberrant response to the sliders. The very shortest response times likely reflect random error (as these participants may not have been reading the scenarios) but on any page, fewer than two per cent of participants took less than 15 seconds, and this contribution to random error was not seen to pose a problem.

During the analyses conducted to assess criterion validity, an attempt was made to use response times to improve behavioural prediction by the implicit attitude measures. To restrict analysis to participants who did not deliberate for long on any pages — whose responses, theoretically, would more closely represent their implicit attitudes — the analyses reported in section 2.3.1.3.5.15 were re-run with those who took longer than 40 seconds excluded. However, this did not improve the detection of effects, and these results are not reported.

2.3.1.3.5.11. Variable creation

The scores for benefits and health-consciousness were subtracted from the maximum score of 100 to create inverse scores (but as discussed above, this step was not necessary for the barriers items). The three variables for each behaviour now represented the participant's implicit attitude (rather than their evaluation of the character's attitude).

All 24 implicit attitude items were positively skewed, deviating significantly from normal distribution (Shapiro-Wilk tests all $p < .001$). Therefore, non-parametric analyses were performed when the continuous version of the variable was used. Additionally, dichotomous variables were created for each implicit attitude (using a median split).

Table 16

Descriptive statistics for implicit attitude measures at Time 1

	N	Attitude	Min.	Max.	Mean	*SD*
Healthy eating	920	Barriers	0	100	16.68	16.59
		Benefits	0	100	81.22	19.40
		Health-consciousness	0	100	81.46	18.30

	N	Attitude	Min.	Max.	Mean	*SD*
Smoking cessation	920	Barriers	0	100	15.03	16.32
		Benefits	0	100	82.61	20.75
		Health-consciousness	0	100	85.37	17.43
Physical activity	920	Barriers	0	100	12.23	12.71
		Benefits	0	100	84.20	17.86
		Health-consciousness	0	100	82.72	17.67
Faecal occult blood test	402	Barriers	0	92	13.14	14.93
		Benefits	0	100	74.81	26.36
		Health-consciousness	5	100	77.99	22.92
Pap smear	502	Barriers	0	100	11.82	16.64
		Benefits	0	100	69.74	30.70
		Health-consciousness	0	100	82.54	21.44
Mammogram	162	Barriers	0	96	9.86	13.46
		Benefits	1	100	78.46	25.11
		Health-consciousness	7	100	85.41	18.13
PSA test	239	Barriers	0	100	10.67	13.89
		Benefits	0	100	80.57	22.98
		Health-consciousness	0	100	83.54	18.66
Digital rectal examination	239	Barriers	0	85	11.23	14.02
		Benefits	0	100	80.82	23.48
		Health-consciousness	0	100	83.36	19.62

2.3.1.3.5.12. Test-retest reliability

At Time 2, three of the implicit attitude sets were administered again. Those applicable to the entire sample (healthy eating, physical activity, and smoking cessation) were chosen due to anticipated lower response rates at follow-up. The nine retest variables were created as described in section 2.3.1.3.5.11, and descriptive statistics can be seen in Table 17. The correlations performed between the Time 1 and Time 2 variables (shown in Table 18) reveal poor test-retest reliability, well below the commonly used benchmark of .70 indicating acceptable reliability (Hagan & Tsushima, 2016). When weighted kappa (an indicator of inter-rater agreement) was calculated to evaluate the test-retest reliability of the dichotomised implicit attitude variables, all were within a range that suggested 'fair' agreement between the two times (Landis & Koch, 1977). In all, the partially structured attitude measure items appear to capture a large amount of random error.

Table 17

Descriptive statistics for implicit attitude measures at Time 2

	N	Attitude	Min.	Max.	Mean	*SD*
Healthy eating	503	Barriers	0	100	16.13	15.67
		Benefits	1	100	81.92	17.49
		Health-consciousness	11	100	81.53	17.24
Smoking cessation	503	Barriers	0	87	15.26	15.54
		Benefits	0	100	82.29	20.25
		Health-consciousness	5	100	84.48	17.79
Physical activity	503	Barriers	0	77	13.19	12.91
		Benefits	0	100	81.47	19.49
		Health-consciousness	0	100	80.26	18.65

Table 18

Correlations and agreement of implicit attitude measures between Time 1 and Time 2

	N	Attitude	Continuous variables	Dichotomous variables
			Correlation	Weighted kappa (SE)
Healthy eating	503	Barriers	.43***	.34 (.04)
		Benefits	.46***	.30 (.04)
		Health-consciousness	.49***	.38 (.04)

	N	Attitude	Continuous variables	Dichotomous variables
			Correlation	Weighted kappa (SE)
Smoking cessation	503	Barriers	.38***	.29 (.04)
		Benefits	.42***	.29 (.04)
		Health-consciousness	.36***	.31 (.04)
Physical activity	503	Barriers	.36***	.28 (.04)
		Benefits	.39***	.26 (.04)
		Health-consciousness	.38***	.29 (.04)

Notes. *** $p < .001$

2.3.1.3.5.13. Divergent validity

Implicit and explicit attitudes about the same object (e.g. faecal occult blood test screening barriers) can differ for the same person. So theoretically, the implicit attitude measures should not be highly correlated with explicit measures of the same attitude. To provide some indicator of what relationship might be expected, the correlation of implicit to explicit attitudes should not be as high as the correlation between explicit attitudes. For example, the correlation between implicit faecal occult blood test barrier attitudes and explicit faecal occult blood test barrier attitudes should be *lower* than the correlation amongst different explicit faecal occult blood test barrier attitudes. To assess divergent validity, correlations were performed between the implicit and explicit measures of barrier and benefit attitudes for each health behaviour (shown in Appendix G, tables G1 to G8, and summarised below in Table 19). For all eight behaviours, and for both barrier and benefit attitudes, the implicit-explicit correlation (ranging from very weak to weak) was lower than the correlation amongst explicit attitudes (very weak to strong). Correlations could not be performed for the health-consciousness measures because an explicit equivalent was not administered.

Table 19

Summary of correlations between explicit and implicit measures of attitudes

	Barriers		Benefits	
	Implicit v Explicit	Explicit v Explicit	Implicit v Explicit	Explicit v Explicit
Healthy eating	.06 – .07*	.00 – .38**	-.01 – .08*	.41*** –.46***
Smoking cessation	-.04 – .02	.17*** –.25***	.14*** –.15***	.30*** –.36***
Physical activity	.08* –.16***	.14*** –.40***	-.01 – .11**	.23*** –.39***
Faecal occult blood test	.06 – .18***	.43*** – .66***	.00 – .06	.28*** – .54***
Pap smear	-.04 – .19***	.13** – .29***	-.03 – -.01	.17*** – .56***
Mammogram	.23** – .33***	.30*** – .43***	.11 – .15	.35*** – .59***
PSA test	-.01 – .07	.30*** –.49***	.09 – .13	.51*** – .63***
Digital rectal examination	-.08 – .01	.31*** – .62***	.03 – .14*	.56*** – .62***

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 229. Spearman's rho reported due to skewed implicit attitude data. For full correlation matrix and N per behaviour, refer to Appendix G.

2.3.1.3.5.14. Convergent validity

If the implicit attitude measures are consistently capturing implicit attitudes, then these attitudes should show predictable correlations with one another. For a given behaviour, implicit benefits should be positively correlated with implicit health-consciousness. On the other hand, implicit barriers should be negatively correlated with both implicit benefits and implicit health-consciousness. These correlations (along with the explicit barrier-benefit correlation, for comparison) are shown in Appendix G, tables G1 to G8, and summarised in Table 20 below.

Implicit attitudes about the same health behaviour had moderate to very strong correlations with one another. Implicit benefit attitudes were positively correlated with implicit health-consciousness while implicit barrier attitudes were negatively correlated with both implicit benefit attitudes and implicit health-consciousness. Implicit barriers and benefits had a more pronounced negative relationship than the explicit barrier and benefit measures, which showed moderate negative to very weak positive correlations.

Table 20

Correlations between attitudes of the same type

		Implicit			Explicit
	N	Barriers v health-consciousness	Benefits v health-consciousness	Barriers v benefits	Barriers[1] v benefits[1]
Healthy eating	865	-.77***	.83***	-.79***	-.20***
Smoking cessation	883	-.65***	.74***	-.61***	.16***
Physical activity	874	-.66***	.66***	-.63***	-.47***
Faecal occult blood test	395	-.66***	.68***	-.58***	-.42***
Pap smear	493	-.65***	.56***	-.41***	-.23***
Mammogram	160	-.71***	.68***	-.55***	-39***
PSA test	229	-.73***	.73***	-.67***	-.45***
Digital rectal examination	229	-.75***	.73***	-.71***	-.22**

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 229. Spearman's rho reported due to skewed implicit attitude data.

1. Composite measure averaging three items.

In regards to these rather strong correlations, it is important to remember that the implicit attitude measures likely capture a number of individual differences in addition to the implicit attitude under study. Specifically, because these variables are derived from judgements participants made about the characters in the scenario, their visual analogue sliding scale rating might be influenced by their empathy, the degree to which they tend to judge others harshly, or their mood at the time. Because these would not change between making the three ratings per scenario, their effect would lead to increased positive correlations between the variables. Additionally, while negative correlations between implicit barriers and the two other implicit attitudes are present, as expected, it should be pointed out that the barrier ratings were not inversed and the other two were. This would likely lead to negative relationships even in the absence of theoretical reasons to expect them.

2.3.1.3.5.15. Criterion validity

As is the case for explicit attitudes, implicit attitudes about a behaviour should predict the degree to which a person reports performing that behaviour, or intends to perform it. In more specific terms, attitudes regarding barriers to performing a behaviour should negatively predict that behaviour or intention, while attitudes about benefits of the behaviour should positively predict it. Behaviour-specific health-consciousness should also positively predict the behaviour/intention. The extent to which implicit attitudes predicted self-reported behaviour and behavioural intentions was assessed by performing a series of regressions in which a single implicit attitude was used to predict behaviour and intentions. As a means of investigating how best to use the implicit attitude measures in future, this was carried out using them in both continuous form (with linear regression) and dichotomous, median-split, form (using logistic regression). Results are reported in full in Appendix G, tables G9 to G24 (linear regressions) and G25 to G39 (logistic regressions). In Table 21, below, a summary is provided presenting the standardised betas from linear regressions, and in Table 22 the odds ratios from logistic regressions are summarised. As can be seen, the implicit attitudes largely predict behaviour in the expected direction — i.e. high barriers negatively predict (or decrease the odds of) higher participation while high benefits and health-consciousness positively predict (or increase the odds). However, only a few parameters are significant.

Table 21

Summary of univariate effects for prediction of behaviour and intentions from continuous implicit attitudes

	Behaviour			Explicit intentions		
	Barriers	Benefits	Health-cons.	Barriers	Benefits	Health-cons.
Healthy eating	-.05	.06	.10**	-.10**	.13**	.08*
Years smoked[1]	.14*	-.09	-.13*	-.12	.07	.05
Physical activity	-.05	.07*	.09*	-.04	.01	.07*
Faecal occult blood test	-.07	.08	.04	.06	-.01	-.01
Pap	-.20***	.08	.14**	.02	-.04	-.09
Mamm.	-.07	.11	.16	-.13	.18*	.21*
PSA test	-.04	.29***	.20**	-.21**	.28***	.24***
Digital rectal examination	.07	.03	.06	-.03	.03	.05

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. For N, confidence intervals, model fit and intercepts, refer to original table (Appendix G).

1. Total years spent smoking (controlling for age), amongst those who were ever regular smokers. Attitudes relate to smoking cessation.

Table 22

Summary of univariate effects for prediction of behaviour and intentions from dichotomised implicit attitudes

	Behaviour			Explicit intentions		
	Barriers	Benefits	Health-cons.	Barriers	Benefits	Health-cons.
Healthy eating[1]	0.76*	1.09	1.27	0.61*	2.04**	2.10***
Smoking cessation[2]	0.50*	1.82	1.94*	-	-	-
Physical activity	0.92	1.09	1.06	0.76	1.28	1.38*
Faecal occult blood test	0.61*	1.51	1.25	0.77	1.26	1.51
Pap	0.60	2.41***	3.32***	0.97	0.93	1.07
Mamm.	0.59	1.71	2.40	0.77	0.89	0.96
PSA test	0.83	1.44	2.03	0.60	4.08**	2.83*
Digital rectal examination	0.71	1.28	1.62	0.92	1.22	1.21

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. For N, confidence intervals, model fit and intercepts, refer to original table. Intentions odds ratios compare the probability of a person high in the specified attitude intending to perform the health behaviour, compared to the probability of a person low in the specified attitude.

1. Dependent variable is diet quality.

2. Dependent variable is having quit (i.e. reporting being an ex-smoker rather than current) amongst those who reported ever being a smoker. Insufficient N of current smokers to model quit intentions.

2.3.1.3.5.16. Incremental validity

In previous research, implicit religiosity attitudes were found to predict unique variance (ß = .09, p = .05) in religious behaviour when regressed simultaneously with explicit attitudes. Following the example of Vargas et al. (2004), simultaneous regression models were run to determine whether implicit attitudes showed incremental validity over explicit attitudes in the prediction of the eight health behaviours. To further explore the usefulness of continuous or categorical versions of the variables, both linear regressions (Table 23, Table 25) and logistic regressions (Table 24, Table 26) were run for each behaviour. Taken together, these regressions suggested that a woman with high implicit health-consciousness about cervical cancer screening through Pap testing (as indicated by the dichotomous implicit attitude variable) was 2.77 times as likely to have ever screened as a woman with low implicit health-consciousness, after controlling for explicit attitudes. Men's implicit perceived benefits of PSA testing predicted 9% of variance in their PSA participation after controlling for explicit attitudes. Some unexpected results (such as men's implicit perceived barriers to PSA positively predicting variance in their participation) were evident — likely due to collinearity (refer to correlation matrices shown in Appendix G, page 325). Incremental validity over explicit attitudes was not seen for other implicit variables, although some parameters approached significance.

Table 23

Prediction of self-reported lifestyle behaviour from implicit and explicit attitudes

	ß		
	Diet quality	Years of smoking[1]	Physical activity
N	843	274	867
r^2	.09	.24	.06
Constant (SE)	106.53 (7.32)	-10.25 (8.85)	6082.75 (1668.17)
Age	-	.44***	-
Implicit barriers	.05	.13††	.03
Implicit benefits	.00	.07	.04
Implicit health-cons.	.10†	.00	.05
Explicit barriers	-.21***	.12*	-.25***
Explicit benefits	.17***	-.08	-.03

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$.

1. Total years spent smoking (controlling for age), amongst ex-smokers

† $p = .088$

†† $p = .053$

Table 24

Prediction of self-reported lifestyle behaviour from implicit and explicit attitudes

	Exp(B) [95% CI] for:		
	having high diet quality (rather than low diet quality)	being an ex-smoker (rather than a current smoker)	having high physical activity (rather than low physical activity)
N	843	328	867
Model pseudo R^2	.08	.05	.06
Model fit	$\chi^2(5) = 51.79$***	$\chi^2(5) = 9.91$	$\chi^2(5) = 37.51$***
Intercept (SE)	0.35 (0.22)	1.51 (0.41)	0.42 (0.22)

	Exp(B) [95% CI] for:		
	having high diet quality (rather than low diet quality)	being an ex-smoker (rather than a current smoker)	having high physical activity (rather than low physical activity)
High implicit barriers	0.71† [0.48, 1.05]	0.70 [0.33, 1.51]	0.98 [0.70, 1.38]
High implicit benefits	0.76 [0.50, 1.17]	1.13 [0.50, 2.56]	1.02 [0.72, 1.44]
High implicit health-consciousness	1.10 [0.73, 1.66]	1.35 [0.59, 3.08]	0.99 [0.70, 1.39]
High explicit barriers	0.40*** [0.29, 0.55]	1.16 [0.60, 2.25]	0.46*** [0.34, 0.62]
High explicit benefits	1.52** [1.14, 2.02]	2.09†† [0.96, 4.56]	1.26 [0.94, 1.69]

Notes. *** p < .001, ** p <.01, * p < .05.

† p = .085

†† p = .064

Table 25

Prediction of self-reported screening behaviour from implicit and explicit attitudes

	ß				
	FOBT	Pap	Mammogram	PSA test	DRE
N	365	387	135	184	184
r^2	.21	.04	.20	.24	.14
Constant (SE)	3.29 (0.47)	2.57 (0.32)	3.53 (0.57)	1.11 (0.53)	1.93 (0.63)
Implicit barriers	-.04	-.01	.08	.29**	.17
Implicit benefits	.05	.03	.07	.30**	.06
Implicit health-cons.	-.05	-.13*	.05	.16	.09
Explicit barriers	-.37***	-.05	-.37***	-.11	-.24**
Explicit benefits	.14**	.15**	.12	.29***	.20**

Note. FOBT = faecal occult blood test. Pap = Pap smear. DRE = digital rectal examination.

*** p < .001, ** p <.01, * p < .05.

Table 26

Prediction of self-reported screening behaviour from implicit and explicit attitudes

	Exp(B) [95% CI] for having ever screened (rather than never having screened)				
	FOBT	Pap	Mammogram	PSA test	DRE
Model pseudo R^2	.22	.15	.18	.07	.11
Model fit	$\chi^2(5)$ = 58.39***	$\chi^2(5)$ = 38.77***	$\chi^2(5)$ = 13.82*	$\chi^2(5)$ = 8.07	$\chi^2(5)$ = 15.58**
Intercept (SE)	2.15 (0.42)	1.73 (0.39)	2.73 (0.90)	1.09 (0.55)	0.89 (0.52)
High implicit barriers	0.67 [0.35, 1.27]	1.27 [0.66, 2.44]	0.95 [0.28, 3.29]	1.52 [0.52, 4.41]	0.84 [0.34, 2.06]
High implicit benefits	1.29 [0.69, 2.43]	1.84† [0.97, 3.50]	0.81 [0.25, 2.95]	0.91 [0.36, 3.17]	0.90 [0.38, 2.17]
High implicit health-cons.	0.69 [0.35, 1.36]	2.77** [1.31, 5.83]	0.42 [0.45, 6.60]	2.50 [0.78, 7.99]	1.31 [0.56, 3.06]
High explicit barriers	0.17*** [0.10, 0.31]	0.29*** [0.15, 0.54]	0.17** [0.04, 0.63]	0.53 [0.22, 1.27]	0.48* [0.25, 0.92]
High explicit benefits	1.48 [0.85, 2.56]	1.50 [0.77, 2.94]	1.75 [0.44, 6.93]	1.92 [0.72, 5.17]	3.36* [1.30, 8.68]

Note. FOBT = faecal occult blood test. Pap = Pap smear. DRE = digital rectal examination.

*** $p < .001$, ** $p < .01$, * $p < .05$.

† $p = .064$

Across the univariate and multivariate models presented above, no clear pattern emerged as to whether continuous or dichotomous forms of the implicit attitude variables are more robust in predicting behaviour or intention. Therefore, this decision can be taken based on the analyses required, as determined by the research question.

2.3.1.3.6. Health behaviour

All behaviours were measured by asking participants to self-report their participation. Existing measures were administered to quantify physical activity (Craig et al., 2003; the short, last 7 days, self-administeread format), a modification of an existing measure (McNaughton, Ball, Crawford, & Mishra, 2008) was administered for diet quality (discussed in section 2.3.1.3.6.1), and items similar to those used in Study 1 were developed for screening behaviour. Smoking exposure was also measured with an established measure (Weitkunat, Coggins, Sponsiello-Wang, Kallischnigg, & Dempsey, 2013), however, for the assessment of criterion validity in this chapter only total smoking duration was used (and only within the group who were ex-smokers). This is due to the fact that the attitudinal measures related to smoking cessation rather than smoking itself. At the planning stage it had seemed strange (and even ethically dubious) to seek responses to statements about smoking being pleasant, harmless, or convenient — as would be required if explicit attitudes about smoking were to be measured — and so the healthy behaviour of quitting was made the focus of the attitude measures. However by measuring attitudes about quitting but the self-reported behaviour of smoking consumption, there was a mismatch between attitude and behaviour (an oversight not discovered until after data collection). Therefore, the number of years a person smoked before quitting was seen to be the most closely related continuous data. Luckily, the current status of people who had ever smoked (i.e. being a current smoker or ex-smoker) was collected, and provided a sensible dichotomous variable to predict from attitudes about quitting.

Self-report data tend to under-estimate unhealthy behaviour and over-estimate healthy behaviour; for instance, the most recent incidence of cancer screening may be recalled as occurring more recently than it actually occurred (Newell, Girgis, Sanson-Fisher, & Savolainen, 1999). However, the collection of self-reported data makes minimal demands on participants' time and effort, and can be done using surveys. Collecting self-reported data enabled us to explore relationships with eight different health behaviours in a large sample from across Australia. Collecting objective data on this number of behaviours in such a large and geographically diverse sample would have been prohibitively expensive, time consuming, and burdensome for participants.

In Chapter 5, where health thinking style was used to predict health behaviour in a series of multivariate regressions, the dependent variables were used in continuous form (or in the case of the screening behaviours, an ordinal categorical form where with levels indicating never screened, overdue for screening, and up to date with screening). In this chapter, because the focus was on assessing the validity and limitations of the implicit attitude measures, dichotomous forms of the variables were also used as dependent variables in logistic regressions. Although useful for this exercise, for the behavioural prediction in Chapter 6 I used behaviour variables in a form that most logically related to real-world behaviour: for diet quality and physical activity scores, a continuous form was appropriate, while for the screening behaviours and smoking cessation, a dichotomous variable provided a better representation. The different variable types are shown in Table 27, and descriptive statistics for all behaviours follow in Table 28 and Table 29.

Table 27

Behaviour variables to be predicted by attitudes

Attitude	Behaviour variable		Criteria	
	Continuous/ordinal	Dichotomous	Age	Sex
Healthy eating	Diet quality score	Diet quality score median split (low / high)		
Smoking cessation	Years of smoking[1] (controlling for age)	Smoking status (current smoker / ex-smoker)		
Physical activity	MET-min/week	MET-min/week median split (low / high)		

Attitude	Behaviour variable		Criteria	
	Continuous/ordinal	Dichotomous	Age	Sex
Faecal occult blood test	Participation (have never screened / screened more than two years ago / screened less than two years ago)	Participation (have never screened / have screened)	≥ 50	
Pap smear				Female
Mammogram			≥ 50	Female
PSA test			≥ 50	Male
Digital rectal examination			≥ 50	Male

1. Duration of smoking was used rather than exposure (pack-years) because the attitudes measured were about stopping smoking, not reducing the amount smoked.

Table 28

Descriptive statistics for health-related lifestyle behaviour

	Continuous/ordinal					Dichotomous	
	N	Min	Max	M(*SD*)	Median		
Diet quality	843	49.12	157.50	119.40 (17.39)	119.82	Low 50.1%	High 49.9%
Smoking exposure	880	0	87.50	4.95 (12.00)	0		
Smoking status[1]	330					Current 15.2%	Quit 84.8%
Physical activity	870	0	23226.00	3817.71 (3769.43)	2598.00	Low 50%	High 50%

1. Among those who reported ever being a smoker.

Table 29

Descriptive statistics for screening behaviour

		Categorical			Dichotomous	
	N	Never	More than two years ago	Two years ago or less	Never screened	Have screened
Faecal occult blood test	365	26.6%	20.0%	53.4%	26.6%	73.4%
Pap smear	441	13.6%	23.8%	62.6%	13.6%	86.4%
Mammogram	135	14.1%	15.6%	70.4%	14.1%	85.9%
PSA test	184	15.8%	12.0%	72.3%	15.8%	84.2%
Digital rectal examination	184	33.2%	36.4%	30.4%	33.2%	66.8%

1. Excluding people who responded that they were unsure whether they had screened, and those who indicated in a follow-up question that the most recent instance of testing was for purposes other than general screening.

Dichotomous variables (rather than variables with three groups or more) were chosen for ease of interpretation. The creation of dichotomous variables was straightforward for the screening variables: the overdue and up-to-date screeners were collapsed into one group representing ‘ever screened’. For smoking cessation, a dichotomous variable that reflected a real-life behaviour was available: namely, whether someone who had ever smoked had subsequently quit (i.e. reporting that they were an ex-smoker rather than a current smoker). For the continuous variables diet quality and physical activity, however, median splits were required to produce the dichotomous variables.

The median physical activity in our sample, 2598 MET-min/week, was comparable to the median of 2514 MET-min/week reported in the validation study for the measure used (Craig et al., 2003). These figures are difficult to align with national physical activity guidelines due to the measure's inclusion of all physical activity (including, for example, incidental walking, and activity at work). Although additional criteria of frequency and intensity should also be considered, a level between 600 and 3000 MET-min/week could broadly be categorised as reflecting moderate physical activity.

The median score for diet quality was 119.82 out of a possible 160. As will be described below in section 2.3.1.3.6.1, the maximum score for any dietary item reflected compliance with the relevant guideline. Thus, a person who reported consistently complying with the guidelines would receive a score of 160. Our sample median was substantially below this, which is unsurprising in light of other findings that Australians' adherence to dietary guidelines is poor (Australian Bureau of Statistics, 2016; McNaughton et al., 2008). In comparison to the measure on which our diet quality measure was based (on which the mean scores were 91.0/150 for females and 99.6/150 for males) the current sample received higher scores (even allowing for the slight scoring differences). However this could well be due to the fact that our study used a smaller set of more general questions, while McNaughton et al. (2008) administered a more exhaustive food frequency questionnaire. Just as self-report overestimates actual diet quality, questions that are more general in focus may overestimate diet quality compared to more detailed questions.

2.3.1.3.6.1. Diet quality

The dietary indicator of interest in this study was the healthiness of participants' diets, which I operationalised as conformity to the Australian Dietary Guidelines (National Health and Medical Research Council, 2013a). The approach and scoring were based on the index published by McNaughton et al. (2008). These authors administered a food frequency questionnaire containing 108 items, as well as additional questions about food habits; these items were then used to assign scores on 15 dimensions related to the guidelines. In the current research, I devised items to directly address the same behaviour captured in the index, but omitted an item evaluating overall variety based on quantities from different food groups (due to complexity) and an item which counted, for a second time, the fat content of dairy consumed. Following the original index (McNaughton et al., 2008), scores were assigned according to the degree to which each dietary guideline had been followed: top marks were given for meeting the recommendation, and marks were assigned proportionately for partially meeting the recommendation. Scoring was adjusted where necessary to allow for age and gender differences in dietary recommendations. The diet quality items and coding scheme are shown in Appendix H (page 353).

2.3.1.4. Sample.

A strength of Study 1 was the parent study's representative sample: a stratified, nationwide probability sample. However, as discussed previously, by the time of the endpoint survey (see Table 2, page 40), the participants remaining in the sample appeared to be highly health-conscious — as evidenced by rates of faecal occult blood test uptake double those in the general population. It was hoped that in recruiting participants to a new study with the offer of a substantial prize, a more representative sample could be obtained.

The anticipated improvement in representiveness on the faecal occult blood test screening dimension did not eventuate, and the Study 2 sample was, similarly, dominated by screening participants. Although there are no faecal occult blood test uptake data for Study 2, self-reported data on whether each participant had ever completed a faecal occult blood test is provided in Table 2 and Table 30 for comparison between the samples. The final Study 1 sample had an 'ever-screened' rate of 71.3%, whereas for the final Study 2 sample the rate was 73.4%. This was not due to the inclusion of females, who tend to participate at a higher rate than males, in the Study 2 sample: in fact, 79.8% of males 50 and over reported having ever used a faecal occult blood test (not shown in table). It is most likely that the recruitment avenues employed (i.e. higher education, scientific, health and community organisations) accessed a relatively health-conscious audience. Additionally, in the three years since the data collection for Study 1 was undertaken in 2012, the chance of exposure to mailed screening offers has increased as the National Bowel Cancer Screening Program continues to send faecal occult blood test kits to Australians turning 50, 55, and 65 (and in 2015 began to invite those turning 60) (Australian Institute of Health and Welfare, 2015b).

The Study 2 sample was also very highly educated compared to Australian adults in the general population, amongst whom the rate of postgraduate education attainment is 6.3% (Australian Bureau of Statistics, 2011b). It somewhat under-represented the 19.3 per cent of the Australian population who speak a language other than English at home (Australian Bureau of Statistics, 2010). However, in terms of SES, the Study 2 sample was more representative than Study 1, as the sample was less concentrated in the most advantaged SES deciles than the Study 1 sample (63.9% of Study 1 participants fell in the top three deciles, while 48.2% of Study 2's sample fell in the same range).

In both studies, the people who completed the second survey had higher rates of faecal occult blood test participation than non-participants. In Study 2, participating in the T2 survey was more likely for females, those spoke only English at home, those with higher educational attainment, and those from higher SES postcodes (with significantly fewer participants in the 9th decile dropping out than expected). However, the final Study 2 sample did not differ in age from those who dropped out.

Table 30

Study 2 sample descriptive statistics at T1 and T2.

		T1 participants	T2 Participants	T2 Non-participants	Difference[3]
N		920	510	410	
Sex	Female	54.6%	59.6%	48.3%	$\chi^2(1) = 11.74$, $p = .001$
	Male	45.4%	40.4%	51.7%	
Age	M (*SD*)	46.40 (16.98)	46.42 (16.49)	46.37 (17.60)	*ns*
Language[1]	Yes	12.1%	10.4%	14.1%	$\chi^2(1) = 3.02$, $p = .082$
	No	87.9%	89.6%	85.9%	
SES[2]	1st decile	3.6%	2.4%	5.2%	$\chi^2(9) = 24.63$, $p = .003$
	2nd decile	3.9%	3.9%	4.0%	
	3rd decile	5.7%	5.3%	6.2%	
	4th decile	8.7%	8.9%	8.4%	
	5th decile	9.1%	10.8%	6.9%	
	6th decile	9.0%	7.5%	10.9%	
	7th decile	11.8%	9.8%	14.3%	
	8th decile	13.3%	13.8%	12.6%	
	9th decile	23.3%	27.2%	18.5%	
	10th decile	11.6%	10.4%	13.1%	
Education	Year 12 or less	14.6%	13.2%	16.6%	$\chi^2(4) = 8.17$, $p = .085$
	TAFE/Trade	9.8%	10.0%	9.5%	
	Dipl./Assoc.	12.3%	10.2%	14.9%	
	Bachelor	29.8%	31%	28.3%	
	Postgraduate	33.5%	35.7%	30.7%	
Thinking style M (*SD*)	Rationality[4]	4.02 (.63)	4.06 (.63)	3.98 (.64)	$t(866.06)=1.75$, $p = .080$
	Imagination[4]	3.88 (.66)	3.90 (.66)	3.87 (.65)	*ns*
	Intuition[4]	3.50 (.70)	3.46 (.69)	3.55 (.71)	$t(866.22)=-1.94$, $p = .053$

		T1 participants	T2 Participants	T2 Non-participants	Difference[3]
	Emotionality[4]	3.57 (.73)	3.58 (.74)	3.55 (.72)	*ns*
	Experientiality[4]	3.64 (.47)	3.64 (.47)	3.66 (.46)	*ns*
Self-reported FOBT[5]	Screened before	73.4%	77.1%	68.2%	$\chi^2(1) = 3.59$, $p = .058$
	Never screened	26.6%	22.9%	31.8%	

Notes. FOBT = faecal occult blood test.

1. Speaking a language other than English at home.

2. 1st decile = most disadvantaged, 10th decile = most advantaged. To reflect the Australian population, 10% of sample should fall in each decile.

3. Test of difference between participants at T2 and those lost to follow-up.

4. Using T1 scores.

5. Excluding ‘unsure’ responses, participants under 50, and those who implied most recent FOBT was not for screening purposes.

CHAPTER 3. THINKING STYLE AS A PREDICTOR OF MEN'S PARTICIPATION IN CANCER SCREENING.

3.1. Preamble

In Study 1, I explored whether there was any link between thinking style and men's prostate and colorectal cancer screening behaviours. A dataset from an NHMRC-funded study[5] was available in which a national sample of males had completed the Rational-Experiential Inventory (REI), were offered a mailed faecal occult blood test, and reported their previous participation in faecal occult blood tests, prostate-specific antigen (PSA) tests, and digital rectal examinations. Although the REI was included in the survey, the link between thinking style and the screening behaviours had not been tested. Therefore, the dataset provided a perfect opportunity to discover whether a relationship existed. It was considered that the presence of any link between thinking style and cancer screening behaviour would itself be a contribution to this relatively unexplored area, and would potentially shine light on men's cancer screening participation, which in many cases needs improvement. Additionally, in the context of the thesis, it was anticipated that such a result would provide a catalyst for a more extensive investigation of the subject, in addition to standing as justification for this focus.

A note about terminology: The version of the REI used in Study 1 was the 1996 short form. In the 1996 scale, the preference for type 2 thinking was called *need for cognition* and the preference for type 1 thinking was called *faith in intuition*. It is appropriate to adopt the 1996 scale's terminology for this chapter, but in this respect it stands apart from the rest of the thesis. Study 2, which provided data for the fourth, fifth and sixth chapters, utilised the

[5] NHMRC Project Grant number 1026510: Optimising men's uptake of FIT screening for bowel cancer: a population based randomised controlled. 2012. Turnbull D., Wilson, C., Flight, I., Zajac, I.

most recent version of the scale (Norris & Epstein, 2011) in which the two main scales are labelled *rationality* and *experientiality*. Therefore Chapters 4, 5, and 6 , and the rest of the thesis, use the terminology of rationality (instead of need for cognition) and experientiality (instead of faith in intuition) for the main scales, in line with more recent versions of the REI.

3.2. Statement of authorship

Title of paper: Thinking style as a predictor of men's participation in cancer screening

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3.2.1. Principal author

Name of principal author (Candidate): Clare McGuiness

Contribution to the paper: Assisted with data collection and study administration (prior to candidature). Formulated aims and hypotheses for the paper in discussion with supervisors. Carried out data analysis. Conceptualised, drafted, wrote, and submitted article, then revised and responded to reviewer comments. Acted as corresponding author.

Overall percentage (%): 80%

Certification: This paper reports on original analysis I performed during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.

Signature: *Date:* 23 December 2016

3.2.2. Co-author contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author: Prof. Deborah Turnbull

Contribution to the Paper: Input regarding study design, sampling and choice of variables. General oversight of study implementation and of article progress. Provided editorial and structural feedback on paper.

Signature: *Date:* 6 January 2017

Name of Co-Author: Prof. Carlene Wilson

Contribution to the Paper: Input regarding study design, sampling and choice of variables. Input on conceptual realisation and interpretation of data. Provided editorial and structural feedback on paper.

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Contribution to the Paper: Co-ordination of data collection. Provided feedback on drafts.

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Contribution to the Paper: Input regarding study design, sampling and choice of variables. Provided feedback on drafts.

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Contribution to the Paper: Input regarding study design, sampling and choice of variables. Oversight of statistics and modelling. Provided editorial and structural feedback on paper.

Signature: *Date:* 25 January 2017

3.3. Published paper

Thinking style as a predictor of men's participation in cancer screening.

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3.4. Abstract

Men's participation in cancer screening may be influenced by their thinking style. Men's need for cognition and faith in intuition were measured to explore whether they varied by demographic variables or predicted screening behaviour. Australian males (*n* = 585, aged 50-74) completed surveys about past screening and were subsequently offered mailed faecal occult blood tests (FOBTs). Demographic predictors included age, socioeconomic status (SES), educational attainment, and language spoken at home. The screening behaviours were self-reported prostate cancer screening (prostate-specific antigen testing and digital rectal examinations [DRE]), and colorectal cancer screening (self-reported FOBT participation and recorded uptake of the FOBT offer). Analysis comprised principal components analysis and structural equation modelling. Need for cognition was positively related to demographic variables education, SES, and speaking English at home. Faith in intuition was negatively related to educational attainment. Need for cognition predicted variance in self-reported DRE participation (r = .11, p = .016). No other relationships with thinking style were statistically significant. The relationship of need for cognition to DRE participation may reflect the way certain attributes of this screening method are processed, or alternatively, it may reflect willingness to report participation. The relationship of thinking style to a range of healthy behaviours should be further explored.

RUNNING HEAD: THINKING STYLE AND MEN'S CANCER SCREENING

3.5. Introduction

Health psychology interventions designed to encourage healthy behaviours have traditionally targeted rational processes. For example, they have targeted constructs such as knowledge about severity of a health problem and beliefs about the benefits of action (Rosenstock, 1974), information-seeking and evaluation (Prochaska & Velicer, 1997), intentions to act (Ajzen, 1991) and self-efficacy (Bandura, 1998). Some researchers have begun to focus on how processes other than those that are rational might influence health behaviour (Friese et al., 2011; Sheeran, Gollwitzer, & Bargh, 2013). While rational processing is conscious and effortful, involves working memory capacity, and relies on algorithmic thinking, another type — experiential processing — operates at high speed, autonomously (triggered by stimuli), and independently of working memory (Epstein et al., 1996; Evans & Stanovich, 2013, provide an in-depth discussion of the broader area of dual-process models of cognition).

People differ in the extent to which they rely on rational processing and experiential processing. These stable individual differences have been labelled *thinking style* (Epstein, 2003). A self-report measure (the Rational-Experiential Inventory, or REI; Epstein et al., 1996) has been developed to capture the preference for rational processing (need for cognition) and preference for experiential processing (faith in intuition) (Epstein et al., 1996). It is possible that stable individual differences in processing preference could influence health behaviour. For instance, the personality variable conscientiousness has been linked to increased preventive health behaviour (Bogg & Roberts, 2004; Takahashi, Edmonds, Jackson, & Roberts, 2013). With scant research conducted to date on the subject, the purpose of this paper is to begin exploring the influence of thinking style on preventive health behaviour.

Higher need for cognition has been associated with constructs of potential benefit to health decision making, including better information recall (Cacioppo et al., 1996), higher internal locus of control (G. J. O. Fletcher, Danilovics, Fernandez, Peterson, & Reeder, 1986), and better probability judgements under pressure (Pacini & Epstein, 1999). Various studies have reported the effects of thinking style variables on the interpretation of health messages (Covey, 2014; Epstein, 2003; G. J. O. Fletcher et al., 1986; Furnham & Thorne, 2013), and it has been suggested that thinking style may moderate the effectiveness of health psychology interventions (Hofmann et al., 2008). Yet few studies have attempted to detect a link between thinking style and health behaviour. Smoking, for one, has been linked to higher faith in intuition and lower need for cognition (Brown & Bond, 2015) and appropriate hand hygiene amongst doctors has been positively linked to faith in intuition but not need for cognition (Sladek et al., 2008).

There is some evidence of gender differences in thinking style, with need for cognition being slightly higher, and faith in intuition slightly lower, in men compared to women (Sladek et al., 2010). In men, need for cognition appears linked to identification with stereotypical masculine attributes (Osberg, 1987) that have been credited with both positive (Oster, McGuiness, Duncan, & Turnbull, 2014) and negative (Galdas, Cheater, & Marshall, 2005) implications for health behaviour. The relationship of men's thinking style to their health behaviour is undoubtedly complex, and may exacerbate or ameliorate the interplay of social, behavioural and biological factors that drive adverse health outcomes for men. In Australia, the rate of male death from cancer is 1.6 times the rate for females (Australian Institute of Health and Welfare, 2012). The two leading causes of male cancer death are prostate cancer and colorectal cancer (Australian Bureau of Statistics, 2013a) and for both, routine screening tests are widely available (Cancer Council Australia, 2016a, 2016b). There remains much to learn about the factors that influence participation in screening for both cancers.

The efficacy of available screening tests differs between prostate cancer and colorectal cancer. For colorectal cancer screening, a test known as a Faecal Occult Blood Test (FOBT) detects minute amounts of blood in stool and has been reported to achieve a 15% relative risk reduction for colorectal cancer-specific mortality when used every two years (Hewitson, Glasziou, Irwig, Towler, & Watson, 2007). The case is less straightforward for prostate screening — whether via the PSA test (which measures blood levels of a protein that may be elevated in the presence of prostate cancer) or digital rectal examination (DRE; in which a doctor manually checks for prostate abnormalities by inserting a gloved finger into the rectum) (Cancer Council Australia, 2016a). Large randomized controlled trials have failed to find any reduction of prostate cancer-specific mortality amongst men screened by PSA (RR 1.00, CI: 0.86-1.17) despite the higher rate of detection amongst those screened (Ilic, Neuberger, Djulbegovic, & Dahm, 2013). Many cases of prostate cancer detected by PSA test or DRE never impact upon the man's health and would have gone unnoticed without screening (Australian Institute of Health and Welfare, 2013). Owing to concerns about overdiagnosis, a lack of evidence of reductions in mortality, potential harms of testing, and side effects of unnecessary treatment, screening at a population level is not recommended in Australia (National Health and Medical Research Council, 2013b).

Despite the proven effectiveness of FOBT screening, only 34% of people who receive a free FOBT complete and return the kit — and although men have an overall higher risk of this disease, the participation rate for males (31.1%) is significantly and consistently lower than for females (35.7%) (Australian Institute of Health and Welfare, 2014c). Counter-intuitively, screening participation rates appear higher for prostate cancer. In the US, approximately 45% of men aged 64-79 report receiving a Prostate-specific Antigen (PSA) test in the past year (Drazer, Huo, Schonberg, Razmaria, & Eggener, 2011) and rates of participation are similar in Australia (Medicare Australia, 2015; Trevena, Rogers, Jorm, Churches, & Armstrong, 2013). While there is an evident need to increase participation in colorectal cancer screening, in regards to prostate cancer screening the objective is to facilitate men's decision-making, preferably in concert with their general practitioner (GP; i.e. family doctor). After becoming thoroughly informed about PSA screening, men may indeed have less intention to participate than before (Thomas et al., 2014).

Nonetheless, in both cases it is of great value to identify the factors that affect screening participation. The differing pathways to participating in these three cancer screening modalities provide a range of behaviours upon which to explore the effects of thinking style. FOBTs may be purchased, provided by a doctor, or received in the mail via organised screening programs, but require the screener to complete several steps. On the other hand, PSA tests and DRE must be provided by a health professional and may be offered opportunistically or at the man's request.

It is also of value to know the contexts in which thinking style is of relevance; for instance, if it is known that certain demographic groups are less likely to prefer rational processing, then health campaigns can be targeted accordingly. The aims of the present study were firstly to determine whether there was an association between demographic factors and thinking style in men, and secondly to test for a link between thinking style and participation in colorectal and prostate cancer screening. The variance in need for cognition and faith in intuition was analysed using the demographic variables age, educational attainment, speaking a language other than English at home, and socioeconomic status (SES). The behavioural outcomes of interest were self-reported participation in three tests (FOBT, PSA, DRE), and for FOBT screening (which can be offered to participants via the mail), the actual completion and return of a mailed FOBT kit was also recorded.

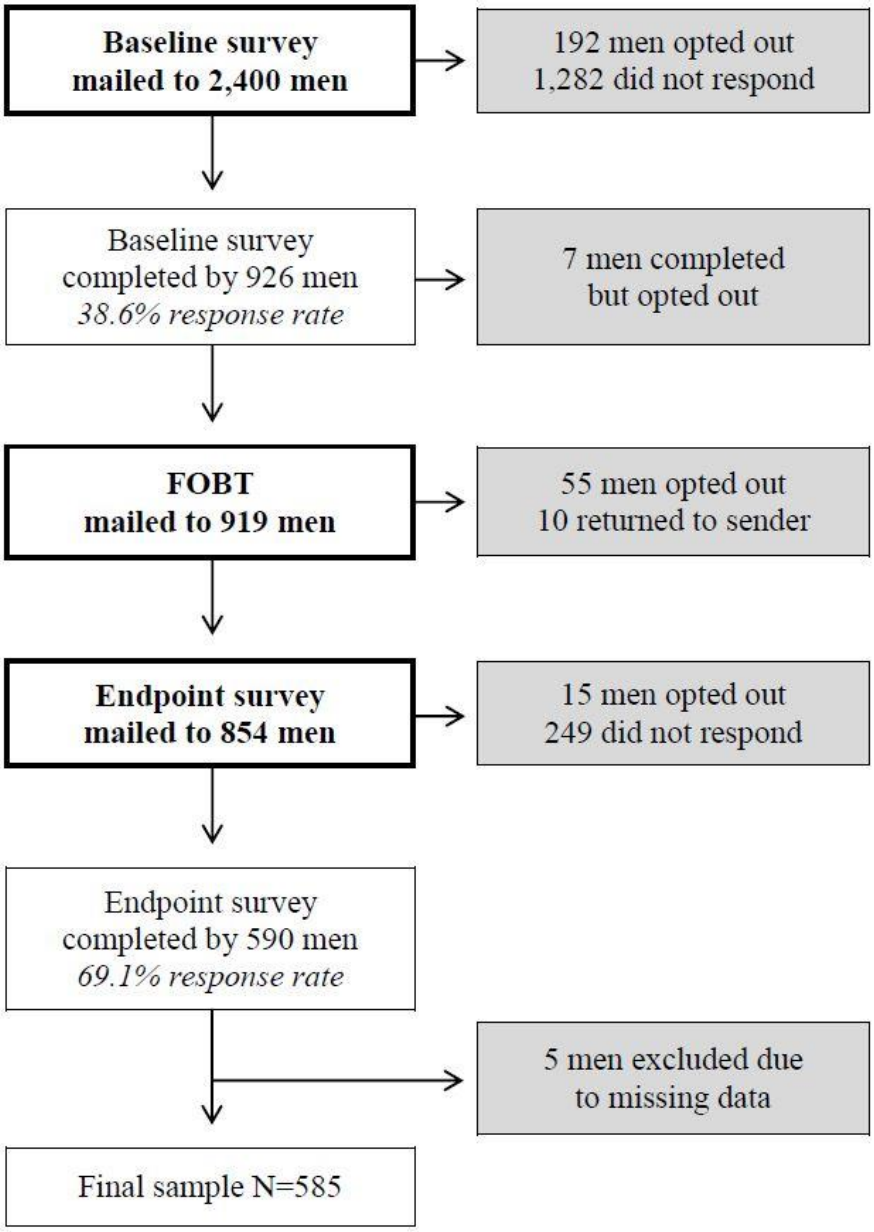
3.6. Method

A subgroup of participants in a larger research trial (A. Duncan et al., 2013) formed the sample for this study. The parent study was a randomized controlled trial (Australian New Zealand Clinical Trials Registry: ACTRN12612001122842) using a 2 x 2 factorial design to assess the effectiveness of modified letters (targeted and non-targeted versions of advance notification and invitation to screen letters) in encouraging the use of a mailed FOBT. The research received approval from the Human Research Ethics Committee at The University of Adelaide, and the inclusion criteria were being male, aged between 50 and 74 years inclusive, and living at a standard residential address in the urban areas of five Australian states (New South Wales, Queensland, South Australia, Victoria, and Western Australia).

For the parent study, individuals randomly selected from the Australian Electoral Roll (N = 9,216) were randomly assigned to one of four trial arms (for further information, see A. Duncan et al., 2013). Random assignment was used once again to select 600 participants from each arm for inclusion in a subgroup that would be sent surveys before and after the intervention. This survey subgroup (of whom n = 585 remained in the final sample) is the focus of the present study. Although effects related to the targeted letters were observed in the rest of the parent study's sample, in the group considered herein, who completed surveys in advance of the screening offer, the intervention had no effect (Zajac et al., 2016) and so for the present study the four trial arms are collapsed together.

The baseline survey was sent in October 2012. It was completed by 926 of the 2400 men who were contacted (a 38.6% response rate) and eligible respondents (i.e. those who had not subsequently withdrawn or indicated screening was inappropriate) were mailed an FOBT screening kit in March 2013. In June 2013, a total of 854 endpoint surveys were sent to participants, of which 590 were completed (a 69.1% response rate). Participants indicated their consent to participate in the study by completing and mailing back the two surveys. Five cases with more than 50% of responses missing were deleted, leaving *n* = 585 participants with data available for analysis (Figure 2). Remaining missing REI responses were imputed using expectation maximization (Dempster, Laird, & Rubin, 1977).

Figure 2. Participant flow.



3.6.1. Materials

The baseline survey contained questions about demographics and past screening. It was sent with an introductory letter (containing information about the research, researcher contact details, and complaints procedures) and a return envelope. Reminder letters were sent to men who had not responded after 3 weeks, and a second reminder with a replacement survey was sent after 6 weeks. Data collection ceased 16 weeks after the baseline survey was mailed out.

The bowel cancer screening kit contained an introductory letter, an FOBT (OC-Sensor by Eiken Chemical Co., Tokyo, Japan), an instruction sheet, a screening information booklet, a participation form, and a reply-paid padded envelope for sending the samples to a laboratory for processing. The FOBT is an immunochemical kit that requires collection of two stool samples and does not necessitate dietary changes. Reminders were sent to men who did not complete the FOBT 6 weeks following the mailing, and data collection ceased after 15 weeks.

The endpoint survey, which contained the REI, was sent to men who had completed the baseline survey and not withdrawn from the study, regardless of whether they had completed their FOBT. Reminder letters were sent to men who had not responded after 3 weeks, and a second reminder with a replacement survey was sent after 6 weeks. Data collection ceased 13 weeks after the endpoint survey was mailed out.

3.6.2. Data analysis

To describe the sample, frequencies were reported as well as percentages, and means and standard deviations were calculated. Before addressing the research questions using structural equation models, it was necessary to check (and prudent to report) the structure of the REI. This was done by subjecting the items to principal component analysis to detect the presence of the underlying factors predicted by the scale's theoretical background (i.e. need for cognition and faith in intuition). Structural equation modelling in AMOS was then used to explore the relationships of thinking style to demographic variables and screening behaviour. Statistics were computed using IBM SPSS version 20, and structural equation models were run using the AMOS plugin.

3.6.3. Measures

3.6.3.1. Demographic items (baseline survey).

Participants were asked for their date of birth, highest education level and whether they spoke a language other than English at home (coded as 1 for 'no' and 2 for 'yes'). Participants' postcodes (obtained from the Electoral Roll) were used to indicate their SES, which was quantified by the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD). This indicator of socioeconomic advantage and disadvantage is compiled by the Australian Bureau of Statistics using information on income, education, employment, occupations and dwelling characteristics from the 2011 Australian Census (2013b). Each participant was assign a score from 1 to 10 based on the decile of the IRSAD distribution in which the postcode fell. Decile 1 represents the 10% of areas that are most disadvantaged and least advantaged, while decile 10 represents the 10% of areas that are most advantaged and least disadvantaged. For example, postcodes in the tenth decile have the largest proportion of residents with above-average incomes, who are making high mortgage or rent payments, who are classified as professionals or managers, who have higher educational attainment, and who are living in houses with four or more bedrooms. Postcodes in the first decile have higher proportions of residents with low incomes, whose residences have no internet connection, who have long-term health conditions or disabilities, who have completed less education, who are unemployed, or who are classified as labourers, machinery operators or drivers (Australian Bureau of Statistics, 2013b).

3.6.3.2. Frequency of GP visits (baseline survey).

As PSA tests and DREs are generally provided by a General Practitioner (GP; i.e. family doctor) and men who visit their GP more frequently have greater chance of being offered or requesting them (Crowe, Wootten, & Howard, 2015), it was sensible to control for frequency of GP visits. An indicator of habitual GP attendance frequency was obtained by asking participants how many times they had visited their GP in the past year, with five response options from 'Not at all' to 'Four or more times'.

3.6.3.3. Self-reported screening data (baseline survey).

Self-reported data regarding PSA tests (srPSA), DRE (srDRE) and FOBT (srFOBT) were collected via three survey questions asking men if they had ever used the screening method in question. Response options were 'Yes' (coded as 1), 'No' (coded as 0) and 'Unsure/don't know' (participants choosing this response for a screening behaviour were excluded from analyses for that behaviour). The sensitivity of self-reported screening participation has been reported as 78% for FOBT, 71% for PSA test and 74% for DRE participation, while specificity was 77%, 73%, and 60%, respectively (Rauscher, Johnson, Cho, & Walk, 2008). Recent results suggest self-reports of FOBT screening are an acceptably accurate representation of actual behaviour (Lo, Waller, Vrinten, Wardle, & von Wagner, 2016).

3.6.3.4. Observed screening data.

Observed FOBT screening data (oFOBT) was recorded by monitoring whether participants returned a completed FOBT to the laboratory for processing by the end of the intervention phase of the study (13 weeks after the screening kits were mailed out). Participation was coded as 1 and non-participation was coded as 0.

3.6.3.4.1. Rational-Experiential Inventory (endpoint survey).

The REI (Epstein et al., 1996) measures thinking style as two independent variables, need for cognition (preference for rational processing) and faith in intuition (preference for experiential processing). A short form questionnaire was used that included a 5-question need for cognition scale (e.g. ‘I prefer complex to simple problems’) and a 5-question faith in intuition scale (e.g. ‘I trust my initial feelings about people’). Responses to each REI statement were indicated on a 5-item Likert scale from 1 (completely false) to 5 (completely true). Higher scores for a statement therefore represented higher identification with that attribute. Three need for cognition items were reverse phrased (e.g. ‘I don’t like to have to do a lot of thinking’) and required reverse-coding. The reliability of this short scale in Australian samples has been reported elsewhere (α = .75 for need for cognition and α = .86 for faith in intuition in a study by Golley et al., 2015). In the present study, the need for cognition (α = .66) and faith in intuition (α = .87) scales both displayed acceptable internal reliability.

Because the baseline survey was already lengthy, and because the measurement of thinking style was not central to the parent study, the REI was administered in the endpoint survey. As need for cognition and faith in intuition are proposed to be stable processing preferences (Cacioppo et al., 1996; Epstein, 2003), the preceding survey and intervention materials received by participants would be unlikely to influence their responses on this measure.

3.7. Results

The eight response items of the educational attainment measure were combined into three roughly even groups: School, Tertiary and Postgraduate attainment. The mean age of participants was 61.4 (*SD* = 6.7) years, most men had tertiary education or greater (175 school, 253 tertiary, 121 postgraduate attainment) and the majority (*n* = 464, 79.3%) did not speak a language other than English at home. Over half the sample (*n* = 312, 53.3%) resided in suburbs classified amongst the highest 20% in terms of SES. Responses to the REI and screening items for the sample and for demographic groups are shown in Table 31.

Table 31

Descriptive statistics

			Screening behaviour: participating Percentage and count				Thinking style[5]: M(*SD*)	
Group		*n*	srPSA[1]	srDRE[2]	srFOBT[3]	oFOBT[4]	Need for cognition	Faith in intuition
Total sample		585	71.7% 411	59.9% 343	62.3% 345	80.3% 465	3.61 (0.74)	3.63 (0.69)
Age	50-54	111	59.1% 65	40.0% 44	63.9% 69	79.3% 88	3.71 (0.72)	3.56 (0.63)
	55-59	131	70.0% 91	55.8% 72	73.2% 93	77.9% 102	3.63 (0.73)	3.65 (0.66)
	60-64	137	72.1% 98	64.7% 88	37.4% 49	81.0% 111	3.61 (0.73)	3.64 (0.71)
	65-69	116	80.9% 93	69.6% 80	74.3% 81	77.6% 90	3.50 (0.77)	3.70 (0.73)
	70-75	84	78.0% 64	71.1% 59	67.1% 53	88.1% 74	3.64 (0.79)	3.55 (0.80)
Education	School	175	65.5% 114	58.4% 101	57.4% 97	72.6% 127	3.37 (0.75)	3.77 (0.67)
	Tertiary	253	73.0% 184	60.7% 153	68.0% 166	85.4% 216	3.61 (0.68)	3.57 (0.72)
	Postgrad	121	78.5% 95	59.5% 72	56.9% 66	75.2% 91	3.99 (0.72)	3.53 (0.68)
Lang[6]	Yes	96	56.3% 54	38.5% 37	54.9% 50	84.4% 81	3.31 (0.69)	3.51 (0.66)

Group		n	srPSA[1]	srDRE[2]	srFOBT[3]	oFOBT[4]	Need for cognition	Faith in intuition
			Screening behaviour: participating Percentage and count				Thinking style[5]: M(*SD*)	
SES decile[7]	No	464	74.7% 345	63.2% 292	63.5% 284	78.7% 365	3.68 (0.74)	3.65 (0.71)
	Lowest (1-3)	47	66.0% 31	53.2% 25	59.1% 26	89.4% 42	3.49 (0.70)	3.69 (0.64)
	Middle (4-7)	147	66.0% 97	45.9% 67	58.9% 83	80.3% 118	3.43 (0.73)	3.69 (0.60)
	Highest (8-10)	391	74.3% 286	65.5% 253	63.7% 239	78.5% 307	3.69 (0.74)	3.60 (0.72)

Sample *n* = 585. *n* missing per cell varies; maximum = 56 (9.6% of respondents with Postgraduate education did not respond to srFOBT question). 1. srPSA = self-reported PSA participation. 2. srDRE = self-reported DRE participation. 3. srFOBT = self-reported FOBT participation. 4. oFOBT = observed FOBT participation. 5. Average response across 5 subscale questions after reverse coding three need for cognition items (shown in Table 2). 6. Language other than English spoken at home. 7. Decile 1 represents the 10% of suburbs with the lowest SES; Decile 10 represents the 10% of suburbs with the highest SES.

3.7.1. Structure of the REI

In the present study, the five need for cognition items (Cronbach's α = .66) and five faith in intuition items (Cronbach's α = .87) of the REI displayed acceptable internal reliability. In order to check the proposed REI structure in the study population, a principal components analysis was performed with Oblimin rotation and Kaiser Normalization. This analysis suggested the presence of three components with eigenvalues greater than 1, which together explained 68.40% of the variance in the REI items. Results of this analysis are shown in Table 2. As can be seen, the five faith in intuition questions clustered on the one component, aptly named Faith in Intuition. However, for the need for cognition items, two separate components emerged. One of the components loaded on the reverse-phrased items, reinforcing previous suggestions that item polarity interferes with the measurement of need for cognition (Bors, Vigneau, & Lalande, 2006). Small correlations existed between the NFC+ (positively-phrased NFC items) and NFC- (negatively phrased need for cognition items) components and between faith in intuition and NFC+ (Table 32).

Table 32

Pattern matrix for REI items.

REI item	Component[1]		
	FI	NFC+	NFC-
1. I don't like to have to do a lot of thinking[2]			.877
2. I try to avoid situations that require thinking in depth about something[2]			.893
3. Thinking hard and for a long time about something gives me little satisfaction[2]			.692
4. I prefer to do something that challenges my thinking abilities rather than something that requires little thought		.811	
5. I prefer complex to simple problems		.866	
6. I trust my initial feelings about people	.721		
7. I believe in trusting my hunches	.804		
8. My initial impressions of people are almost always right	.850		
9. When it comes to trusting people I can usually rely on my "gut feelings"	.878		
10. I can usually feel when a person is right or wrong even if I can't explain how I know	.784		
Factor Correlations			
NFC+	.15***	--	
NFC-	-.04	.17***	--

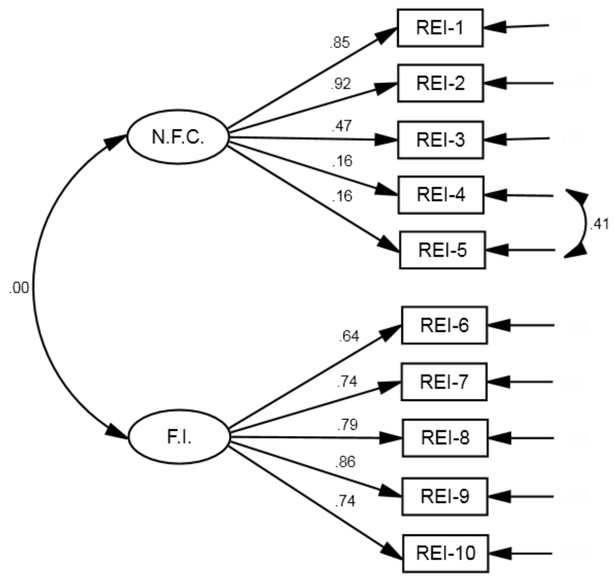
Note. NFC+ = positively-phrased need for cognition items; NFC- = negatively phrased need for cognition items; FI = faith in intuition. $n = 585$.

*** $p > .001$, two-tailed.

1. Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. 2. Reverse coded.

In preparation for the behavioural outcome models, the REI structure was generated using structural equation modelling. In an effort to retain the theoretical two-factor model, the residuals of the positively-phrased need for cognition items which separated from other need for cognition items in the principal components analysis were correlated. The fit of this two-factor model was considered reasonable and the model is shown as Figure 3 [$\chi^2(33) = 171.28$, $p < .001$, CFI=.94, RMSEA=.09, 90% CI (.07, .10)]. Guided by Cognitive-Experiential Self-Theory (Epstein, 2003), the previous documentation of a methodological factor related to item valence (Bors et al., 2006), and the fact that the model provided a reasonable fit, the intended two-factor structure of the REI was adhered to. In line with original theory the two factors need for cognition and faith in intuition were unrelated.

Figure 3. Latent structure of thinking style [$\chi^2(33) = 171.28$, $p < .001$, CFI = .94, RMSEA = .09, 90% CI [.07, .10].

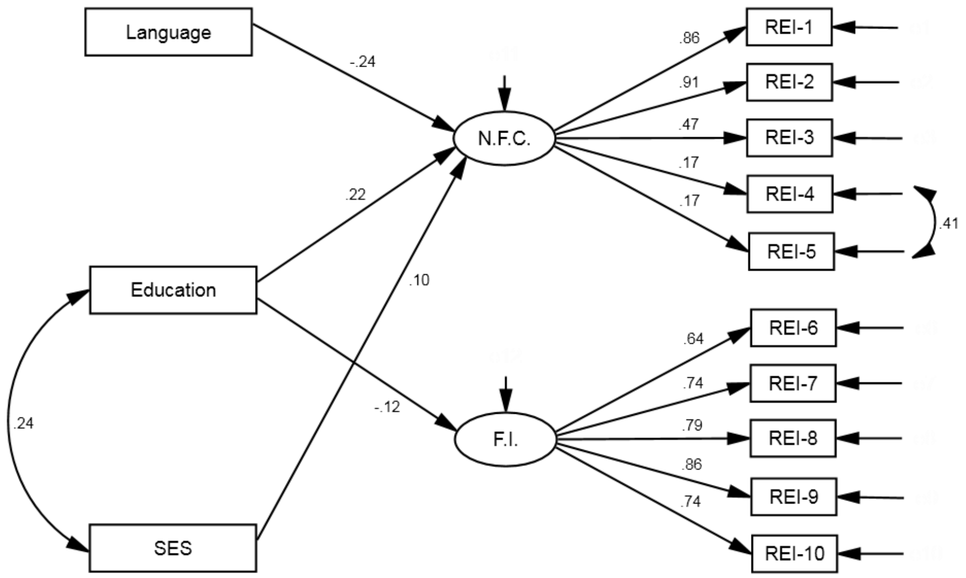


Note: All paths significant at $p < .001$. $n = 585$. NFC = need for cognition; FI = faith in intuition.

3.7.2. Association between thinking style and demographic variables

In order to explore whether demographic variables accounted for unique variance in REI constructs, need for cognition and faith in intuition were regressed onto the demographic variables age, language, education and SES. The fit of the initial model was acceptable [$\chi^2(72) = 271.58$, $p < .001$, CFI=.92, RMSEA=.07, 90% CI (.06, .08)]. Given that socioeconomic status and education levels are linked (Australian Bureau of Statistics, 2013b, 2013c), the model was further refined by allowing these to covary. Furthermore, paths that were not statistically significant were removed and this involved removing Age altogether as it did not predict either REI construct. These adjustments resulted in a significant improvement in fit [$\Delta\chi^2(10) = 46.75$, $p < .01$] and the final model had acceptable fit and is provided as Figure 4 [$\chi^2(62) = 224.83$, $p < .001$, CFI=.93, RMSEA=.07, 90% CI (.06, .08)]. Demographic variables were more strongly related to need for cognition, accounting for 11.6% of the variance, compared to faith in intuition, accounting for only 1.4% of the variance.

Figure 4. Demographic predictors of thinking style [$\chi^2(62) = 224.83$, $p < .001$, CFI=.93, RMSEA=.07, 90% CI (.06, .08)].

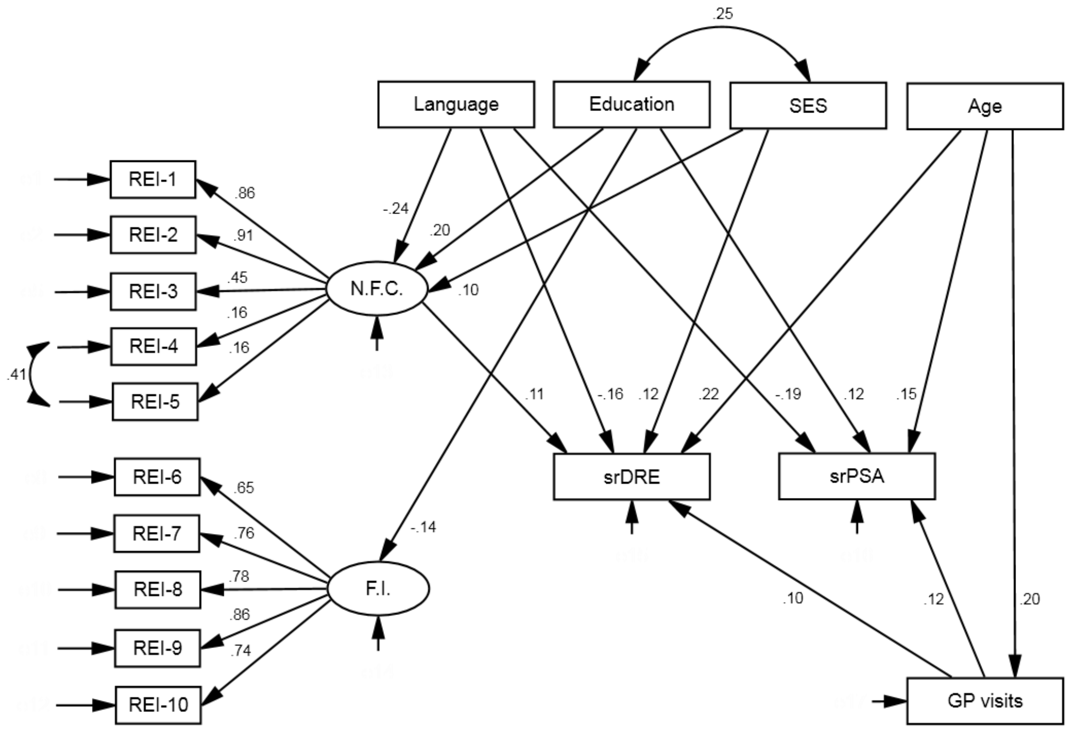


Note: NFC = need for cognition; FI = faith in intuition. All paths shown are significant at the $p < .001$ level, except for *NFC* ← *SES* and *FI* ← *Education*; significant at $p < .05$. $n = 553$.

3.7.3. Association between thinking style and prostate cancer screening

To explore the influence of thinking style on prostate cancer screening behaviour, screening variables (srPSA and srDRE) were regressed onto need for cognition and faith in intuition. In this model, demographic predictors of screening and number of GP visits in the past year were controlled for, given a plausible link between this and prostate screening behaviour. The initial model—which allowed thinking style, demographics, and GP visit variables to covary freely with srPSA and srDRE—had acceptable fit [$\chi^2(96) = 285.70$, $p > .001$, CFI=.92, RMSEA=.06, 90% CI (.05, .07)]. However, the model was refined by the removal of paths which were not statistically significant. This resulted in a slight decrease in fit but the change was not statistically significant [$\Delta\chi^2(14) = 12.37$, *ns*]. The refined model had acceptable fit and is shown as Figure 5 [$\chi^2(110) = 298.07$, $p > .001$, CFI=.92, RMSEA=.06, 90% CI (.05, .06)]. As can be seen, need for cognition accounted for 1.2% of the variance in srDRE but did not relate to srPSA; faith in intuition was not related to either screening variable.

Figure 5. Demographic and thinking style predictors of self-reported prostate cancer screening by PSA and DRE [$\chi^2(110) = 298.07$, $p > .001$, CFI=.92, RMSEA=.06, 90% CI (.05, .06)].



Note: NFC = need for cognition; FI = faith in intuition. All paths shown are significant at the $p < .001$ level, except for *NFC* ← *SES*, *srDRE* ← *NFC* and *srDRE* ← *GP visits* (significant at the $p < .05$ level) and *FI* ← *Education*, *srPSA* ← *GP visits*, *srDRE* ← *SES* and *srPSA* ← *Education* (significant at the $p < .01$ level). $n = 548$.

3.7.4. Association between thinking style and colorectal cancer screening

In a similar fashion to the model for prostate screening above, colorectal cancer screening variables (srFOBT and oFOBT) was regressed onto the thinking style variables. The initial model had acceptable fit [$\chi^2(92) = 250.76$, $p > .001$, CFI=.93, RMSEA=.06, 90% CI (.05, .06)]. However, thinking style variables and demographic variables failed to predict any variance in self-reported or observed FOBT screening. Thus, the model is not shown herein.

3.8. Discussion

This study sought to determine the relationships between thinking style, demographics and cancer screening behaviours in men. The analyses indicated that need for cognition was positively related to educational attainment and SES and negatively related to speaking English at home. Education's positive relationship with need for cognition (Cacioppo et al., 1996) has been documented elsewhere and the positive link with SES is unsurprising given that education is an indicator of socioeconomic advantage (Australian Bureau of Statistics, 2013b). The slight negative relationship found between education and faith in intuition has not been explored in detail, however, a previous study reported a weak negative association between faith in intuition and performance on Raven's Advanced Progressive Matrices (Liberali, Reyna, Furlan, Stein, & Pardo, 2012). These results suggest that health campaigns and interventions aimed at men with lower educational attainment or SES, or whose first language is not English, should allow for a lower preference for rational processing. This could include providing emotion-focused health information (Vidrine, Simmons, & Brandon, 2007), refining information so that it is less detailed, or incorporating advocacy by well-known individuals (Williams-Piehota, Schneider, Pizarro, Mowad, & Salovey, 2003).

Thinking style did not predict men's screening behaviour in this sample, with one exception. Need for cognition explained a very small amount of variance in self-reported DRE screening, even after controlling for frequency of doctor visits. Faith in intuition, however, explained no variance. In other words, these results indicate that men who identified as tending to think effortfully were slightly more likely to report undergoing a digital rectal examination than men who disliked thinking hard, while it did not make a difference whether men trusted or distrusted their intuitions. An effect of thinking style on DRE participation has not been reported before.

Health behaviours towards which rational processes may be positive and experiential processes may be negative have been termed ‘hard to sustain’ behaviours (Borland, 2014) and DRE appears to fit this categorisation. Specifically, its positive consequences (such as prevention of harm from prostate cancer) are long-term and best understood through rational processing, but the immediate and experientially processed aspects (such as shame, Naccarato, Reis, Matheus, Ferreira, & Denardi, 2011) are potentially negative. In this framework, it makes sense that a preference for rational processing would share variance with the decision to have a DRE, while a negative relationship with faith in intuition might be expected. The lack of any relationship with faith in intuition could indicate that factors evaluated by experiential processes were not uniformly negative (for instance, one may hold a positive implicit attitude towards following doctors’ advice).

The other two screening behaviours would also be classed as hard to sustain, having long-term preventive health benefits and immediately aversive aspects of participation (needles and faecal matter). However, no effects were detected for PSA tests or FOBT. This leads us to consider the level of involvement men have in their screening decisions: in order for thinking style to affect participation, a man must be making his own decision to undertake screening. The fact that men may be only minimally involved in the choice to have a PSA test (Slevin, Donnelly, Clarkson, English, & Ward, 1999) and may even be unaware one was carried out after blood was given (Chan, Vernon, Ahn, & Greisinger, 2004) suggests that thinking style cannot impact the screening decision-making process in some cases. Effects may be detectable for DRE participation because this is the most invasive, and arguably most volitional, of the two prostate screening methods.

Low involvement in the screening decision does not explain the lack of effects for FOBT, for which self-administration cannot occur without some effort. Although mailing kits, free of charge, to men's homes (in this study and the National Bowel Cancer Screening Program) removes the need to purchase or request a kit, their completion remains highly volitional. This hard-to-sustain behaviour would be expected to show influence from thinking style in a similar manner to DRE; indeed, effects may be detected in samples that are less homogenous in their FOBT screening participation.

Finally, an alternative explanation for the finding should also be considered, given the possibility of feelings such as shame regarding DRE (Naccarato et al., 2011). Men higher in need for cognition may simply have been more willing to report that they had been given a DRE.

3.8.1. Implications

It has previously been pointed out that health information should be structured so as to appropriately engage both forms of processing to capitalise on their strengths and counter their weaknesses (de Vries, Fagerlin, Witteman, & Scherer, 2013). The finding in this study that higher need for cognition in men tended to be linked to higher levels of education, higher SES, and English as a first language — but that little variance in faith in intuition was linked to demographic variables — reinforces this recommendation. Specifically, it suggests that health communications with elements geared toward experiential processing may be more equitable, because unlike rationally-processed information, these elements would be expected to perform just as well with groups of lower SES, education, and whose first language is not English.

3.8.2. Strengths and limitations

The research obtained a large sample of adults from the general population, and investigated the relationship between thinking style and cancer screening — an area about which little is known. Limitations of the study relate largely to issues with the REI and attributes of the sample. The presence in the original need for cognition scale (Cacioppo & Petty, 1982) of a second factor differentiated by reverse phrasing of questions, which places greater demand on verbal ability, has been documented in previous studies (Bors et al., 2006; Furnham & Thorne, 2013), and complicates the scale's construct validity. The possibility that the need for cognition scale is measuring something in addition to need for cognition reduces confidence in the relationships, or lack of, between need for cognition and the demographic and screening variables.

Our sample reported higher need for cognition and lower faith in intuition than participants in a large survey of Australian males and females chosen at random from the Electoral Roll (in which mean need for cognition was 3.51 (0.82) and mean faith in intuition was 3.77 (0.74); Golley et al., 2015). Need for cognition has been reported to correlate with education level (Cacioppo et al., 1996) and given this sample had roughly four times the postgraduate education attainment rate of the same-aged Australian male population (Australian Bureau of Statistics, 2011a), it is likely that the sample was also higher in need for cognition than the general population. Relatedly, need for cognition is positively related to participation in cognitively effortful activities (von Stumm, 2012) and thus participants in this sample (who voluntarily completed two surveys) may have been more likely to do so because of their higher need for cognition. Additionally, the sample overrepresented individuals of high SES, and this is known to predict colorectal cancer screening participation (Singh et al., 2004).

A methodological limitation was that only men who responded to the baseline survey were provided with a mailed FOBT and the endpoint survey. Accordingly, the rate of observed FOBT return (80.3%) was roughly double the rate of participation by the non-survey group in the parent study (attributed to selection effects insofar as men who return surveys are likely to participate in screening) (Zajac et al., 2016) and double the rate of male participation in the National Bowel Cancer Screening Program (Australian Institute of Health and Welfare, 2014c). A large study in which FOBT kits were mailed to Danish participants (without any preceding letter or survey) displayed uptake much closer to the parent study and the National Bowel Cancer Screening Program than to the subgroup used for the present research, with 43.6% uptake amongst males (Frederiksen, Jorgensen, Brasso, Holten, & Osler, 2010). Thus, the sample is highly biased towards FOBT screening. High levels of need for cognition coupled with high screening participation estimates may have limited the effects detected herein, but the presence of any effect in such a sample indicates that investigation in broader samples is worthwhile. Notwithstanding these issues, the fact that need for cognition influences DRE participation is an interesting contribution.

3.8.3. Future directions

The types of information men drew on in rational or experiential decision-making about screening has been speculated about above, but these results can tell us nothing about the types of information drawn upon by men with different thinking styles. For instance, experiential processing of attitudes toward prostate screening may have an anti-screening influence (e.g. 'PSA tests are uncomfortable') or a pro-screening influence (e.g. 'PSA tests are effective'), or both. Following work suggesting that indicators of rational processing moderate the influence of rationally-processed attitudes over behaviour (and likewise for experiential processing and experientially-processed attitudes) (Conner et al., 2007), future research should explore the relationship between thinking style and screening behaviour in a manner that can account for rationally and experientially processed attitudes.

Factors not measured, such as context, affect, and features of the health behaviour may privilege one form of processing over the other when making a decision. For instance, it is reasonable to accept that an individual may answer a general statement such as ‘I don’t like to do a lot of thinking’ as ‘completely true’, when in fact they thought very hard about taking their last PSA test, perhaps due to personal experience or a recently viewed news story. This state versus trait distinction in relation to rational and experiential processing requires further exploration if processing types are to be targeted in future research or interventions. A measure of thinking style that is specific to health-related thinking would be useful for promoting screening and other healthy behaviours, and would add to the understanding of need for cognition and faith in intuition. Finally, although modest, the effects found lead us to suggest that it is worthwhile replicating these results and extending investigations to other health behaviours. Studying a range of health behaviours varying in frequency, difficulty, and level of individual control may provide a more nuanced understanding of the relationships between thinking style and health behaviour.

3.8.4. Conclusions

Need for cognition explained a small amount of variance in self-reported DRE participation. While the effect was very small, it is interesting given the lack of existing knowledge in this area, and suggests possibilities for further research. These findings form a springboard for future work, suggesting that research that is conducted with more diverse samples, and which includes other behaviours, is warranted to shed light on the relationship of thinking style to healthy behaviour.

CHAPTER 4. THE REIM-13: A BRIEF MEASURE OF THINKING STYLE.

4.1. Preamble

The analyses reported in Chapter 3 showed a small, statistically significant link between rationality (referred to in Chapter 3 as need for cognition) and self-reported digital rectal examination participation. The results spurred the development of Study 2 (the basis for Chapters 4, 5, and 6), which attempted to improve upon Study 1 in several ways including the sample composition and diversity of health behaviours (which will be returned to in the preamble to Chapter 5). Of most relevance to this chapter is that in the time between Study 1 and Study 2, a new version of the REI was released, and this new version (the Rational-Experiential Multimodal Inventory, or REIm) took a more detailed approach to measuring experientiality. The fact that no relationships had been found with experientiality (faith in intuition) in the previous chapter left open the possibility that the scale used had simply not been accurate in measuring this variable. With its potential to better detect effects related to experientiality, the REIm was a useful addition to the REI lineage, but no validated short form was available. This posed problems for my research due to the large amount of data that had to be collected, and also because it was my intent that the health thinking style scale planned for development in Chapter 5 (which would be based on the REIm) be brief. Furthermore, despite having been published five years ago, the REIm seemed to still be used far less frequently than earlier REI versions, perhaps due to the lack of a short form. Therefore, in this chapter I will document the development and validation of a short form of the REIm — the REIm-13.

4.2. Statement of authorship

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4.2.1. Principal author

Name of principal author (candidate): Clare McGuiness

Contribution to the paper: Devised study aims and hypotheses. Planned and carried out data collection. Cleaned data and performed data analysis. Conceptualised, drafted, wrote, and submitted article, then revised and responded to reviewer comments. Acted as corresponding author.

Overall percentage (%): 85%

Certification: This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.

Signature: *Date:* 24 December 2016

4.2.2. Co-author contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of co-author: Prof. Deborah Turnbull

Contribution to the paper: General oversight of study conceptualisation, design and implementation. Monitoring and guidance of study planning, data collection and article progress. Provided editorial and structural feedback on paper.

Signature: *Date:* 6 January 2017

Name of co-author: Prof. Carlene Wilson

Contribution to the paper: Advised on research design and planning. Input on conceptual realisation and data analysis. Provided editorial and structural feedback on paper.

Signature: *Date:* 18 January 2017

Name of co-author: Dr Ian Zajac

Contribution to the paper: Advised on research design and planning. Oversight of statistics and modelling. Contribution to statistical analyses. Provided editorial and structural feedback on paper.

Signature: *Date:* 25 January 2017

4.3. Paper accepted for publication

The REIm-13: a brief measure of thinking style.

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4.4. Abstract

The Rational-Experiential Multimodal Inventory (REIm) is a recent tool showing promise in the measurement of self-reported thinking style — preference for rational or experiential processing — and offers three-faceted measurement of the latter. We present the first short form of the measure, the REIm-13, and test its factor structure, reliability and validity in a large community sample. Participants were N = 920 Australian adults (502 females) who completed an online survey (N = 510 of whom participated in a follow-up survey). In addition to the REIm, participants completed a Big Five personality measure. The internal consistency of the REIm-13 was acceptable given the limited number of items (.52 - .68). Furthermore, test-retest reliability was high (ρ = .64 - .74) for the theorized four-factor and two-factor solutions. Construct validity was established by examining the relationship between short form and full REIm factors (ρ = .65 - .71), and the validity of composite scoring was confirmed against factor scoring. Relationship with age (a slight negative relationship to both main scales), gender (females reporting higher Experientiality, males higher Rationality) and Big Five variables largely followed previous findings, demonstrating concurrent validity. The study demonstrates that the REIm-13 provides sound measurement of thinking style.

Keywords: thinking style; rational processing; experiential processing; cognitive style; scale validation

4.5. Introduction

Individuals can engage in two broad kinds of thinking. The rapid, associative processes that occur without controlled attention are labelled type 1 processes, whereas type 2 processes are slower, rely upon working memory, and are involved in abstract and logic-based thought. This distinction is the basis of *dual-process* models of reasoning, which propose that all human cognition is made up of these two fundamentally different forms of processing. Currently, the most widely held view is that type 1 processes are rapidly generated in response to stimuli, and slower type 2 processing may augment or override the default response (Evans & Stanovich, 2013).

Two decades of research point to stable individual differences in preference for each type of thinking, and these preferences are known as an individual's *thinking style*. The Rational-Experiential Inventory (REI; Epstein et al., 1996; Pacini & Epstein, 1999) is arguably the most prominent measure of thinking style, and developed from a theory of personality — Cognitive-Experiential Self Theory. The REI measures a person's reliance on, and ability in, type 1 processing (which is referred to as Experientiality) and type 2 processing (labelled Rationality). In the context of dual-process theory, it has been argued that descriptive and value-laden labels should be avoided (Evans & Stanovich, 2013), and in this respect the REI scales are somewhat at odds with current practice. In particular, it is important to underline that Rationality should not be interpreted as a tendency to think more sensibly or reasonably, but merely taken to reflect preference for type 2 processes. Regardless, for consistency with previous versions of the inventory, we have retained the same scale names. In addition, dual-process theorists have recently argued that all individual differences in thinking styles are actually a function of the degree to which one intervenes upon default type 1 responses with type 2 processes (for a discussion see Evans & Stanovich, 2013). Nonetheless, when measuring thinking style it is expedient simply to ask participants how much they like using one type of thinking, and the other.

In the most recent version, the Rational-Experiential Multimodal Inventory (REIm) (Norris & Epstein, 2011), the Experientiality scale is described as multimodal because it contains three subscales; Intuition, Imagination, and Emotionality. In addition to the full Experiential scale providing broad measurement of experiential processing, each of the subscales can be examined independently to measure use of, and ability in, specific kinds of experiential processing. The Intuition facet, which is equivalent to earlier versions' Experientiality scale, focuses on nonverbal, associative processes commonly described as instincts or gut reactions. The Imagination facet focuses on imagination and aesthetic perception, while the Emotionality facet focuses on affective processes. The REI requires individuals to self-report their usual ways of thinking and is thus understood to be a measure of self-perceptions (which draw on rational processes) rather than of actual processing. Yet, its self-report modality enables the REI to be used in survey-based research covering large samples. Furthermore, people do seem to have a degree of insight into their usual reliance on experiential or rational processes. Trait thinking style has been shown to correlate with people's self-reported use of rational or experiential processing on a task they have just completed. Specifically, across a range of tasks, Novak and Hoffman (2009) demonstrated weak to moderate correlations for rational processing and moderate to strong associations for experiential processing.

Findings of small gender effects on thinking style have been relatively consistent in the literature: males report higher Rationality than females, and females report higher Experientiality than males (Epstein, 2003; Norris & Epstein, 2011; Sladek et al., 2010). Increasing age has been linked to an overall decrease in preference for both Rational and Experiential processing (Sladek et al., 2010). Relationships with established personality variables have also been demonstrated using an earlier version of the REI. Both scales had weak positive correlations with Extraversion and Conscientiousness, while Rationality showed a moderate positive correlation with Openness to Experience and a weak negative correlation with Neuroticism. Weak positive correlations with Experientiality were found for Agreeableness and Openness to Experience (Pacini & Epstein, 1999).

Given improvements in the measurement of Experientiality (Norris & Epstein, 2011), the REIm is potentially a useful tool for advancing our understanding of thinking style and its relationship to other variables. A validated brief form of the REIm may facilitate its inclusion in future studies, as short measures may be more acceptable to participants (Burisch, 1997) and are of practical utility, particularly for group-level analysis and when efficiency of measurement is important (Ziegler, Kemper, & Kruyen, 2014). The present study aimed to develop and validate a brief multimodal measure of thinking style, comprising a subset of REIm items. The shortened measure was designed to preserve the factor structure of the original REIm, representing two main factors of rationality and experientiality, as well as three sub-factors representing different facets of experientiality. The reliability and validity of short form factors was assessed against those derived from the full REIm, measured on a separate occasion. Furthermore thinking style, as measured using the new shortened measure, was expected to relate to age, gender, and to personality variables in a manner consistent with previous findings.

4.6. Method

4.6.1. Design and participants

Online surveys were conducted in August 2015 (T1) and February 2016 (T2)[6]. At T1 N = 920 people aged between 18 and 87 (54.6% female, M_{age} = 46.40) took part, and N = 510 participated in the follow-up survey at T2 (59.6% female, M_{age} = 46.42). At T2, the group who re-participated was similar to those who were lost to follow-up, but females were more likely to re-participate (Table 33).

Table 33

Sample descriptive statistics

		T1 participants	T2 Participants	T2 Non-participants	Difference[2]
N		920	510	410	
Sex	Female	54.6%	59.6%	48.3%†	$\chi^2(1) = 11.74$, $p = .001$
	Male	45.4%	40.4%	51.7%†	
Age	M (*SD*)	46.40 (16.98)	46.42 (16.49)	46.37 (17.60)	*ns*
Language[1]	Yes	12.1%	10.4%	14.1%	*ns*
	No	87.9%	89.6%	85.9%	
Education	Year 12 or less	14.6%	13.2%	16.6%	*ns*
	TAFE/Trade	9.8%	10.0%	9.5%	
	Dipl./Assoc.	12.3%	10.2%	14.9%	
	Bachelor	29.8%	31%	28.3%	
	Postgraduate	33.5%	35.7%	30.7%	
Employ-ment	Employed	61.2%	61.2%	61.2%	*ns*
	Unemployed	3.3%	2.7%	3.9%	

[6] Further methodological details about this study can be found in Chapter 2, section 2.3, page 40. The required sample size was governed by the analyses reported in Chapter 6; for further information refer to page 43.

		T1 participants	T2 Participants	T2 Non-participants	Difference[2]
	Student	8.80%	9.60%	7.80%	
	Retired	16.4%	17.5%	15.7%	
	Carer/home duties	2.7%	2.5%	2.9%	
	Pension	3.6%	3.1%	4.1%	
	Other	4.0%	3.3%	4.9%	
Thinking style[3] M (*SD*)	Rationality	4.02 (.63)	4.06 (.63)	3.98 (.64)	*ns*
	Imagination	3.88 (.66)	3.90 (.66)	3.87 (.65)	*ns*
	Intuition	3.50 (.70)	3.46 (.69)	3.55 (.71)	$t(866.22)=-1.94$, $p = .053$
	Emotionality	3.57 (.73)	3.58 (.74)	3.55 (.72)	*ns*
	Experientiality	3.64 (.47)	3.64 (.47)	3.66 (.46)	*ns*

Notes. 1. Speaking a language other than English at home.

2. Test of difference between participants at T2 and those lost to follow-up. Categorical variables for which those lost to follow-up differ significantly from T2 participants (indicated by adjusted standardised residuals greater than 2) marked with †.

3. Using REIm-13 scores from T1.

4.6.2. Measures

4.6.2.1. Thinking style.

Thinking style was measured using the full REIm (Norris & Epstein, 2011) and a short form developed herein for validation, named the REIm-13 due to its 13 items. For both the full and short versions, participants rated their agreement with the relevant statements on a 5-point Likert scale. The full REIm contained 42 items; 12 in the Rationality scale and 30 in the Experientiality scale (10 for each subscale). Internal consistency for the full REIm was good for all scales and subscales (α = .87 for Rationality, α = .76 for Imagination, α = .80 for

Intuition, α = .70 for Emotionality, α = .84 for Experientiality). Items in the REIm-13 can be seen in Table 34 and internal consistency of its scales/subscales at both time points is shown in Table 35. Internal consistency was generally good for the REIm-13, although the alphas were somewhat below the standard of a Cronbach's alpha of .7 (Bland & Altman, 1997) which is likely due to the short-form nature of this questionnaire.

Table 34

The REIm-13

Scale	Subscale	Item
Rationality		I am not very good in solving problems that require careful logical analysis[1]
		Reasoning things out carefully is not one of my strong points[1]
		I enjoy intellectual challenges
		I enjoy problems that require hard thinking
Experientiality	Imagination	I enjoy reading things that evoke visual images
		I can clearly picture or remember some sculpture or natural object (not alive) that I think is very beautiful
		I enjoy imagining things
	Intuition	I don't think it is a good idea to rely on one's intuition for important decisions[1]
		I often go by my instincts when deciding on a course of action
		I trust my initial feelings about people
	Emotionality	Emotions don't really mean much: they come and go[1]
		When I have a strong emotional experience, the effect stays with me for a long time
		When I'm sad, it's often a very strong feeling

1. Items have been reverse coded.

4.6.2.2. Personality.

Participants completed a 10-item version of the Big Five Inventory, the BFI-10 (Rammstedt & John, 2007) by rating their agreement with statements on a 5-point Likert scale. This scale measures the personality traits Openness to experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism with two questions each.

4.6.2.3. Procedure

This research received ethics approval from the School of Psychology Ethics Committee at The University of Adelaide. The survey was open to adults aged 18 and over, and was restricted to people who usually resided in Australia (regardless of whether they were currently in the country). The latter requirement was because the research aims did not include comparison between people of different nationalities. Both surveys were conducted via the online survey platform SurveyGizmo. The T1 survey (including demographic questions, the BFI-10, and the REIm-13) was available for 105 days in August, 2015, and took participants roughly 25 minutes to complete. As an incentive to encourage broad uptake of the survey, participants were offered entry into a draw to win a tablet computer. At T2, 750 participants (who had consented at T1 to be re-contacted) were emailed a personalized link to the second survey, which included the REIm and took approximately 10 minutes to complete. The second survey was available for 14 days in February 2016, and a reminder email was sent on the tenth day. A prize draw for a $100 shopping voucher was offered as an incentive.

Items for the REIm-13 were chosen based on the factor analytic outcomes of Norris and Epstein (2011). Items were selected from amongst the highest-loading items for the intended factor (e.g., Imagination), but care was taken to balance the number of items addressing ability and engagement in each type of thinking (see Pacini & Epstein, 1999). Nine items were selected for the Experiential scale—comprising three items for each of the

Intuition, Imagination, and Emotionality subscales—and four items comprised the Rational scale. The REIm-13 was completed by participants at T1 to ensure that initial responses to this questionnaire were not biased by previous exposure to the full REIm.

4.6.2.4. Data cleaning and analysis

In total, 1031 participants attempted the survey at T1. Of these, 113 were excluded from the survey for not meeting age or country of residence criteria, or completing less than 80% of the REIm-13. The final T1 sample contained $N = 920$ participants. At T2, the only necessary exclusions were 7 individuals who completed less than 80% of the REIm. The final T2 sample contained $N = 510$ participants. The mean interval of time between completion of the two surveys was 122 days (SD 22.02, min = 82, max = 188). Descriptive statistics, correlations, and MANOVAs were carried out in IBM SPSS Statistics 20. Factor analyses were performed in MPlus 4.2.

4.7. Results

4.7.1. REIm-13 scores and test-retest reliability

Means and standard deviations of the composite (averaged) variables for the REIm-13 scales and subs cales are shown in Table 35, along with test-retest reliability, which was assessed using nonparametric correlations (due to all scales and subscales being negatively skewed, with Shapiro-Wilk statistics for each being p > .001). As can be seen, correlations between time points were generally strong, showing good retest reliability.

Table 35

Internal consistency and average REIm-13 scale/subscale scores at T1 and T2

Scale/subscale	Internal consistency (α)		M(SD)		T1 – T2 correlation[1]
	T1[1]	T2[2]	T1[1]	T2[2]	
Rationality	.68	.73	4.02 (0.63)	3.92 (0.61)	.69***
Imagination	.59	.62	3.88 (0.66)	3.81 (0.66)	.68***
Intuition	.63	.65	3.50 (0.70)	3.42 (0.68)	.64***
Emotionality	.52	.60	3.57 (0.73)	3.57 (0.72)	.64***
Experientiality	.61	.66	3.65 (0.47)	3.60 (0.47)	.74***

Note. Individual items' mean, standard deviation, skewness and kurtosis, and correlations between time points, are available from the first author. *** p < .001.

1. N = 920.

2. N = 510.

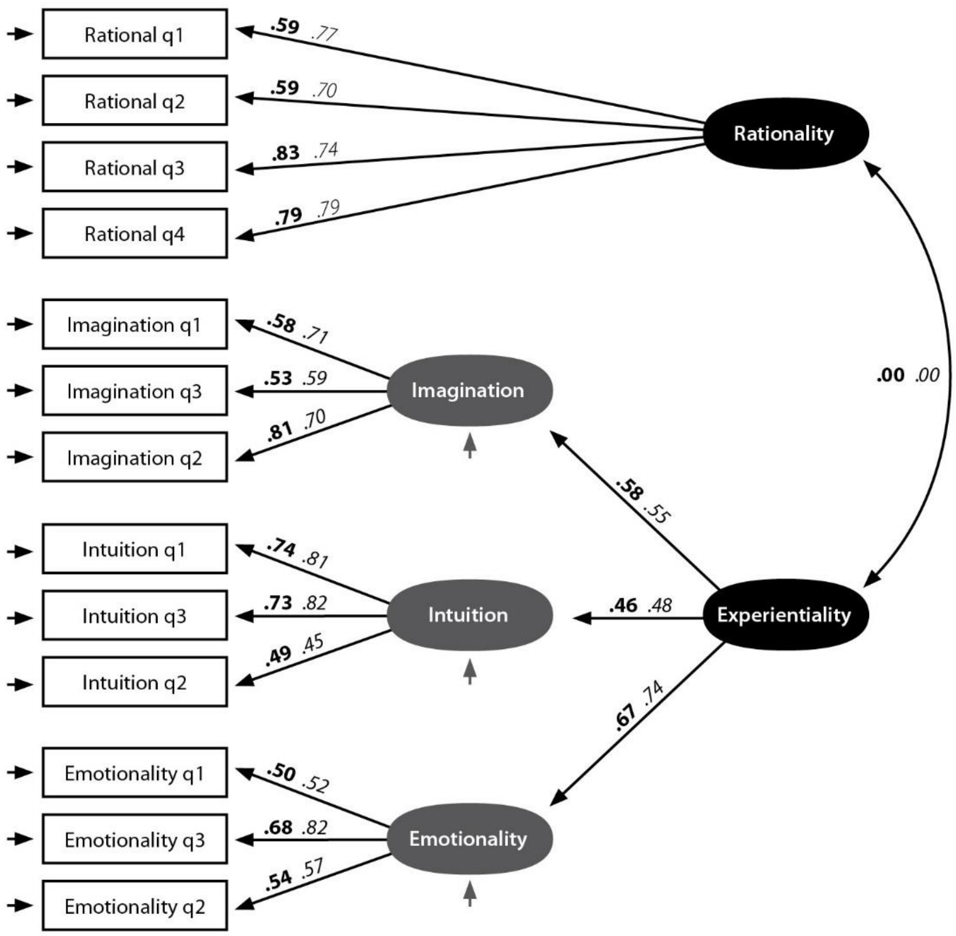
4.7.2. Factorial Structure of the REIm

The REIm-13 was developed to measure a distinct set of latent variables that should have a four-factor structure (comprising the first-order factors Rationality, Intuition, Imagination and Emotionality). In order to check whether the scales were measuring these four factors as intended, we performed a confirmatory factor analysis with WLSMV estimation to assess model fit criteria. Items were specified to load solely on their hypothesized factor, and all factors were allowed to covary. The fit of the model was acceptable at T1 [$\chi^2(40)=248.91$, $p=.00$, CFI=.92, RMSEA=.07, SRMR=.06] and at T2 [$\chi^2(35)=157.42$, $p=.00$, CFI=.93, RMSEA=.08, SRMR=.06]. For both models, all items showed moderate to strong loadings on their intended factor and the Experiential subscales were more strongly related to one another than to the Rational factor. Given that Experientiality is hypothesized as reflecting all three subdomains, the final model tested incorporated a higher order Experiential factor predicted by its three facets, as shown in Figure 6. In line with the theoretical independence of the two thinking styles, the relationships between rational and experiential factors was constrained to zero, and this final model fit the data adequately for T1 [$\chi^2(33)=282.94$, $p=.00$, CFI=.91, RMSEA=.09, SRMR=.08], and for T2 [$\chi^2(28)=138.73$, $p=.00$, CFI=.94, RMSEA=.09, SRMR=.08].

The two-factor structure (Rationality and Experientiality factors) was assessed through a second confirmatory factor analysis at T1 and T2 independently. The nine items measuring intuition, imagination and emotionality were loaded onto a single Experientiality factor, with the remaining items defining the Rational factor. Rational and Experiential factors were not allowed to covary. The fit of this model was not acceptable at T1 [$\chi^2(33)=609.78$, $p=<.001$, CFI=.78, RMSEA=.13, SRMR=.11] or T2 [$\chi^2(27)=333.28$, $p=.<001$, CFI=.82, RMSEA=.15, SRMR=.12]. This did not change appreciably when the factors were allowed to covary at T1 [$\chi^2(38)=708.11$, p=<.001, CFI=.75, RMSEA=.14, SRMR=.10] or T2 [$\chi^2(30)=405.76$, p=.<001, CFI=.78, RMSEA=.16, SRMR=.12] suggesting that a four factor model alone or in combination with a higher-order experiential factor is the best fit to the data.

Figure 6

Confirmatory factor analysis model for the REIm-13.



Bold text = T1 (N = 920; $\chi^2(33)$=282.94, p=.00, CFI=.91, RMSEA=.09, SRMR=.08);

Italicized text = T2 (N = 510; $\chi^2(28)$=138.73, p=.00, CFI=.94, RMSEA=.09, SRMR=.08).

4.7.3. Construct validity and reliability of REIm-13 factors

Weighted-sum factor scores were generated to assess construct validity of the REIm-13. Exploratory factor analyses (using Weighted Least Squares Means and Variance adjusted estimation due to the non-normal distributions of all items) were run for the REIm-13 at T1 and T2 and the full REIm at T2, and the loadings on the varimax-rotated four-factor solutions were used in creation of factors. Factors were created for the REIm-13 scales and subscales at both times (labelled Short-T1 and Short-T2), full REIm scales and subscales at T2 (Full-T2), and reduced REIm scales and subscales at T2 including only those items excluded from the REIm-13 (e.g. rational items 5 to 12; labelled Remainder-T2). The purpose of the latter was to remove statistical dependencies in the relational analyses that follow.

Table 36 provides the reliability estimates for the REIm-13 factors — i.e. correlations between the Short-T1 and Short-T2 factor scores. Also shown are the correlations of Short-T1 with both the Full-T2 and Remainder-T2 factor scores. As can be seen, reliability was generally high, as indicated in the first two columns by the similar correlations with substantially overlapping confidence intervals. It was somewhat lower for the Experiential scale and subscales in the correlation between Short-T1 and Remainder-T2 factor scores, where the variables were created from different items and measured at different time points.

Table 36

Reliability estimates for REIm-13.

	Correlations [95% CI]		
Factor	Short-T1, Short-T2	Short-T1, Full-T2	Short-T1 Remainder-T2[1]
Rationality	.72*** [.68, .76]	.71*** [.67, .75]	.67*** [.61, .71]
Imagination	.71*** [.67, .75]	.65*** [.56, .70]	.57*** [.50, .62]
Intuition	.66*** [.61, .71]	.66*** [.61, .71]	.58*** [.52, .64]
Emotionality	.68*** [.63, .72]	.68*** [.63, .72]	.56*** [.50, .62]
Experientiality	.74*** [.,71 .78]	.71*** [.67, .75]	.57*** [.52, .63]

Notes. *N* = 510. Loadings from the exploratory factor analysis used in creation of factor scores is available from the first author.

1. Containing REIm items *not* included in REIm-13.

*** $p < .001$.

4.7.4. Composite Scoring of REIm-13 Factors

In order to establish the validity of using item composite scoring methods of the REIm-13 in future research, CFA-derived factor scores from each time point were correlated with composite scores for each time. As expected correlations were extremely high — the average being .96 (Min = .94, Max = .99, $p < .001$) — supporting the use of composite scoring in future studies.

4.7.5. Demographic and personality predictors of thinking style

Links to age, gender, and personality were explored using the REIm-13. The effect of gender across all scales and subscales was investigated using MANOVA, with a significant effect detected at both T1 [$F(4, 915) = 21.27$, $p < .001$; Wilk's $\Lambda = 0.92$, partial $\eta^2 = .09$] and T2 [$F(4, 505) = 13.85$, $p < .001$; Wilk's $\Lambda = 0.90$, partial $\eta^2 = .01$]. At T1, females scored higher on Imagination [$F(1, 918) = 18.71$, $p > .001$, $M_{female} = 3.87$, $M_{male} = 3.78$], Intuition [$F(1, 918) = 7.04$, $p = .008$, $M_f = 3.55$, $M_m = 3.43$], Emotionality [$F(1, 918) = 73.33$, $p > .001$, $M_f = 3.75$, $M_m = 3.35$] and overall Experientiality [$F(1, 918) = 61.87$, $p > .001$, $M_f = 3.76$, $M_m = 3.52$]. At T2, males reported higher Rationality [$F(1, 508) = 9.70$, $p = .002$, $M_f = 3.85$, $M_m = 4.02$], while females reported higher Imagination [$F(1, 508) = 13.93$, $p > .001$, $M_f = 3.90$, $M_m = 3.68$], Emotionality [$F(1, 508) = 43.34$, $p > .001$, $M_f = 3.74$, $M_m = 3.33$], and overall Experientiality [$F(1, 508) = 32.63$, $p > .001$, $M_f = 3.70$, $M_m = 3.46$].

Nonparametric correlations were performed with age and the BFI-10 (Table 37). Rationality was found to have negative relationships with Neuroticism and positive relationships with Conscientiousness and Openness, in line with previous research. The full

Experientiality scale was positively correlated with all BFI-10 variables. Both main scales showed small negative correlations with age. When correlations with age were performed separately for males and females, Emotionality was negatively correlated with age for females (ρ = -.11, p = .019), and Rationality was negatively correlated with age for males (ρ = -.22, p > .001).

Table 37

Correlations between REIm-13 variables, BFI-10 variables, and age.

	Rationality	Imagination	Intuition	Emotionality	Experientiality
Extraversion	.09**	.10**	.15***	.00	.12***
Agreeableness	.10**	.08*	.06	-.01	.08*
Conscientiousness	.25***	.10**	.12***	-.02	.10**
Neuroticism	-.21***	.00	-.09**	.38***	.16***
Openness	.13***	.46***	.02	.17***	.32***
Age	-.09*	-.06	-.01	-.15***	-.12***

Note. Spearman's rho. N = 900-920. *** $p < .001$, ** $p < .01$, * $p < .05$.

4.8. Discussion

This article has demonstrated acceptable validity and reliability for the REIm-13, a brief version of the Rational Experiential Multimodal Inventory. The theorized four-factor structure (based on the REIm) was established and confirmed in separate analyses, demonstrating the construct validity of the REIm-13. The internal consistency of the REIm-13 was within acceptable bounds for a brief measure given that lower alpha values are to be expected (Cortina, 1993). Moreover, test-retest reliability was adequate, ranging from .64 to .74. Validity was further established by the robust and comparable correlations between the T1 short-form weighted-sum factor scores and a) their T2 equivalent and b) their full REIm equivalent. Composite scoring was shown to be as valid as weighted-sum factor scoring.

The relationship of the REIm-13 scales and subscales to age and gender provided evidence of concurrent validity. Gender effects for Rational processing were in keeping with previous findings (Epstein, 2003; Norris & Epstein, 2011; Sladek et al., 2010), with males scoring more highly (though only significantly so at T2). Similarly, females reported higher preference for Experiential processing and its facets (though the difference for Intuition was only significant at T1). Older participants reported lower preference for both thinking styles, and this age-related effect supported the findings of Sladek et al. (2010). The decline in self-reported preference for particular kinds of processing was greater for males than for females, and affected different scales for each gender. Interestingly, with increasing age, males' preference for rational processing (a scale on which males scored higher than females) reduced, and females' preference for affect-based processing (on which females scored higher than males) reduced. This apparent reduction in preference with age may reflect lower confidence due to age-related cognitive changes that participants have noticed (Snitz et al., 2015). However, the fact that the changes appeared to be driven by reductions in the more preferred type of thinking for each gender also suggests that over the lifespan males and females come to differ less in their thinking styles.

The associations between Big Five personality traits and thinking style generally followed those found by Pacini and Epstein (1999), supporting the validity of the REIm-13. Some interesting additional relationships were evident due to the multimodal measurement of Experiential processing. Tellingly, whereas in earlier comparisons with Big Five traits (using the previous REI; Pacini & Epstein, 1999) the larger associations were those between Rationality and aspects of personality (i.e., Conscientiousness, Openness and Neuroticism), in the current study — with its multimodal measurement of experiential processing — the largest three associations were between Experientiality and Openness, the Emotionality facet and Neuroticism, and the Imagination facet and Openness.

4.8.1. Limitations

The fact that the full REIm was not administered at T1 (due to concerns about the length of that survey) is a limitation of the research, as the analyses comparing the full and brief scale can only draw on the smaller sample who participated at both times. Additionally, comparison of the REIm-13 with other thinking style measures, such as the Preference for Intuition and Deliberation Scale (Betsch, 2008) or the General Decision Making Style questionnaire (Spicer & Sadler-Smith, 2005), could have provided additional evidence of concurrent validity.

4.8.2. Future directions

It is proposed that thinking style is one of a number of factors that affect whether an experiential process will either influence behavior, or be modified or overriden by rational processes (Hofmann et al., 2008). Therefore, thinking style can play an important role in investigating the impacts of rational and experiential processing on behavior. The prediction of health behavior, for instance, can be improved by accounting for thinking style (e.g. Conner et al., 2007). Further, the suggestion that an individual's cognitive style varies across different domains (Pachur & Spaar, 2015) provides an interesting avenue for research.

Additionally, discovering the degree to which the REIm-13 correlates with other measures of thinking style, such as those mentioned above, would enhance claims for this new measure's validity. The brief but reliable REIm-13 enables thinking style to be captured quickly in large survey samples and can be efficiently deployed in future research to enhance understanding of this important individual difference variable.

4.8.3. Conclusion

This research established that individual differences in thinking style in a large and diverse sample of Australian adults can be measured with good reliability and validity using a short measure. With replication, the REIm-13 can be established as a useful tool for measuring thinking style in research applications where participant time may be limited.

CHAPTER 5. HEALTH THINKING STYLE: A NEW SCALE SHOWS INCREMENTAL VALIDITY IN PREDICTING HEALTH BEHAVIOUR.

5.1. Preamble

The longstanding assumption that thinking style, as measured by the various REI scales, applies ‘in general’ to a person’s thinking across all areas of their life appeared to be worth testing. To explore whether the way people reported approaching health-related thinking differed from the way they reported their general thinking style, and to add to the tools available for understanding and predicting health behaviour, I created a measure of thinking style that focused specifically on thinking and deciding about health matters. As reported in Chapter 4, the REIm-13 was judged to be reliable, and therefore it was suitable for conversion into a thinking style measure specific to health-related thinking. This chapter describes the selection and conversion of items, and the analyses performed in order to assess the reliability and validity of the new measure, the REI-Health.

Given that the Study 1 sample (from which the dataset analysed in Chapter 3 was obtained) appeared rather favourably disposed toward cancer screening, it seemed possible that in a more representative sample there may be other associations to discover between thinking style and health behaviour. Therefore, in Study 2, I aimed to attract a sample that better reflected the general population (though with limited success, as discussed in the Method chapter, page 92). It also appeared useful to widen the net beyond the prostate and colorectal cancer screening behaviours considered in Chapter 3. This chapter includes a total of eight health behaviours that will be predicted using the REI-Health: diet quality, physical activity, smoking, and participation in five types of cancer screening: faecal occult blood test, Pap smear, mammogram, PSA test, and digital rectal examination.

5.2. Statement of authorship

Title of paper: A test of the incremental validity of a brief measure of Health Thinking Style.

Publication status: Submitted for publication.

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5.2.1. Principal author

Name of principal author (candidate): Clare McGuiness

Contribution to the paper: Devised study aims and hypotheses. Planned and carried out data collection. Cleaned data and performed data analysis. Conceptualised, drafted, wrote, and submitted article, then revised in response to reviewer comments and submitted again. Acted as corresponding author.

Overall percentage (%): 85%

Certification: This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.

Signature: *Date:* 24 December 2016

5.2.2. Co-author contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of co-author: Prof. Deborah Turnbull

Contribution to the paper: General oversight of study conceptualisation, design and implementation. Monitoring and guidance of study planning, data collection and article progress. Provided editorial and structural feedback on paper.

Signature: *Date:* 6 January 2017

Name of co-author: Prof. Carlene Wilson

Contribution to the paper: Advised on research design and planning. Input on conceptual realisation and data analysis. Provided editorial and structural feedback on paper.

Signature: *Date:* 18 January 2017

Name of co-author: Dr Ian Zajac

Contribution to the paper: Advised on research design and planning. Oversight of statistics and modelling. Contribution to statistical analyses. Provided editorial and structural feedback on paper.

Signature: *Date:* 25 January 2017

5.3. Paper submitted for publication

Health thinking style: A new scale shows incremental validity in predicting health behaviour.

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5.4. Abstract

Thinking style — the preference for using rational or intuitive processes — is theorised to be trait-like, although research suggests people's thinking style varies across life domains. Our aim was to explore whether people adapt their 'trait' thinking style when it comes to health matters; specifically, we aimed to identify predictors of health thinking style, and to test its incremental validity over trait thinking style in the prediction of health behaviour. This study utilised a cross-sectional design to test the relationship between trait and domain-specific thinking style and health behaviour. We adapted an existing thinking style measure, the Rational-Experiential Multimodal Inventory short form, to produce the REI-Health, a measure of health thinking style. A community sample of 992 Australian adults was recruited (54.1% female; mean age 46.5 years) and data were collected via online survey in 2015. Retest data were provided by 519 participants 3 to 6 months later, in 2016.

The main predictors of health rationality (preference for using rational processes for health-related thinking) were trait rationality and health importance, whereas trait intuition was the main predictor of health intuition (preference for using intuitive processes for health-related thinking). The incremental validity of health thinking style was demonstrated over trait thinking style for the prediction of several health behaviours. After controlling for trait thinking style, health importance, and demographics, health rationality explained variance in diet quality (2.9%), faecal occult blood test participation (3.8%), and Pap smear participation (2.0%), and health intuition explained 4.2% of variance in faecal occult blood test participation. The finding that health thinking style predicts additional variance in several health behaviours over and above trait thinking style suggests that people adapt their thinking style for health matters.

5.5. Introduction

Dual-process models of cognition propose that human reasoning draws upon two kinds of processing: one rapid, automatic, and associative (experiential processes); and the other more deliberate, effortful, and with the capability for abstract thought (rational processes) (Evans & Stanovich, 2013). Although rational processes have traditionally been the focus of health behaviour models, their primacy in directing health behaviour has been called into question over the past decade, with a meta-analysis revealing that changes in intentions (traditionally measured as a controlled, rational process) fail to translate to equivalent changes in health behaviour (Webb & Sheeran, 2006). In recent years, the relative contribution of experiential processes (such as implicit attitudes) and rational processes (including explicit attitudes) to health behaviour has been explored in experimental settings (e.g. manipulating the influence of implicit and explicit attitudes over food and drink consumption in a laboratory; Friese et al., 2008) and intervention studies (e.g. conditioning negative implicit attitudes to reduce alcohol consumption; Houben, Havermans, & Wiers, 2010).

The dispositional reliance on experiential or rational processes (known as *thinking style*) is measured by means of a self-report scale, the Rational-Experiential Multimodal Inventory (REIm; Norris & Epstein, 2011). Its two main scales measure self-reported rationality (the preference for rational processing) and experientiality (the preference for experiential processing — which contains three subscales measuring preferences for processing using intuition, affect, and imagination). Thinking style is one of a number of factors that influence which type of processing guides a decision (Phillips et al., 2016) or health behaviour (Hofmann et al., 2008).

The mechanisms by which processing strategy influences behavioural outcomes are not well understood. However, it appears that while both rational processing and experiential processing are theoretically adaptive (Epstein, 2003) the most effective decision-makers are those that match processing type to task demands (Phillips et al., 2016). For example, while those using rational processing tend to do better on tests of abstract reasoning such as Raven's Advanced Progressive Matrices (Novak & Hoffman, 2009), people high in experientiality are more likely to excel in tests evaluating intuition, sense of humour, and creativity (Norris & Epstein, 2011).

Recent findings suggest that experiential or rational processes actually draw on different information, such as implicit or explicit attitudes — which may not be consistent in regard to the same object (e.g. 2007; for a discussion see Shoda, McConnell, & Rydell, 2014). Furthermore, given that experiential processes are thought to activate knowledge learned in similar situations, it is suggested that in settings to which a person has been exposed less routinely (such as medical decision-making), experiential processes may be less adept (Pachur & Spaar, 2015). Consequently, the behavioural outcome following information processing is influenced by the strategy employed (i.e., rational versus experiential processing) and the associated type of content to which this is applied (e.g., explicit attitudes or implicit associations).

The domain of life in which a behaviour falls may cue a particular processing preference. Recently, Pachur and Spaar (2015) adapted a measure of decision style to six different domains of life (mate choice, clothing, restaurants, medical, electronics, and vacations) and found that the preference for deliberation (i.e. rationality) or intuition (a facet of experientiality) differed between contexts. Comparing the six life domains tested, domain-specific preferences for medical decision-making had the second-lowest correlation with domain-general preference for intuition, and the equal-lowest correlation with preference for deliberation — a weak positive correlation in both cases. This suggests that when it comes to medical decision-making, people adhere only minimally to their trait thinking style.

5.5.1. Thinking style as a predictor of health behaviour

Earlier, we noted growth in research that focuses on the comparative influence of experiential or rational processes within experiments or interventions. However, the relationship of stable, trait-like, thinking style to actual (or self-reported) health behaviour has to date only been explored in a small number of studies. Nonetheless, the findings begin to build a picture of a variable with conceptual and predictive validity for important behaviours. For example, a small association between rationality and reported participation in digital rectal examinations (DRE) has been documented (McGuiness et al., 2016). Another study reports that good hand hygiene amongst doctors appears to be linked to use of experiential processing (Sladek et al., 2008), and smokers are over-represented amongst those whose thinking style was high in experientiality and low in rationality (Brown & Bond, 2015). In a study of tertiary students, self-administration of complementary and alternative medicines correlated positively with experientiality but negatively with rationality (weak correlations in both cases; Wheeler & Hyland, 2008). Finally, those higher in rationality tend to report higher intake of fruits and vegetables (experientiality not measured; Williams-Piehota, Pizarro, Navarro Silvera, Mowad, & Salovey, 2006) and may be more likely to avoid products containing wheat after experiencing symptoms related to its consumption (effect approaching significance; Golley et al., 2015).

Certainly, interest has been growing about the impact thinking style has on the accuracy of health behaviour models (McEachan, Conner, Taylor, & Lawton, 2011) and the effectiveness of health communication (e.g. food labelling, Ares et al., 2014; pathology reports, Dreyfus, Lederman, Smith, & Monagleglegle, 2011; and anti-smoking public service announcements, Shen, Monahan, Rhodes, & Roskos-Ewoldsen, 2009). Additionally, experientiality and rationality have shown associations with psychological variables of relevance to health behaviour, including perceived vulnerability to disease (L. A. Duncan et al., 2009) and attitudes to genetically modified and organic foods (Saher et al., 2006). Despite some empirical evidence highlighting possible importance of thinking style to health behaviour, there remain many unanswered questions about this potential relationship, including whether any particular style is associated with greater participation in specific healthy behaviours.

5.5.2. Health-specific measurement of thinking style

The studies listed above have used measures of individual differences in thinking style that contain very broad items applicable to any domain of life such as: ‘I enjoy problems that require hard thinking’ (e.g. Epstein et al., 1996) — we refer to these as *trait* measures. However, as discussed earlier, it is possible that people are more or less rational or experiential in different domains of their life. Thus, someone may be guided largely by intuition when making judgements about relationships but rely on rational processes when making finance decisions. Petty and Briñol (2012) in the Elaboration Likelihood Model suggest that a person is more likely to use rational processing when a topic is seen as important. This suggests that people who rate their health to be very important may score more highly than others in health rationality.

With this in mind, validating a measure of health thinking style could serve three useful functions. First, it could add to knowledge about the extent to which people approach different domains with a different information processing strategy (i.e. high or low reliance on rational or experiential processes). Second, identifying individual differences in health-specific thinking style may enable improved prediction of health behaviour over trait thinking style alone (i.e., demonstrate incremental validity), leading to greater understanding of health behaviour. Given the mixed results in predicting health behaviour using measures of trait thinking style, validation of a health thinking style measure should involve a range of different health behaviours including cancer screening behaviours (aimed at detecting cancers before symptoms are obvious) and health-related lifestyle choices that influence the risk of developing chronic disease. Lastly, possible links between health thinking style and demographic variables should be explored because this information could aid the targeting of health information to population subgroups.

In this study, we adapted a validated measure of trait thinking style so as to measure health thinking style, and we assessed the reliability, validity, and factor structure of the new scale. The degree to which health thinking style was predicted by demographic variables, trait thinking style, and health importance was explored. In line with suggestions that domain-specific measurement of rational and experiential processing should be applied to the prediction of real-world outcomes (Pachur & Spaar, 2015), we used health thinking style to predict a range of self-reported health behaviours, controlling for demographic predictors, trait thinking style, and health importance.

5.6. Method

5.6.1. Participants and procedure.

The Ethics Committee of the School of Psychology at the University of Adelaide approved the research. The necessary sample size was determined in relation to analyses that will be reported elsewhere (McGuiness, Turnbull, Wilson, & Zajac, 2017), for which a minimum of 127 participants were required in the following demographic groups: males aged 50 and over, females aged 50 and over, males aged 18-49, and females aged 18-49. Australians aged over 18 were recruited for two online surveys using email, social media, posters, and leaflets[7]. Special efforts were made to increase participation amongst males and people of lower socioeconomic status (SES), who tend to participate in research at lower rates than females or more socioeconomically advantaged individuals (Radler & Ryff, 2010). To this end a leaflet drop was carried out in three suburbs where SES ranked in the most disadvantaged decile nationally, and men's health organisations assisted in social media and email promotion. Incentives were offered: at Time 1 (T1), a computer tablet, and at Time 2 (T2) a $100AUD shopping voucher. Both surveys were hosted on the online survey platform SurveyGizmo, and took participants an average of 20 minutes (T1) and 10 minutes (T2) to complete. Participants completed the two surveys 122 days apart, on average (*SD* 22.02, min = 82, max = 188). The final sample contained N = 920 participants (M_{age} = 46.40, 54.6% female) at T1 and N = 510 (59.6% female, M_{age} = 46.42) at T2.

[7] Further methodological details about this study can be found in Chapter 2, section 2.3, page 40.

5.6.2. Measures

5.6.2.1. Demographic predictors of health behaviour.

Participants reported their age, gender (coded as female = 1, male = 2), and whether they spoke a language other than English at home (henceforth, referred to as Language) which was used to indicate migrant background (other language spoken at home = 1, only English spoken at home = 2). Highest educational attainment was reported, and coded from 1 (primary or secondary school) to 5 (postgraduate qualification). Employment status was also requested, with those responding that they were unemployed coded as 1 and those reporting any other status (including employed, retired, carer, student, or receiving a pension) coded as 2. Post codes were collected in order to assign an SES decile by reference to Australian Bureau of Statistics (2013d) data; the first decile being the least advantaged group.

Age and gender are classed as determinants of health, while migrant status, SES, education, and employment have been classified as social determinants of health, and all are linked to health behaviour (Australian Institute of Health and Welfare, 2014a). The behaviours considered herein are each predicted by some or all of these demographic variables (Australian Institute of Health and Welfare, 2013, 2014a, 2014b, 2015a, 2015b, 2016b; McGuiness et al., 2016; McNaughton et al., 2008) in Australian samples.

5.6.2.2. Health importance and GP visits.

A five-point Likert scale was used to assess the importance of health to participants: ‘At the present time, how important is your health in your life?’ with response options from *not at all important* to *extremely important*. Participants were also asked how many times they had attended a GP in the past year (a five-item Likert scale from *not at all* to *four or more times*), and this variable was included in regression models for those cancer screening tests — given that frequent attendance provides increased chance of opportunistic screening or referral to screening services.

5.6.2.3. Trait thinking style.

A brief measure of trait thinking style, the REIm-13 (McGuiness, Zajac, Wilson, & Turnbull, in press) measured trait rationality (4 items) and trait experientiality (9 items, with subscales of imagination, intuition, and emotionality comprising 3 of these items each). Items are shown in Table 38. Participants responded to each item using a five-point Likert scale with responses ranging from *Strongly disagree* to *Strongly agree*. Internal consistency for subscales ranged from $\alpha = .52$ to $\alpha = .68$.

5.6.2.4. Health thinking style.

To produce the REI-Health scale, each item in the REIm-13 was rewritten by the first author to pertain to the health context (corresponding items are shown in Table 38). The other three authors independently reviewed and assessed the new items, following which all authors met to assemble the final measure. The REI-Health was expected to demonstrate either the two-factor (i.e. health rationality and health experientiality) or four-factor (whereby the second-order factor health experientiality is predicted by health imagination, health intuition, and health emotionality) structures reported by Norris and Epstein (2011). Internal consistency for these scales and subscales is shown in Table 39. Response options were the same as the REIm-13.

Table 38

Conversion of items in initial pool for REI-Health

REIm-13 subscale	REIm-13 items	REI-Health items *(italicised items excluded from final scale)*
Rationality	I am not very good at solving problems that require careful logical analysis[1]	I think about strategies for improving my health
	Reasoning things out carefully is not one of my strong points[1]	I'm not the best at reasoning complex health issues out carefully[1]
	I enjoy intellectual challenges	I'm not one to spend time pondering my health[1]
	I enjoy problems that require hard thinking	When a decision may affect my health, I think hard about it
Experientiality (imagination)	I enjoy reading things that evoke visual images	*Photographs of illness and disease don't have any impact on me*[1, 2]
	I can clearly picture or remember some sculpture or natural object (not alive) that I think is very beautiful	*I prefer health professionals to explain things to me in a way that helps me visualise them*[2]
	I enjoy imagining things	*My imagination helps me to understand my health choices and their consequences*[2]
Experientiality (intuition)	I don't think it is a good idea to rely on one's intuition for important decisions[1]	When making an important health decision, I don't believe you should rely on gut reactions[1]

REIm-13 subscale	REIm-13 items	REI-Health items *(italicised items excluded from final scale)*
	I often go by my instincts when deciding on a course of action	My instincts know what's best for me
	I trust my initial feelings about people	I trust my initial feelings about health matters
Experientiality (emotionality)	Emotions don't really mean much: they come and go[1]	*My emotions don't provide any useful guidance in health matters*[1, 2]
	When I have a strong emotional experience, the effect stays with me for a long time	*When the health issues of someone I know (or a health story on television) affects me emotionally, I remember for a long time*[2]
	When I'm sad, it's often a very strong feeling	*I find my emotions seem to overpower my good intentions about acting healthily*[2]

1. Item requires reverse-coding.

2. Scale removed following Principal Components Analysis (see Table 40).

Table 39

Internal consistency of REI-Health subscales at T1 and T2

Scale/subscale	no. items	T1[1] α	T2[2] α
Health rationality	4	.62	.57
Health imagination[3]	*3*	*.33*	*.38*
Health intuition	3	.62	.64

Scale/subscale	no. items	T1[1] α	T2[2] α
Health emotionality[3]	*3*	*.23*	*.37*
Health experientiality[4]	*9*	*.55*	*.58*

1. N = 904-905.

2. N = 505-508.

3. Scale removed following Principal Components Analysis (see Table 40).

4. Full experientiality scale statistics redundant due to only intuition subscale being retained.

5.6.2.5. Health-related lifestyle choices.

5.6.2.5.1. Physical activity.

The International Physical Activity Questionnaire (Craig et al., 2003) quantified physical activity in the last seven days, with adjustments for activity level. It included items such as ‘During the last 7 days, on how many days did you do vigorous physical activities?’ and ‘How much time did you usually spend doing vigorous physical activities on one of those days?’ The number of minutes per week spent doing vigorous activity, moderate activity, and walking was multiplied by a Metabolic Equivalent of Task (MET) level score of 9, 4, and 3.3, respectively. The resulting MET-minutes values for each activity level were summed to produce the physical activity variable. Scores ranged from 0 to 23226 MET-minutes per week.

5.6.2.5.2. Diet quality.

The Dietary Guideline Index (McNaughton et al., 2008), which is usually calculated based on food frequency reports and a dietary habits questionnaire, was modified to capture self-reported compliance with the Australian Dietary Guidelines. The 17 items included specific reports about the previous day (e.g., ‘How many serves of fruit did you eat yesterday?') and items about habits (e.g. 'How often would you eat high fat foods and snacks?'). Responses were scored from 0 to 10 (with a score of 10 representing the best adherence to the guidelines) and the scores summed to create the diet quality variable. Higher overall diet quality scores indicated higher dietary quality – in other words, eating patterns that were closer to those recommended for the person's gender and age group, including: consuming a variety of foods from different food groups; choosing wholemeal, wholegrain, lean or low-fat foods more frequently; and consuming fewer sugary and high fat items. Scores ranged from 49.12 to 157.50.

5.6.2.5.3. Smoking.

A simplified version of the Smoking Questionnaire (Weitkunat et al., 2013) measured cumulative smoking exposure. If participants had never smoked, or never smoked regularly (defined as at least one cigarette per day) they were given a value of zero. For those who had been smokers, the number of years they regularly smoked was multiplied by the number of 20-packs of manufactured cigarettes usually smoked per day during those periods (or the equivalent in tobacco or hand-rolled cigarettes). Scores on the resulting 'pack-years' variable ranged from 0 to 87.50.

5.6.2.5.4. Screening behaviours.

Participants reported their participation in colorectal cancer screening by faecal occult blood test (FOBT), breast cancer screening by mammogram, cervical cancer screening by Pap smear, and prostate cancer screening by prostate-specific antigen (PSA) test or digital rectal examination (DRE). Gender and date of birth, recorded at the outset of the survey, were used to show or hide screening items as appropriate (for instance, mammogram screening questions were only shown to females aged over 50). Using FOBT as an example, participants were asked, ‘Have you ever completed a home stool test?’ and selected an answer from *Unsure*, *No* (scored as 1), *Yes, more than 2 years ago* (scored as 2), and *Yes, in the past 2 years* (scored as 3). Participants were excluded from analyses for a particular type of screening if they responded that they were unsure, or if they indicated in a follow-up question that the most recent use of the test was not for *screening* purposes (i.e. detection of disease indicators in asymptomatic individuals) but for some other reason (e.g. an FOBT given to investigate a symptom).

5.7. Results

5.7.1. Structure of the REI-Health

The structure of the REI-Health was assessed using a principal components analysis with Varimax rotation and Kaiser normalisation on the data from T1 and T2. At neither time was the theorised four-factor structure present (i.e., factors loading on health rationality, health imagination, health intuition, and health emotionality). The third health emotionality item (‘I find my emotions seem to overpower my good intentions about acting healthily’) was removed because in a one-factor solution its loading (-.117) was unsuitably low and not statistically significant — and in combination with a communality of .014 this suggested this item had little in common with the others. A four-factor solution run after this item was removed revealed that the three health imagination items and the remaining two health emotionality items (listed in Table 38) did not load coherently onto the theorised health imagination and health emotionality factors. Specifically, instead of loading together on a single factor per subscale, the health imagination items loaded (.583–.802) onto two different factors, and the health emotionality items loaded on three factors (.314–.525, with both items loading on two factors each). Given this, and the poorer internal consistency these subscales displayed (Table 39), the health imagination and health emotionality items were removed.

After removal of these five non-conforming items, the principal components analysis revealed two factors with eigenvalues greater than one, onto which loaded the items designed to reflect health rationality and health intuition. This structure was confirmed at Time 1 and Time 2. This two-factor structure reflects the rationality (or need for cognition) and experientiality (or faith in intuition) scales of earlier versions of the REI, which did not encompass imagination or emotionality (Epstein et al., 1996; Pacini & Epstein, 1999). However, in recognition that experientiality is a broader construct than intuition alone, we named the factors health rationality and health intuition so that the specific focus of health intuition was made explicit. The final 7-item REI-Health, containing separate scales of health rationality and health intuition, is shown in Table 40. Consistent with the theoretical basis of the scale (Epstein, 2003), health rationality and health intuition were uncorrelated ($\rho = .00$, $p = .896$; Spearman's rho used due to non-normal data).

Table 40

Structure of REI-Health

	HR	HI
I think about strategies for improving my health	**.72** *.75*	
I'm not the best at reasoning complex health issues out carefully[1]	**.65** *.56*	
I'm not one to spend time pondering my health[1]	**.69** *.65*	
When a decision may affect my health, I think hard about it	**.70** *.70*	
When making an important health decision, I don't believe you should rely on gut reactions[1]		**.68** *.61*
My instincts know what's best for me		**.79** *.85*
I trust my initial feelings about health matters		**.79** *.82*

Note. T1 loadings in **bold**. T2 loadings in *italic*. HR = health rationality; HI = health intuition.

1. Item has been reverse-scored.

5.7.2. Reliability of REI-Health

Descriptive statistics and test-retest reliability for the REI-Health are shown in Table 41. Weighted-sum factor scores were calculated using the principal components analysis loadings reported in Table 40. Their correlations with summed composite variables (also shown) were extremely high, suggesting that summed composites would be valid for determining these constructs when using the REI-Health.

Table 41

Descriptive statistics and reliability estimates for REI-Health

	HR	HI
Average M(*SD*)	T1: 3.81 (.57) [1] T2: 3.78 (.55)	T1: 2.90 (.67) [1] T2: 2.86 (.66)
T1-T2 correlation[2]	ρ = .66***	ρ = .55***
Factor-composite correlation	T1: ρ = .99***[1] T2: ρ = .99***	T1: ρ = .99***[1] T2: ρ = .99***

Note. N = 505. HR = health rationality; HI = health intuition.

1. N = 904.

2. Spearman's rho calculated as Shapiro-Wilk tests indicated the data were not normally distributed.

5.7.3. Predictors of REI-Health

Multiple regression was performed to assess the extent to which health rationality and health intuition were predicted by *trait* rationality and *trait* intuition respectively, in combination with a measure of health importance and other demographic variables. For comparison, demographic predictors were also modelled for trait rationality and trait intuition. In the final model shown in Table 42, variance in health rationality was predicted by health importance (13.0%) and trait rationality (6.3%), while variance in health intuition was predicted 26% by trait intuition and 0.5% by health importance. Being female predicted higher health rationality (1.4% variance explained), health intuition (3.2%) and trait intuition

(1.2%) while being male predicted higher trait rationality (1.4%). Higher educational attainment predicted higher health rationality (explaining 2.9% variance) and trait rationality (3.2%) while lower attainment predicted higher trait intuition (0.8%).

Table 42

Predicting health thinking style and trait thinking style

	HR	HI	TR	TI[1]
	N=898	N=898	N=913	N=913
Step 1: demographics				
Model	R^2 = .06	R^2 = .03	R^2 = .06	R^2 = .03
(constant)	2.90 (*SE* = 0.26)	3.48 (*SE* =0.31)	2.91 (*SE* = 0.28)	4.47 (*SE* = 0.32)
Age	.06	.03	-.09**	.00
SES	.01	-.04	.04	-.06
Gender	-.12***	-.18***	.12**	-.11**
Language	.00	.00	-.10**	-.04
Education	.17***	-.07[2]	.18***	-.09**
Employment	.08*	.00	.01	-.06
Step 2: demographics and trait thinking style				
Model	R^2 = .13 ΔR^2 = .08***	R^2 = .29 ΔR^2 = .26***	-	-
(constant)	1.20 (*SE* =0.26)	1.09 (*SE* =0.30)		
Age	.08*	.03		
SES	.00	-.01		

	HR	HI	TR	TI[1]
Gender	-.15***	-.12***		
Language	.01	.02		
Education	.12***	-.02		
Employment	.08*	.03		
TR	.28***	-		
TI	-	.52***		
Step 3: demographics, trait thinking style and health importance				
Model	R^2 = .26 ΔR^2 = .12***	R^2 = .30 ΔR^2 = .01*	-	-
(constant)	1.25 (*SE* =0.25)	1.09 (*SE* =0.30)		
Age	.02	.02		
SES	.00	-.01		
Gender	-.12***	-.11***		
Language	-.01	.02		
Education	.10**	-.02		
Employment	.06	.02		
TR	.25***	-		
TI	-	.51***		
Health importance	.36***	.07*		

Note. Hyphen indicates variable or model not included. HR = health rationality; HI = health intuition; TR = trait rationality; TI = trait intuition.

1. To enable comparison, only the three-item Intuition subscale of the REIm-13 is used.

2. $p = .058$

*** $p < .001$, ** $p < .01$, * $p < .05$.

5.7.4. REI-Health as predictor of health behaviour

In a series of multiple regressions, we investigated the extent to which health thinking style predicted eight health behaviours over and above trait thinking style, health importance, and demographic predictors of the behaviour (including GP frequency for Pap smear, DRE, and PSA test participation).

5.7.4.1. Health-related lifestyle choices.

In the final multivariate models, health rationality predicted 2.9% variance in diet quality (Table 43). Neither trait thinking style nor health thinking style predicted variance in smoking or physical activity.

Table 43

Predicting health-related lifestyle choices from health thinking style, trait thinking style, health importance, and demographics

	Diet quality	Smoking	Physical activity
	N=837	N=874	N=864
Step 1: demographics			
Model	$R^2 = .06$	$R^2 = .13$	$R^2 = .02$
(constant)	92.70 (*SE* = 8.10)	12.73 (*SE* = 5.78)	2571.82 (*SE* = 1767.94)
Age	.16***	.28***	.06
SES	.05	-.09***	.00

	Diet quality	Smoking	Physical activity
Gender	-.16***	.04	.10**
Language	-.09**	.00	.02
Education	.05	-.12**	-.02
Employment	.06	-.07	.01
Step 2: trait thinking style and health importance			
Model	R^2 = .10 ΔR^2 = .04***	R^2 = .14 ΔR^2 = .01*	R^2 = .04 ΔR^2 = .02**
(constant)	68.74 (*SE* = 9.42)	13.15 (*SE* = 6.82)	-1534.10 (*SE* = 2095.30)
Age	.15***	.29***	.04
SES	.04	-.08**	.00
Gender	-.15***	.04	.11**
Language	-.09**	.01	.02
Education	.02	-.10**	-.03
Employment	.05	-.06	.00
TR	.11**	-.02	.06
TI	.01	.06	.04
Health importance	.16***	-.08*	.11**
Step 3: Demographics, trait thinking style, health importance, and health thinking style			
Model	R^2 = .12 ΔR^2 = .02***	R^2 = .14 ΔR^2 = .00	R^2 = .04 ΔR^2 = .01
(constant)	62.50 (*SE* = 9.49)	12.44 (*SE* = 6.95)	-2404.05 (*SE* = 2130.96)

	Diet quality	Smoking	Physical activity
Age	.14***	.29***	.04
SES	.04	-.09**	.00
Gender	-.13***	.05	.12**
Language	-.09**	.01	.02
Education	.00	-.10**	-.04
Employment	.04	-.06	.00
TR	.07*	-.03	.04
TI	-.01	.05	.01
Health importance	.10**	-.08*	.09*
HR	.17***	-.01	.06
HI	.02	.03	.06

Note. HR = health rationality; HI = health intuition; TR = trait rationality; TI = trait intuition.

*** $p < .001$, ** $p < .01$, * $p < .05$.

5.7.4.2. Screening behaviours.

After controlling for other variables, variance in FOBT participation was predicted by both health rationality (3.8%) and health intuition (4.2%), while health rationality predicted 2.0% of variance in Pap smear participation (Table 44). In the final models for mammogram, PSA test, and DRE, neither trait thinking style nor health thinking style variables predicted participation. Trait intuition initially predicted 4.8% of variance in DRE but did not explain statistically significant amounts of variance after the addition of health intuition.

Table 44

Predicting screening behaviour from health thinking style, trait thinking style, health importance, and demographics

	FOBT	Pap smear	Mammo-gram	PSA test	DRE
	N=363	N=439	N=134	N=183	N=183
Step 1: Demographics					
Model	R^2=.03	R^2=.09	R^2=.15	R^2=.11	R^2=.05
(constant)	1.78 (*SE* = 0.76)	1.64 (*SE* = 0.45)	1.88 (*SE* = 0.99)	2.44 (*SE* = 0.85)	1.00 (*SE* = .92)
Age	.05	.18***	.09	.13	.16*
SES	.04	-.06	.05	.03	.12
Gender	.13*	-	-	-	-
Language	-.04	-.12*	-.05	.03	-.03
Education	.04	.16**	.12	.04	.02
Employment	.01	.03	-.03	-.04	03
GP frequency	.07	.14**	.37***	.29***	.12
Step 2: trait thinking style and health importance					
Model	R^2=.04 ΔR^2=.01	R^2=.11 ΔR^2=.03**	R^2=.18 ΔR^2=.02	R^2=.16 ΔR^2=.05*	R^2=.12 ΔR^2=.07**
(constant)	1.43 (*SE* = 0.87)	0.84 (*SE* = 0.53)	0.71 (*SE* = 1.22)	1.70 (*SE* = 0.96)	-0.45 (*SE* = 1.03)
Age	.05	.17***	.10	.12	.15
SES	.02	-.07	.04	.00	.13

	FOBT	Pap smear	Mammo-gram	PSA test	DRE
Gender	.12*	-	-	-	-
Language	-.05	-.12**	-.06	.02	-.02
Education	.03	.14**	.11	.02	.04
Employment	.01	.02	-.02	-.07	.03
GP frequency	.07	.14**	.39***	.32	.11
TR	.05	.07	.02	.11	-.03
TI	-.03	.00	.02	-.08	.22**
Health importance	.08	.14**	.15	.18*	.16*
Step 3: Demographics, trait thinking style, health importance, and health thinking style					
Model	R^2=.09 ΔR^2=.06***	R^2=.13 ΔR^2=.01*	R^2=.18 ΔR^2=.02	R^2=.17 ΔR^2=.02	R^2=.13 ΔR^2=.01
(constant)	0.51 (*SE* = 0.87)	0.81 (*SE* = 0.54)	0.55 (*SE* = 1.25)	1.67 (*SE* = 0.99)	-.94 (*SE* = 1.07)
Age	.06	.17***	.10	.13	.17*
SES	.02	-.07	.03	.01	.14
Gender	.16**	-	-	-	-
Language	-.06	-.11*	-.06	.03	-.02
Education	.01	.12*	.13	.01	.04
Employment	-.01	.00	-.02	-.07	.02
GP frequency	.05	.12**	.39***	.33***	.12
TR	.00	.03	-.02	.14	-.05
TI	-.14*	-.01	-.02	-.16	.15

	FOBT	Pap smear	Mammo-gram	PSA test	DRE
Health importance	.01	.10	.15	.19*	.13
HR	.20**	.14**	-.01	-.07	.09
HI	.20**	-.01	.08	.14	.13

Note. Gender not included in models for gender-specific cancer screening. HR = health rationality; HI = health intuition; TR = trait rationality; TI = trait intuition.

*** $p < .001$, ** $p < .01$, * $p < .05$.

5.8. Discussion

We developed and assessed a brief measure of preference for using rational or intuitive processes when it comes to health matters. The final measure had acceptable internal consistency for a short measure (Cortina, 1993), and composite scoring (i.e. summing the items in each scale) were shown to be valid for future research use. Test-retest reliability was within acceptable limits.

The degree to which the two new health thinking style variables were predicted by trait thinking style variables was not uniform, echoing recent work on variation between domains (Pachur & Spaar, 2015). Health intuition was more closely linked to trait intuition (sharing 27% of variance) than health rationality was to trait rationality (7.8% variance shared). When health importance was added to the respective models, it improved prediction of health rationality (explaining 13% of variance) far more than it did prediction of health intuition (explaining 0.5% variance). The finding that health rationality was better predicted by health importance than by trait rationality seems to support the Elaboration Likelihood Model's assertion that issues of personal relevance are processed in a more effortful manner (Petty & Briñol, 2012).

Some demographic variables had slightly different relationships to health thinking style than they did to trait thinking style. The small negative relationship of trait rationality and trait intuition to age that has been found previously (Sladek et al., 2010) was present for trait rationality (though not trait intuition) in our sample, but was not evident for either health thinking style variable. Established (Epstein, 2003; Norris & Epstein, 2011; Sladek et al., 2010) small gender effects on trait thinking style were replicated, with male gender predicting higher trait rationality (1.4% variance explained) and female gender predicting higher trait intuition (1.2% variance explained). However, health thinking style showed a different pattern: female gender predicted higher health rationality *and* health intuition (explaining 1.4

and 3.2% of variance, respectively). While small, these effects could be interpreted as reflecting lower confidence amongst males in their ability to process (whether rationally or intuitively) health-related matters. However, the relationship of educational attainment to trait thinking style, which repeated previous results (McGuiness et al., 2016), was echoed by health thinking style. Higher health rationality was related to higher educational attainment (2.9% shared variance), and higher health intuition was related to lower educational attainment (0.5% shared variance, approaching significance).

Incremental validity for health thinking style was established with the prediction of some health behaviours (after controlling for trait thinking style, health importance, and demographic predictors) — in particular, for the health rationality scale. Health rationality predicted small amounts of unique variance in diet quality, FOBT participation and Pap smear participation. The effects seen are comparable in magnitude to the correlations found between Big Five personality variables and diet quality (Lunn, Nowson, Worsley, & Torres, 2014). Furthermore, where health rationality and health intuition predicted variance in behaviour, they did so to a similar or larger extent than known demographic predictors. The drivers of the positive relationship between rational processing and health behaviour should be further investigated; for instance, by exploring whether existing health messages about these behaviours are more suited to rational than intuitive processers. Additionally, other findings (Conner et al., 2007) suggest that these individual differences may have a moderating effect on the behavioural influence of attitudes, such that the link between explicit attitudes and behaviour is moderated by health rationality (and similarly for implicit attitudes and intuition).

Health intuition predicted FOBT participation better than trait intuition. Interestingly, FOBT participation was positively related to health intuition but negatively related to trait intuition. These results serve as a reminder that although people do seem able to report how they think about health-related matters, a trait processing preference may be more relevant to behavioural decisions that are not processed as a health decision (for instance, starting smoking because it looks stylish, or throwing a just-received FOBT kit in the bin on impulse because one's life is busy). Furthermore, although it may be expected that as the one highly addictive behaviour we measured, smoking would be *more* strongly predicted by health intuition than were the other behaviours (see Borland, 2014), the REI-Health is very much oriented towards volitional reliance on intuitive processes in health thinking — rather than, for instance, being driven by a craving.

The finding in previous work (McGuiness et al., 2016) that DRE was predicted by rationality but not by experientiality was not replicated herein; instead, it was trait intuition that predicted some variance in DRE participation. A few years before data collection for the study mentioned (2012) and the present data collection (2015), findings cast doubt on the efficacy of digital rectal examinations as a population-level prostate cancer screening tool for asymptomatic men (Andriole et al., 2009), and screening guidelines had begun changing from being agnostic about prostate cancer screening for asymptomatic men (e.g. U.S. Preventive Services Task Force, 2008) to recommending against screening (Screening Subcommittee of the Australian Population Health Development Principal Committee & Cancer Council Australia, 2010). It is difficult to speculate as to the nature of the impact upon responses to the surveys, but it is possible that the dissemination of the new guidelines to the general public and the change in the prediction of reported digital rectal examination participation by thinking style are in some way associated. It is useful to consider that neither type of processing is inherently more associated with acting healthily than the other — nor do these processes alone guide behaviour; rather, the content accessed by the rational or intuitive processes plays an important role, too. Again, the possible interaction between processing types and different forms of attitudes is an intriguing area for further research.

5.8.1. Implications

Rational processing of health matters was positively related to participation in three of the eight health behaviours we tested, while a positive relationship with intuitive processes was found for one behaviour. One conclusion is that a potential avenue for improving uptake of healthy behaviours is to include more intuitively-processed elements in health information to increase impact for individuals who process health decisions intuitively. Secondly, a recent meta-analysis found that the match between processing type and decision type was related to normatively correct responses, leading the authors to suggest that the effectiveness of mass communication messages could be improved by encouraging the use of the appropriate kind of processing (Phillips et al., 2016). Our results support the application of this recommendation to health messaging. For instance, if abstract probabilities are the basis of the most persuasive argument for performing a health behaviour, rational processing should be encouraged – but at the same time, intuitively processed content could also be incorporated so as to communicate to those who will not process the message rationally.

5.8.2. Strengths and limitations

Recruitment targeted adults in the community, and aimed to boost participation by males and people from areas of lower socioeconomic status, leading to a more representative sample than could be achieved by drawing on convenient populations such as university students. However, the means of recruitment (online and offline promotion to the public) was not based on a defined sampling frame and therefore no data are available regarding individuals who saw, but did not respond to, promotional messages. The short scale we describe captures health thinking style for research purposes and should not be used in clinical settings. Furthermore it should be viewed as an exploration of Cognitive-Experiential

Self Theory (Epstein, 2003), rather than as asserting a new theory of health behaviour (Sniehotta, Presseau, & Araujo-Soares, 2015).

5.8.3. Conclusion

This study enhances our understanding of thinking style by demonstrating that individuals report their thinking style for health matters to be different to their trait thinking style. This difference is not solely explained by the importance individuals ascribe to health, and health thinking style provides improved prediction of several health behaviours. Health thinking style varied across demographic groups to a small degree, and in a slightly different pattern to trait thinking style.

CHAPTER 6. HEALTH THINKING STYLE AS A MODERATOR OF THE RELATIONSHIP BETWEEN IMPLICIT AND EXPLICIT ATTITUDES AND HEALTH BEHAVIOUR: A DUAL PROCESS APPROACH.

6.1. Preamble

The groundwork for this chapter was laid in the previous three chapters. In Chapter 3 a small effect of thinking style on self-reported participation in preventive health behaviour was detected (specifically, participation in digital rectal examinations), while in Chapter 4 a short form of a thinking style inventory promised better measurement than the version used in Chapter 3. Chapter 5 described the development of a health-specific measure of thinking style, the REI-Health, based on the short form presented in Chapter 4. The REI-Health showed incremental validity over 'trait' thinking style in the prediction of three health behaviours (diet quality, faecal occult blood test participation and Pap smear participation) and support was thereby provided for the hypothesis that people use different combinations of type 1 and type 2 processing in for health-related thinking. However, there was a lack of clarity regarding *why* health or trait thinking style should predict health behaviour, and attitudes were postulated to potentially explain the relationship. In this chapter, the role of attitudes in relation to health thinking style and health behaviour is explored.

The influence of explicit attitudes on health behaviour has been a mainstay of health psychology research and practice for decades (e.g. Becker & Becker, 1975). However, since Wilson et al. (2000) applied a dual-process approach to attitudes, suggesting that explicit attitudes (stemming from type 2 processes) and implicit attitudes (based on type 1 processes) may simultaneously be stored for any given object, there has been growing interest in the degree to which implicit attitudes affect health behaviour. Measures of implicit attitudes have an important role in predicting behaviour over and above being a means to circumvent social desirability biases in participant reports of potentially contentious explicit attitudes (e.g., to issues like race or sexuality). Implicit attitudes have been found to predict behaviour in areas without obvious political or social bias including participation in a number of health behaviours (Conner et al., 2011; Conroy et al., 2010; Prestwich et al., 2011).

As discussed in the introduction, thinking style describes a person's strength of preference for using type 1 processes and type 2 processes (Epstein et al., 1996; of course in the case of health thinking style, these preferences refer to health-related thinking specifically, McGuiness, Zajac, Turnbull, & Wilson, 2017). It can therefore be said that each thinking style variable indicates the likelihood that the corresponding type of processing will be used for a given task: for instance, a person reporting high experientiality is more likely to use type 1 processes (Novak & Hoffman, 2009). Thus, when predicting behaviour there will be differences between people in the extent to which they have utilised type 1 and type 2 processing and the relative dependence they will place on each type of processing for that decision.

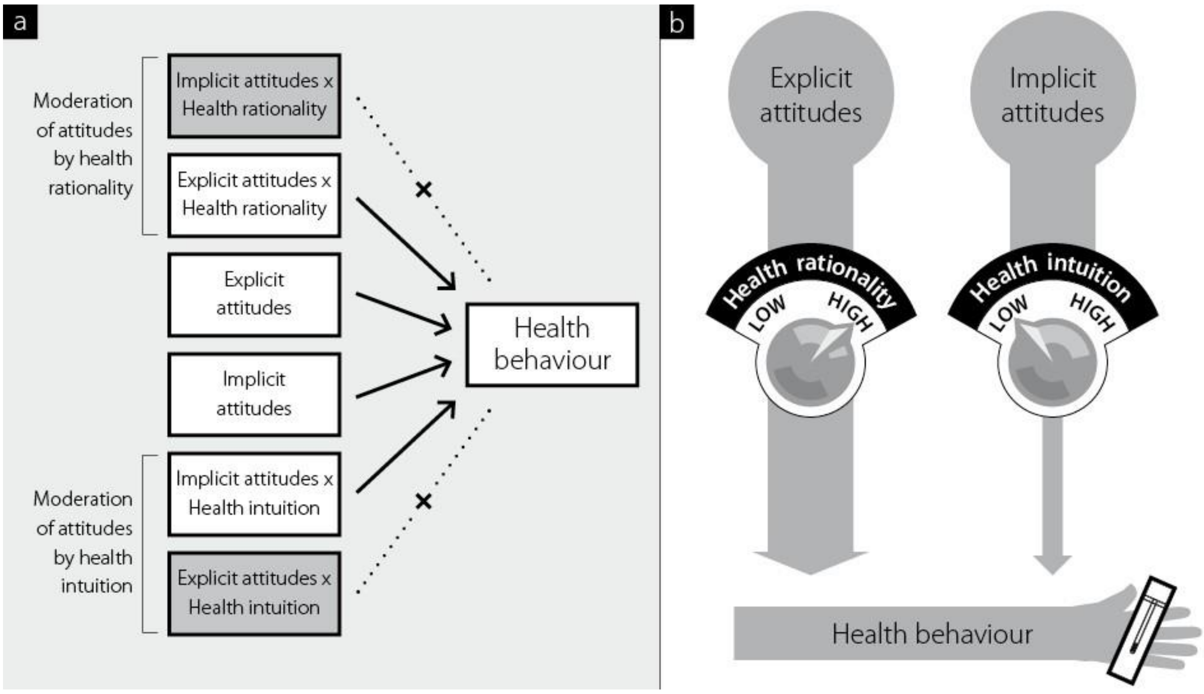
Section 1.2.1.4 (page 6) introduced the dual-process views of attitudes, in which it is suggested that implicit attitudes are instantiated in type 1 processing and explicit attitudes are formed by type 2 processes (Gawronski & Bodenhausen, 2006). Thinking style variables can therefore indicate the likelihood that the corresponding type of attitude will be used to inform decisions or guide behaviour: in other words, a person reporting high preference for type 1 processing (i.e. high experientiality or health intuition) is more likely to rely on implicit attitudes (Kendrick & Olson, 2012). When considering the effect on behaviour, the thinking style variables theoretically have a moderating effect: at high levels of health intuition, implicit attitudes should have more of an effect on health behaviour (whereas at low levels of health intuition, type 1 processing and implicit attitudes are less likely to be relied upon).

The purpose of this chapter is to use the REI-Health to test for moderation of health attitudes by health thinking style in the prediction of health behaviour. Previous research provides the basis for hypothesising that thinking style moderates the effect of implicit/explicit attitudes on behaviour. An early attempt to detect this moderating effect, and which informed the development of this chapter, was carried out by Conner et al. (2007). The authors measured implicit and explicit attitudes, thinking style, and dietary behaviour, and tested for moderation using multiple regression. Implicit preference for sweets compared to fruit was captured using an Implicit Association Test (Greenwald et al., 1998) and for explicit attitudes, participants provided Likert scale ratings indicating their preference for sweets compared to fruit. Behaviour was measured by asking participants to record, for seven days, their consumption of fruit and sweets. The REI (Epstein et al., 1996) was also administered, with the intent of testing for attitude moderation by rationality and experientiality. As hypothesised, rationality was found to moderate the relationship between explicit attitudes and dietary behaviour — the dietary behaviour of more rational participants was more strongly predicted by their explicit attitudes (compared to less rational participants). However, a footnote indicated that no main or interaction effects were detected for the experientiality scale. In the regression models presented, experientiality was replaced by a rather different psychological variable indicating how habitual it was for the participant to consume chocolate (Verplanken & Orbell, 2003), and an interaction was detected: amongst participants for whom chocolate consumption was highly habitual, implicit, attitudes were a stronger predictor of behaviour. However, the conflation of these two moderators — by presenting habit strength and rationality as equivalent moderators of type 1 and 2 processes, respectively — is problematic, as they are different types of variables.

A considerable amount of health psychology research focuses on understanding and changing people’s attitudes as a means to influence their health behaviour (Sheeran et al., 2016). As indicated by previous research (Conner et al., 2007; Marks et al., 2008) understanding the individual differences that may complicate the relationship between attitudes and behaviour is therefore of considerable importance. Moreover, it is possible that a domain-specific measure of health thinking style, as developed in this dissertation and validated in the previous chapter, will enable a clearer understanding of whether thinking preferences affect the impact of attitudes.

Based on the theory and research described above, it was hypothesised that health rationality would moderate the effect of explicit attitudes on health behaviour, and health intuition would moderate the effect of implicit attitudes on behaviour. A graphic representing the expected pattern of interactions is shown in Figure 7. Additional interactions have been reported: specifically, in the prediction of cigarette smoking, affective associations (similar to implicit attitudes) were moderated by both thinking style variables (Marks et al., 2008). Therefore, rather than only testing for interactions that would confirm the traditionally expected pattern, in this chapter I will include interaction terms between the two forms of attitudes, between the two thinking style variables, and between each attitude type and the two thinking style variables.

Figure 7. An illustration of the hypothesised interactions: health rationality moderates the effect of explicit attitudes on health behaviour, and health intuition moderates the effect of implicit attitudes on health behaviour. Health rationality does not interact with implicit attitudes, and health intuition does not interact with explicit attitudes, nor do the two health thinking style variables or two forms of attitudes interact.



Study two, for which I hoped to attract approximately one thousand participants, required the measurement of implicit attitudes to a total of eight health behaviours in a large sample (with the number of behaviours for each participant ranging between three and six, depending on their age and sex). Prominent implicit attitude measures such as the Implicit Association Test (Greenwald et al., 1998) were considered too time-consuming to administer for multiple behaviours; something brief that could be incorporated into a survey format was sought through a review of the literature on measurement of implicit attitudes. As discussed in section 2.3.1.3.5 (page 55), a self-report implicit attitude measure was located that had been successful in measuring implicit attitudes to dishonesty, religion, and political orientation, and these implicit attitudes in turn predicted related behaviour (Vargas et al., 2004). The method required participants to read a short scenario and provide three simple ratings about the main character, a task that was reasonable to ask people to complete several times. Like the Implicit Association Test, participants' implicit attitudes are inferred from indirect evidence: in the case of the Implicit Association Test they are inferred from response times, and in the case of the Vargas measure they are inferred from the severity of participants' judgements of others. For instance, the implicit attitude about the benefits of a health behaviour is taken to be the inverse of the ratings participants make in response to the scenario; someone who implicitly believes that there are few benefits to physical activity will be less harsh in their judgement of a character who is ambivalent about activity, compared to a participant who is implicitly sees more benefits. The fact that this method of measuring implicit attitudes had not been used in relation to health before meant that adapting it would be a useful contribution to health psychology research.

The effect of thinking style on the degree to which attitudes impact behaviour has been minimally studied, with mixed results, but represents an important potential insight into when and how attitudes are able to influence health behaviour. The new approaches being brought to the topic in this chapter are the use of the newly produced REI-Health (which predicts health behaviour better than its more general predecessor), the use of a self-report method for measuring implicit attitudes that is being applied to health behaviour for the first time, and the measurement and modelling of eight important preventive health behaviours in the same study.

A note about terminology: Because the REI-Health scale is used in this chapter, and its scale measuring type 1 preference is called health intuition, discussions pertaining to trait thinking style will also use the label 'intuition' for the scale measuring preference for type 1 processing. This is done within this chapter to avoid confusion, but remains consistent with the lexicon of the Rational-Experiential Inventory scales given that the original type 1 preference scale was called faith in intuition.

6.2. Statement of authorship

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6.2.1. Principal author

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Overall percentage (%): 85%

Certification: This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.

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6.2.2. Co-author contributions

By signing the Statement of Authorship, each author certifies that:

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ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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Contribution to the paper: Advised on research design and planning. Oversight of statistics and modelling. Provided editorial and structural feedback on paper.

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6.3. Paper

Health thinking style as a moderator of the relationship between implicit and explicit attitudes and health behaviour: a dual process approach.

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Abstract

Background: It has been proposed that the effect of explicit attitudes on health behaviour may be moderated by preference for rational (or type 2) processing, and correspondingly, that the effect of implicit attitudes on health behaviour may be moderated by preference for intuitive (or type 1) processing. However, the small number of studies exploring this have reported mixed results.

Methods: Australian adults (N = 920, M_{age} = 46.40, 54.6% female) completed an online survey including a health thinking style scale, the REI-Health. Participants reported explicit and implicit attitudes and diet behaviour, physical activity, success in smoking cessation, and participation in faecal occult blood tests, cervical cancer screening, mammograms, prostate specific antigen testing, and digital rectal examinations. Hierarchical regressions were used to determine whether health thinking style (i.e., health rationality and health intuition) moderated, respectively, the influence of explicit attitudes and implicit attitudes on specific health behaviour.

Results: Most models failed to reveal interactions. The only model that indicated a significant interaction operated in the opposite direction to predicted; explicit attitudes were more strongly positively associated with diet quality amongst low-health rationality participants and implicit attitudes about healthy eating were more strongly positively associated with differences in diet quality amongst participants with lower health intuition.

Conclusions: Health thinking style did not moderate the effect of attitudes on behaviour in the manner expected. Replication may provide clarity on whether health thinking preferences affect the impact of health attitudes.

Keywords: health thinking style, health rationality, health intuition, attitudes, health behaviour

6.4. Introduction

Dual-process models of cognition propose that all processes of human reasoning can be classified into one of two broad types based on certain fundamental features. Rapid, associative processes that are triggered by stimuli are labelled *type 1* and processes that are cognitively effortful and involve abstract thought are labelled *type 2* (the latter being slower, but able to evaluate and override the faster type 1 processes; Evans & Stanovich, 2013). In earlier theories, type 1 processes were labelled experiential, intuitive, or impulsive while type 2 processes were labelled rational or reflective (e.g. Epstein, 2003; Strack & Deutsch, 2004). The dual-process view of cognition can also be extended to attitudes. In this context, *implicit attitudes* are evaluations that use type 1 processes whereas *explicit attitudes* are evaluations that use type 2 processes (Gawronski & Bodenhausen, 2006).

Health psychology research has traditionally focused on explicit attitudes as predictors of health behaviour (for example the perceived benefits and barriers described in the Health Belief Model, Janz & Becker, 1984). Interest in implicit attitudes originally centred on the fact they were theoretically unaffected by the social desirability concerns to which explicit attitudes measures were subject (Vargas et al., 2007). However, in recent decades, they have received attention as important predictors of health behaviour in their own right (for instance in predicting exercise behaviour; Forrest et al., 2016; or food purchasing behaviour; Prestwich et al., 2011). A person can hold both explicit attitudes and implicit attitudes about the same thing (e.g. about having a mammogram) that may not necessarily be consistent with one another, and both forms of attitude have the capacity to influence behaviour (Wilson et al., 2000).

Theory suggests that for an explicit attitude to affect behaviour, type 2 processing must be deployed at the relevant time; and correspondingly, for an implicit attitude to affect behaviour, type 1 processes must be relied upon to some degree rather than being overridden

(Strack & Deutsch, 2004). For example, if a person holds a negative implicit attitude towards faecal occult blood tests, but ignores their ‘gut reaction’ when deciding whether to participate, the implicit attitude may be prevented from affecting their behaviour. Therefore, the engagement of type 1 and type 2 processes moderates the ability of implicit and explicit attitudes to affect behaviour. When data are not available regarding the type of processing that led to an instance of behaviour (such as when the behaviour of interest occurred in the past), *thinking style* can serve as a proxy. Thinking style comprises two individual difference variables that vary independently (Epstein et al., 1996). *Intuition* is the preference for using type 1 processes and *rationality* is the preference for using type 2 processes, and as would be expected they predict the use of these processes on specific tasks (Kendrick & Olson, 2012; Novak & Hoffman, 2009). As such, they can be viewed as indicators of the likelihood that type 1 or type 2 processes will be used at a given time. Therefore, thinking style can be hypothesised to moderate the effect of attitudes on behaviour. Specifically, rationality moderates the effect of explicit attitudes on behaviour, and intuition moderates the effect of implicit attitudes on behaviour. To re-state the above example, if a person holds a negative implicit attitude towards faecal occult blood tests, but tends not to rely on their gut reactions, the implicit attitude is less likely to affect their behaviour.

A small number of studies have previously investigated this topic, with mixed results. Conner et al. (2007, Study 2) tested for moderation of attitudes by thinking style in predicting participants’ consumption of sweets versus fruit when offered both as snacks in the laboratory, and as recorded in a self-report diary. In predicting self-reported consumption, the effect of explicit attitudes was moderated by rationality, but implicit attitudes were not moderated by intuition. When predicting the laboratory snack choice, no moderation effects were found. Richetin et al. (2007) expected a to find the described pattern of effects for prediction of fizzy drink consumption, but such effects were not found.

Marks et al. (2008) used affective associations with smoking and explicit expectancies about smoking (which they note are very similar to implicit and explicit attitudes respectively), moderated by thinking style, to predict self-reported smoking behaviour. Interactions were observed for affective associations but not explicit expectancies. Interestingly, the capacity of affective smoking associations to predict current smoking was not moderated independently by either rationality or intuition but was moderated by both together in a three-way interaction. This interaction indicated that affective associations were better predictors of reported smoking for those high in intuition and low in rationality, high in both preferences, and low in both preferences — in other words, all participants except for those who reported they preferred to think using type 2 processing exclusively (i.e. low in intuition and high in rationality). Furthermore, the interaction between rationality and intuition was also significant. Additionally, direct interactions between implicit and explicit attitudes have been seen in the prediction of accelerometer-measured physical activity (Cheval, Sarrazin, Isoard-Gautheur, Radel, & Friese, 2016). These latter results give reason to ask whether a moderation between thinking style variables, implicit and explicit attitudes, or moderation of attitudes by the 'non-congruent' preference variable should be anticipated (e.g. intuition moderating the effect of explicit attitudes on behaviour).

Having established that explicit and implicit attitudes can each influence health behaviour, and that thinking style predicts the use of processing type (and hence attitudes), the focus of this chapter is the interaction between these variables in the prediction of health behaviour. Using hierarchical regression, we will test the hypothesis that rationality and intuition, respectively, moderate the impact of explicit and implicit attitudes on eight self-reported health behaviours. Additionally, we follow up on previous results by exploring whether thinking preference variables moderate the non-congruent attitude type (e.g. rationality moderating the effect of implicit attitudes), whether rationality moderates the effect of health intuition on behaviour, and whether both thinking style variables together moderate any implicit or explicit health attitudes' prediction of behaviour.

To our knowledge, no study has detected moderation of implicit attitudes by intuition and moderation of explicit attitudes by rationality for the same behaviour. Our research builds on earlier studies in several ways. First, we address eight self-reported health behaviours within the same sample, focusing on lifestyle behaviours and screening behaviours. Second, we capture implicit attitudes using a method that is new to this area of research. Other studies have used word association approaches (Peters & Slovic, 1996) or computerised tests that use response times to infer associations between an attitude object and positively- or negatively-valenced stimuli (such as implicit association tests; Greenwald et al., 1998). Vargas et al. (2004) had developed a method to measure implicit attitudes in a self-report format that could be included in a survey and applied to multiple behaviours, and this is adapted in the present research to relate to health behaviour. Finally, compared with other studies that have used more general measures of thinking preference (e.g. Betsch, 2008; Epstein et al., 1996; Maio & Esses, 2001) this study extends past research by utilising a health domain specific measure of thinking style with demonstrated incremental validity over general thinking style for predicting health behaviour (McGuiness, Zajac, et al., 2017).

6.5. Method

6.5.1. Participants and procedure

The research project was approved by the Ethics Committee of the School of Psychology at the University of Adelaide, and the chance to win a computer tablet was offered as an incentive to complete an online survey. To determine the necessary sample size, the work by Conner et al. (2007, Study 2) was used as a guide to the size of effect that could be expected, and that study had reported main effects of .13–.17 (.23–.25 with interaction terms). Based on recommendations by Warner (2013), statistical power of .80 and an alpha level of .05 could be attained by recruiting at least 127 participants per moderation analysis. It was therefore necessary to have at least N = 127 participants who were females aged 50 or more (for the mammogram analysis) and N = 127 participants who were males aged 50 or more (for the DRE and PSA test analyses). To create more representative samples for the other analyses which included younger adults or both genders, an equivalent number of males and females aged under 50 was also sought. The final sample contained N = 920 community-dwelling adult participants (M_{age} = 46.40, 54.6% female) who responded to survey promotional information they received via email, saw on social media, read on a poster in a public place, or read on a flyer dropped in their letterbox. Further methodological details are reported elsewhere (McGuiness, Zajac, et al., 2017).

6.5.2. Measures

6.5.2.1. Health thinking style.

As our focus is health attitudes and behaviour we used a domain-specific measure, health thinking style (McGuiness, Zajac, et al., 2017), which comprises two individual difference variables: health intuition, the preference for utilising type 1 processes in thinking about health; and health rationality, the preference for overriding those processes to use type 2 processes when thinking about health. Health thinking style was measured using the REI-Health, which is based on the Rational-Experiential Inventory (Norris & Epstein, 2011). The REI-Health comprises a 4-item scale measuring health rationality (e.g. ‘I think about strategies for improving my health’) and a 3-item scale measuring health intuition (e.g. ‘I trust my initial feelings about health matters’). Once averaged, possible scores ranged from 1 to 5 for each scale. For further details about the scale structure and reliability, refer to McGuiness, Zajac, et al. (2017), which presents work carried out on the same dataset used here.

6.5.2.2. Explicit attitudes to 8 health behaviours.

For each behaviour, participants rated their agreement with three statements about benefits and three statements about barriers on 5-point Likert scales. The items were based on existing measures of perceived benefits and barriers to healthy eating and physical activity (Tucker et al., 2011), smoking cessation (Macnee & Talsma, 1995), faecal occult blood tests (Rawl et al., 2001), Pap smears (Guvenc, Akyuz, & Acikel, 2011), mammograms (Champion, 1999), and PSA tests (Avery et al., 2012) and new items were created along the same lines for digital rectal examinations[8]. For each behaviour, a composite variable was created by summing the six responses (barrier scores inversed), with this score reflecting overall positivity of explicit attitudes towards that behaviour, with possible scores from 6 to 30.

[8] Details about the adaptation of these existing measures are provided in Chapter 2, section 2.3.1.3.4 (page 52) and Appendix F, page 311.

6.5.2.3. Implicit attitudes to 8 health behaviours.

To measure implicit attitudes in a self-report survey format, we adapted an implicit attitude measure originally used to measure implicit attitudes regarding dishonesty, religion and politics (Vargas et al., 2004). The materials were rewritten to pertain to the eight health behaviours of interest in this study[9]. A short scenario was written that depicted a person behaving in an ambivalent manner regarding each of the eight health behaviours. Scenarios addressed the same barriers and benefits targeted by the explicit measures, and were edited to be 80 words in length and to be readable by a person with a seventh grade education. All scenarios are provided in Table S1 of the online supplementary materials. Participants were asked to rate the character's response to barriers, response to benefits, and overall health consciousness by use of a response slider (which were unlabelled but recorded the response as a number from 0 to 100). The theory underlying partially-structured attitude measures is that a person who has favourable attitudes toward a behaviour will rate the ambivalent character more harshly than would a person who feels less positively about the behaviour. Because participants are not asked to report their own feelings, but to provide an assessment of another person without thinking too long, it is proposed that implicit attitudes are drawn upon in making the judgement (Vargas et al., 2004). Therefore, the ratings can be used to compare participants' implicit attitudes relative to one another. The benefits and health-consciousness ratings were inverted because a lower rating on these dimensions implies the participant perceives higher benefits and has a more health-conscious attitude toward the behaviour (whereas a low rating of the character's response to barriers implies perceiving less barriers). Finally, the three ratings were summed to produce a composite (from 0 to 300) that captured overall positivity of implicit attitudes towards the behaviour.

[9] A detailed description of the development of these measures can be found in Chapter 2, section 2.3.1.3.5 (page 52).

6.5.2.4. Physical activity.

The International Physical Activity Questionnaire was administered (last 7 days, self report version; Craig et al., 2003). Participants reported how many minutes in the past week they had spent walking or doing moderate or vigorous physical activity, and these quantities were multiplied by 3.3 (for walking), 4 (for moderate activity), or 9 (for vigorous activity). The resulting three figures represented Metabolic Equivalent of Task (MET) minutes per activity level, and were summed to produce a final MET-minutes per week variable. The theoretical maximum score of 90,720 MET-minutes is not informative because it reflects the impossible performance of high intensity activity, 24 hours a day, for a week; see Table 45 (Results) for descriptive statistics.

6.5.2.5. Diet quality.

Guided by an existing measure requiring more extensive reporting of dietary behaviour (McNaughton et al., 2008), a simpler indicator of diet quality (operationalised as adherence to the Australian Dietary Guidelines) was calculated. Participants were asked to report the previous day's intake of foods and beverages (for example, 'How many serves of fruit did you eat yesterday?') and general food habits ('How often would you eat high fat foods and snacks?'). Responses to the 17 items were scored from 0 (worst adherence) to 10 (best adherence) following the existing scheme (McNaughton et al., 2008) that took into account the slightly different dietary recommendations for males and females in certain age groups.

6.5.2.6. Smoking cessation.

A single item from a smoking exposure measure was used (Weitkunat et al., 2013). Participants were asked to select their smoking status from three options: current smoker, ex-smoker, or never having been a smoker. Those who had never smoked were excluded from the model. Current smokers were coded as 1 and ex-smokers were coded as 2.

6.5.2.7. Screening behaviours.

Participation in colorectal cancer screening (faecal occult blood test) was reported by participants aged over 50, participation in breast cancer screening (mammogram) and cervical cancer screening (Pap smear) were reported by females over 50, and participation in prostate cancer screening (by prostate-specific antigen [PSA] test or digital rectal examination) was reported by males over 50 years of age. Never having had the screening test in question was coded as 1 and having screened one or more times was coded as 2.

6.5.3. Analyses

Using SPSS, hierarchical linear regressions were run to predict the two continuous health behaviour variables (diet quality and physical activity) and hierarchical logistic regressions were run for the six categorical health behaviour variables (quitting smoking and the five types of cancer screening). The health thinking style variables and attitude variables were centred and standardised prior to the creation of interaction terms. When statistically significant interaction terms were returned, simple slope diagrams and post-hoc comparisons were carried out using Excel templates available online (Dawson, 2013).

Where results involved combinations of high or low scores on health thinking style variables (i.e. interaction between health rationality and health intuition), for simplicity a profile approach was used to label the combinations, following the work of J. M. Fletcher et al. (2012). Profiles are labelled as follows: intuitive (high health intuition, low health rationality), rational (high health rationality, low health intuition), dual preference (high on both) and disengaged (low on both).

6.6. Results

Descriptive statistics for the health thinking style and health behaviour variables are shown in Table 45 and Table 46 and those for the implicit and explicit attitudes about health behaviours are shown in Table 47. Correlations between the health thinking style variables and attitude variables are shown in Table 48 and Table 49. Relationships between attitudes and the relevant health behaviour are shown with bivariate correlations in Table 50.

Table 45

Descriptive statistics for continuous health thinking style and health behaviour variables

	N	*M* (*SD*)	Min	Max
Health rationality	904	3.81 (0.57)	1.75	5.00
Health intuition	904	2.90 (0.66)	1.00	4.67
Diet quality	843	119.40 (17.39)	49.12	157.50
Exercise	870	3817.71 (3 769.43)	0.00	23226.00

Table 46

Descriptive statistics for categorical health behaviour variables

		Smoking status		Screening participation	
	N	Current smoker	Ex-smoker	Never screened	Ever screened
Smoking status	330	50 (15.2%)	280 (84.8%)		
Faecal occult blood test	365			97 (26.6%)	268 (73.4%)
Pap smear	441			60 (13.6%)	381 (86.4%)
Mammogram	135			19 (14.1%)	116 (85.9%)
PSA test	184			29 (15.8%)	155 (84.2%)
Digital rectal examination	184			61 (33.2%)	123 (66.8%)

Table 47

Descriptive statistics for implicit and explicit attitudes about health behaviour

Attitude about	Implicit attitude[1]			Explicit attitude[2]		
	M (*SD*)	Min	Max	*M* (*SD*)	Min	Max
Eating healthily	245.99 (49.24)	3.00	300.00	19.52 (2.73)	9.00	27.00
Exercising	254.65 (39.00)	78.00	300.00	19.64 (3.41)	9.00	27.00
Quitting smoking	255.61 (44.16)	31.00	300.00	16.69 (2.35)	10.00	23.00
Having a faecal occult blood test	239.38 (54.01)	24.00	300.00	21.58 (3.42)	9.00	27.00
Having a Pap smear	241.05 (54.80)	19.00	300.00	18.24 (3.10)	9.00	27.00
Having a mammogram	252.87 (46.27)	91.00	300.00	20.04 (3.50)	11.00	27.00
Having a PSA test	253.84 (47.91)	0.00	300.00	21.41 (3.32)	11.00	27.00
Having a digital rectal examination	256.14 (46.01)	55.00	300.00	18.15 (3.42)	9.00	27.00

1. Composite of ratings for benefits, barriers (inversed), and health-consciousness.

2. Composite of three ratings each for barriers (inversed) and benefits.

Table 48

Correlations between health thinking style and explicit attitudes about health behaviour

		2	3	4	5	6	7	8	9	10
1	Health rationality	.02	.39***	.34***	.12*	.25***	.15**	0.15	.21**	.19*
2	Health intuition		0.06	0.02	0.04	-0.02	0.01	-0.08	0.05	0.06
3	Diet quality			.52***	.18**	.29***	.31***	.18*	.31***	.32***
4	Exercise				.20***	.21***	.26***	0.13	0.12	0.10
5	Smoking cessation					.23**	.21*	0.17	0.09	.29**
6	Faecal occult blood test						.54***	.41***	.49***	.54***
7	Pap smear							.58***	-	-
8	Mammogram								-	-
9	PSA test									.46***

		2	3	4	5	6	7	8	9	10
10	Digital rectal examination									

Note. * *p* > .05, ***p* > .01, ****p* > .001.

Hyphen indicates no participants completed both measures.

Table 49

Correlations between health thinking style and implicit attitudes about health behaviour

		2	3	4	5	6	7	8	9	10
1	Health rationality	.00	.09**	.08*	.13*	.07	.07	.04	.04	.00
2	Health intuition		.04	.06	-.10	.00	-.07	-.08	-.01	-.06
3	Diet quality			.48***	.57***	.56***	.44***	.54***	.55***	.46***
4	Exercise				.49***	.41***	.30***	.41***	.41***	.34***
5	Smoking cessation					.54***	.29***	.40**	.66***	.58***
6	Faecal occult blood test						.69***	.66***	.73***	.69***
7	Pap smear							.81***	-	-
8	Mammogram								-	-
9	PSA test									.74***
10	Digital rectal examination									

Note. ***p* > .01, ****p* > .001.

Spearman’s rho reported due to skewed implicit attitude data. Hyphen indicates no participants completed both measures.

Table 50

Correlations between health behaviour and implicit and explicit attitudes

Behaviour	N	Explicit attitude	Implicit attitude[2]
Diet quality	843	.30***	.05
Exercise	867	.20***	.05
Smoking cessation[1]	328	.12*	.13*
Faecal occult blood test[1]	365	.44***	.09
Pap smear[1]	441	.20***	.18***
Mammogram[1]	135	.37***	.10
PSA test[1]	184	.32***	.20**
Digital rectal examination[1]	184	.35***	.06

Note. * $p > .05$, ** $p > .01$, *** $p > .001$.

1. Point biserial correlations calculated due to dichotomous outcomes. For smoking, 1 = current smoker, 2 = ex-smoker. For screening variables, 1 = never screened, 2 = screened.

2. Spearman's rho reported due to skewed implicit attitude data.

Statistically significant interactions were detected in the model predicting diet quality (shown in Table 51). Some main effects were also statistically significant, but for the detection of moderation this is not important (Baron & Kenny, 1986). Health rationality moderated the influence of explicit attitudes on diet quality: there was a stronger relationship between explicit attitudes about healthy eating and diet quality scores amongst participants with lower rather than higher health rationality (Figure 8). Similarly, health intuition moderated the influence of implicit attitudes on diet quality (Figure 9); implicit attitudes about healthy eating were more strongly related to diet quality for people low in health intuition than for people high in health intuition. A third statistically significant instance of moderation was also detected in the form of a three-way interaction between explicit attitudes, health rationality and health intuition. As can be seen in Figure 10, more positive explicit attitudes about healthy eating were related to higher diet quality for all four health thinking style profiles. However compared to the other three profiles, for participants with an intuitive profile (low health rationality and high health intuition) the relationship between explicit attitudes and diet quality was stronger. Slope difference tests confirmed that the relationship between explicit attitudes and diet quality was stronger for those with an intuitive profile than for those with dual-preference [$t(841) = -4.14$, $p < .001$], rational [$t(841) = -2.66$, $p = .008$] or disengaged [$t(841) = 2.19$, $p = .034$] profiles.

Table 51

Prediction of lifestyle behaviours from attitudes and health thinking style

Standardised predictors	Diet quality (score)		Physical activity (quantity)	
	B (SE)	ß	B (SE)	ß
Step 1	$R^2 = .11$		$R^2 = .05$	
(constant)	119.36 (0.57)		3828.06 (125.38)	
Health rat	2.77 (0.62)	0.16***	72.57 (133.59)	0.02
Health int	0.51 (0.57)	0.03	192.95 (126.70)	0.05
Explicit att	3.94 (0.62)	0.23***	695.32 (133.72)	0.18***
Implicit att	0.71 (0.57)	0.04	230.83 (126.42)	0.06†
Step 2	$R^2 = .14$ $\Delta R^2 = .03$**		$R^2 = .06$ $\Delta R^2 = .01$	
(constant)	120.18 (0.60)		3750.27 (131.09)	
Health rat	2.68 (0.62)	0.16***	98.94 (134.92)	0.03
Health int	1.27 (0.62)	0.07*	218.09 (134.29)	0.06
Explicit att	4.08 (0.63)	0.23***	669.23 (134.93)	0.18***
Implicit att	0.54 (0.57)	0.03	252.22 (129.55)	0.07‡
Exp att x HR	-1.79 (0.52)	-0.12**	210.40 (111.92)	0.06††

Standardised predictors	Diet quality (score)		Physical activity (quantity)	
	B (SE)	ß	B (SE)	ß
Imp att x HI	-1.42 (0.60)	-0.08*	99.40 (128.91)	0.03
Exp att x HI	0.41 (0.62)	0.02	169.10 (128.42)	0.05
Imp att x HR	-0.48 (0.58)	-0.03	-109.58 (121.09)	-0.03
Exp att x HR x HI	-1.30 (0.49)	-0.10**	-25.27 (107.44)	-0.01
Imp att x HR x HI	0.22 (0.48)	0.02	-109.48 (90.51)	-0.04
HR x HI	-0.11 (0.59)	-0.01	-297.98 (128.79)	-0.08*
Exp att x Imp att	-0.10 (0.66)	-0.01	102.13 (147.65)	0.03

Note. HR = health rationality; HI = health intuition.

† p = .068

‡ p = .052

†† p = .060

N = 843 for diet quality model; N = 867 for physical activity model.

Figure 8

Simple slope diagram for health rationality x explicit attitude interaction in the prediction of diet quality

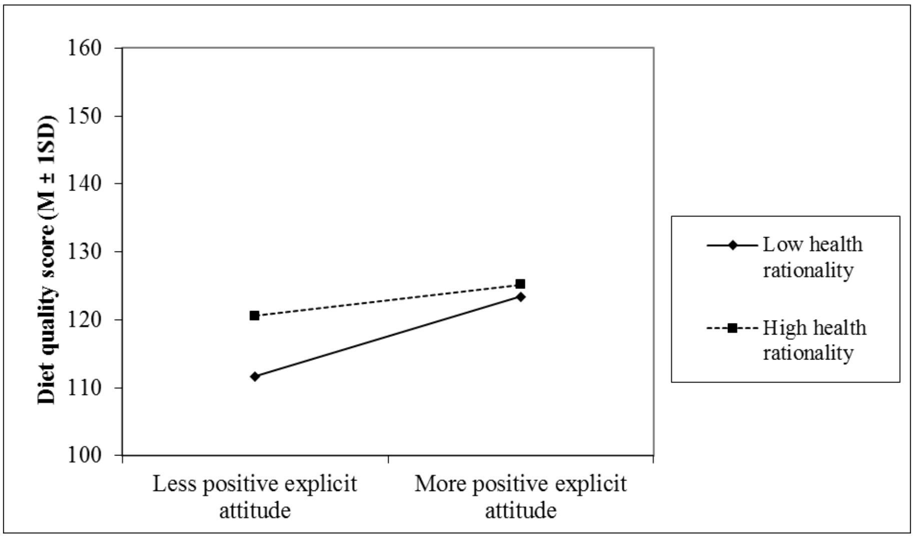


Figure 9

Simple slope diagram for health intuition x implicit attitude interaction in the prediction of diet quality

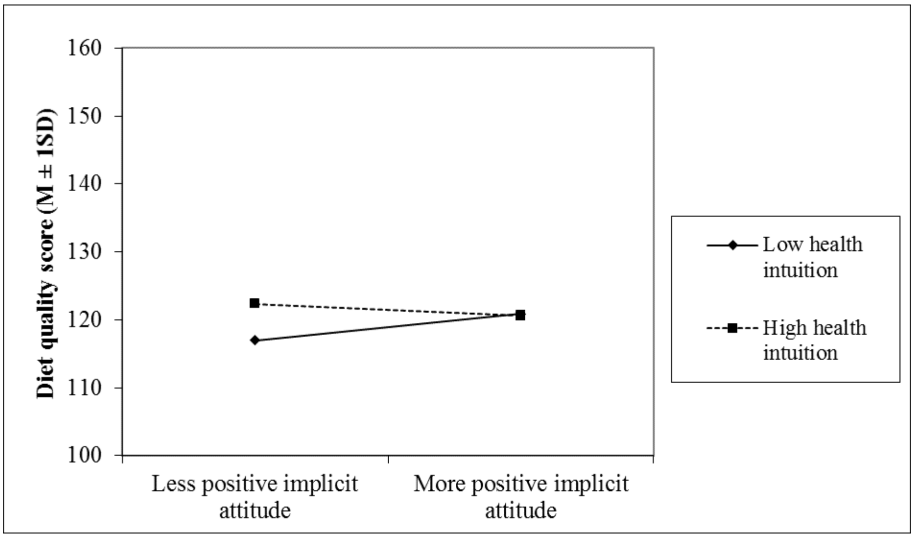
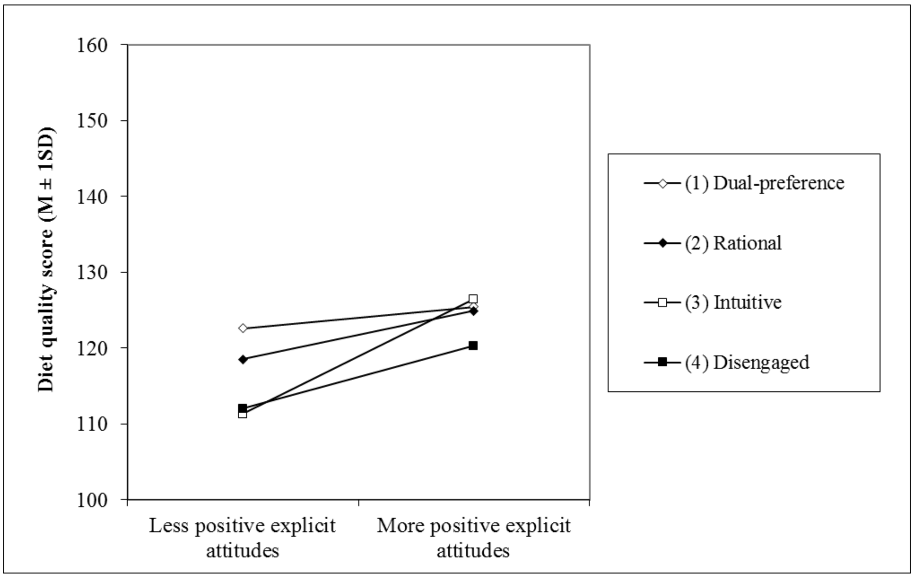


Figure 10

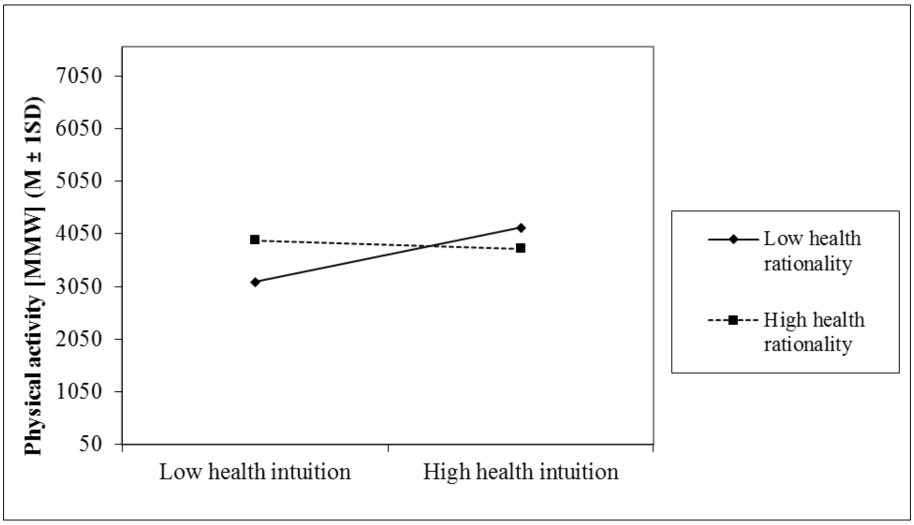
Simple slope diagram for health rationality x health intuition x explicit attitude interaction in the prediction of diet quality



In the model predicting self-reported levels of physical activity (shown in Table 51), the interaction term between health rationality and health intuition was significant. Simple slopes are shown in Figure 11 (with health rationality positioned as the moderator due to the theoretical assumption that type 2 processes follow and alter type 1 processes). Amongst participants with low health rationality, the relationship between health intuition and physical activity was stronger than among those with high health rationality. Alternatively, if health intuition is viewed as the moderator: among those with low health intuition, possessing high health rationality was related to higher diet quality, whereas for people with high health intuition the addition of high health rationality did not relate to higher diet quality.

Figure 11

Simple slope diagram for health rationality x health intuition interaction in the prediction of physical activity



MMW = MET-minutes per week.

For the remaining six models — those predicting smoking status, faecal occult blood test participation, mammogram participation, Pap smear participation, PSA test participation and digital rectal examination participation — no statistically significant interaction effects were detected. The tables displaying these regression models are included as supplementary material (page 227, Table 54 to Table 56).

6.7. Discussion

The aim of this research was to identify whether individual differences in health thinking style moderated the impact of implicit and explicit health attitudes on health behaviour. Guided by previous results, in addition to interaction terms between health rationality/intuition and the congruent attitude type, we tested for the influence of interaction terms between each health thinking style variable and its non-congruent attitude type, between health rationality and health intuition, and three-way interactions where each attitude type was moderated by both thinking style variables.

The expected pattern of interactions (i.e. health rationality moderates explicit attitudes, health intuition moderates implicit attitudes, and no other interactions are present) was not found in full for the prediction of any behaviour. Few moderation effects were found overall. The greatest number of interactions between attitudes and thinking style was seen in the model predicting diet quality. Although the influence of explicit attitudes was moderated by health rationality and the influence of implicit attitudes was moderated by health intuition for this behaviour, the direction of these effects was opposite to that hypothesised and the reverse of that found for rationality by Conner et al. (2007, Study 2). Amongst people who scored higher on the health thinking style variable in question (health rationality or health intuition), the effect of the congruent attitude type (explicit attitudes or implicit attitudes, respectively) on diet quality was weaker. For people in our sample with low health rationality, those with more positive explicit attitudes had comparatively better diet quality (while the same difference was not apparent for those with high health rationality). Similarly, positive implicit attitudes had a more positive relationship with diet quality for participants with low health intuition than those with high health intuition. A three-way moderation was also detected, in which health rationality and health intuition both moderated explicit attitudes' behavioural influence: of the four health thinking style profiles, intuitive participants' diet quality was most clearly differentiated by the positivity of their explicit attitudes. This is also inconsistent with a previously reported three-way interaction (Marks et al., 2008) wherein affective associations predicted smoking behaviour for all profiles except the rational profile. Put simply: in our sample, explicit attitudes made a difference to diet quality when health rationality was low (especially for those with an intuitive profile), and implicit attitudes made a difference to diet quality when health intuition was low.

In addition, health rationality and health intuition showed a significant interaction in the prediction of physical activity. Higher health intuition was associated with more physical activity when health rationality was low, whereas amongst people who had high health rationality, those who also had high health intuition were not more active. Marks et al. (2008) also found an interaction between thinking style variables in predicting smoking, which serves to further highlight the relevance of considering (health) thinking style in terms of profiles rather than single variables. No statistically significant moderation was seen for quitting smoking or cancer screening behaviours.

Results we have previously reported from the same dataset when validating the REI-Health showed that health rationality predicted some variance in diet quality (McGuiness, Zajac, et al., 2017). It had been anticipated that once attitudes were included in regression models, health thinking style (which should merely indicate the likelihood that each type of processing would be used in health-related thinking) would simply moderate the effect of attitudes on behaviour rather than explain any variance itself. However, in the final moderation model, health rationality explained 2.6% of variance in diet quality, and health intuition explained 0.5%. Given that both health thinking style variables were positively related to the outcome, we must ask what it is about having a higher preference for each type of thinking that relates to healthier behaviour after controlling for attitudes. One possibility is that, due to wording such as 'I'm not the best at reasoning complex health issues out carefully’ (which is a reverse-scored item), the REI-Health captures a person’s confidence in dealing with health matters more generally, in addition to genuine thinking preferences for health matters.

6.7.1. Implications

The absence of the hypothesised interactions (e.g. explicit attitudes predict behaviour more strongly when health rationality is higher; Conner et al., 2007) is surprising. Yet what may be more problematic for the expectation that high preference for one type of thinking increases the influence of the congruent attitude type (and does not affect the influence of the other attitude type) is the presence of interactions that should *not* exist if this pattern holds true: specifically, the weakening of attitudes’ influence over behaviour when the congruent health thinking style variable is high, and the moderation of explicit attitudes about healthy eating by both health rationality *and* health intuition. These findings call into question the separation of implicit attitudes and intuition from explicit attitudes and rationality, at least in terms of predicting self-reported engagement in health behaviour. At the least, the three-way interaction where health rationality and health intuition both moderated the impact of explicit attitudes about healthy eating may show the importance of the profiles approach suggested by several authors (Akinci & Sadler-Smith, 2013; Brown & Bond, 2015; J. M. Fletcher et al., 2012). While rationality and intuition are independent (Epstein et al., 1996), the combinations in which these preferences occur may be important.

Due to the lack of consistent effects across behaviours it is not possible to draw out implications for preventive health. However, a tentative conclusion is that (contrary to our original expectation) attitudes and health thinking style promote healthier behaviour in an additive manner. It may be that people high on health rationality or intuition are better equipped to think about health when required to than people low on the respective dimension, and are more likely to make healthy decisions regardless of their attitude about a behaviour. On the other hand, for those reporting lower favourability for a particular type of thinking about health, positive attitudes of the congruent form appear to steer them towards healthier behaviour.

6.7.2. Strengths and weaknesses

The results may have been compromised by poor validity in the measurement of implicit attitudes to the 8 health behaviours. While a small amount of variance was explained in bivariate correlations with behaviour, once variance explained by explicit attitudes was controlled for, the implicit attitudes did not add to prediction of behaviour. It is possible that the scenario approach used is more suited to capturing attitudes about fundamental constructs such as dishonesty and political conservatism (which the original study used successfully to predict behaviour; Vargas et al., 2004) rather than about quite specific health behaviours, as used here. Any inability on the part of these measures to capture implicit attitudes would naturally have limited our ability to detect moderation of the behavioural influence of these attitudes.

In addition, to assess the numerous two- and three-way interactions suggested by previous studies we included a large number of terms in each regression model. This created the possibility that type 1 errors would be made, and also meant that the models' residuals were difficult to interpret. The small size and unexpected direction of the findings mean this possibility should not be ignored, and until such time as the findings are replicated these issues should be kept in mind when interpreting them.

A strength of this study was its application of processing preferences and dual forms of attitudes to the prediction of actual behaviour (as far as can be ascertained by means of self-report). Because its correlational format (with no laboratory visit or intervention required) allowed data to be collected using an online survey, we were able to attract a sample of close to one thousand adults from the general community, with a wide range of ages and backgrounds. However, care should be taken that the moderations presented herein are not interpreted as demonstrating changes in behaviour resulting from changes in attitudes. Rather, the effects relate to behavioural differences between people who report different attitudes and health thinking styles.

6.7.3. Future directions

The health rationality and health intuition scales were linked positively with some health behavioural outcomes, and the reasons for this are not entirely clear. The construct validity of the REI-Health could be strengthened if it were shown that this effect was not due (or not wholly due) to inadvertent measurement of a person's general confidence in managing health matters. Future work would benefit from measuring factors known to relate to health behaviour, such as a general form of Bandura's (1977) self-efficacy known as perceived health competence (M. S. Smith, Wallston, & Smith, 1995; see also Bachmann et al., 2016). If this variance is controlled for, a clearer picture of health thinking style may emerge.

It has been proposed that type 1 and type 2 processes relate differentially to impulsive versus controlled health behaviour (Friese et al., 2008), and to health behaviour that is difficult to reduce versus that which is difficult to maintain (Borland, 2014). It was beyond the scope of the current study to add this layer of analysis, but it may be fruitful to explore the way health thinking style and attitudes interact when applied to behaviours differentiated along these lines.

6.7.4. Conclusion

Moderation effects were detected in diet quality and physical activity behaviour, but their direction differed from expectations and past research. In many cases, higher health intuition and higher health rationality were associated with healthier behaviour. However, for diet quality at least, having positive explicit attitudes about healthy eating was more helpful for those with low health rationality. In the same manner, having positive implicit attitudes about healthy eating was more important for people with low health intuition. More research is required to understand the interaction between health thinking style, health attitudes, and health behaviour.

6.8. Chapter 6 supplementary materials.

Table 52

Scenarios used in the measurement of implicit attitudes about health behaviour

Attitude about	Scenario	FRE	FKGL
Healthy eating	Jay feels like no matter what he eats, he's always overweight. But when it's so much effort to buy and prepare healthy foods, he often just can't be bothered. He's always so tired by dinner time so he craves something tasty and easy like fast food. He recently found out that he is at higher than average risk of heart disease. Since then he feels he has made an effort, such as starting to order his coffees with skim milk.	78.5	6.2
Exercising	Mary says she has nowhere she can do exercise. But really, she has never enjoyed exercising at all. Her doctor said she should get more active to lower her risk of disease, so she signed up at a nearby gym. But Mary dislikes exercising in public. Her weight troubles her and because of this she hates to wear gym clothes. She often finds herself at home watching TV rather than going to the aerobics classes that she signed up for.	76.9	5.8
Quitting smoking	James knows that his wife and kids would be really pleased if he quit smoking for good. But he doesn't think they understand how hard it is to quit, because they've never been addicted. He's cut down a bit over the past couple of years. He says he doesn't think that it makes a difference to his health. He hates wasting money and is known to be thrifty, but his cigarettes feel like something he can't live without, just now.	84.8	5.4
Having a faecal occult blood test	Months ago, the government mailed Terry a home stool test. He thought this was a good program that would save lives. Ignoring his embarrassment, he put the test in his family's busy kitchen as a reminder. Doing the test would stop him worrying about bowel cancer. He thinks if cancer is found early the treatment won't be as awful. Yet he still can't bring himself to collect his stool samples even on those days when he has plenty of time.	78	5.6

Attitude about	Scenario	FRE	FKGL
Having a Pap smear	When Selma's colleague needed large amounts of chemotherapy for cervical cancer that was found late, Selma said she'd begin having Pap smears every two years. But she hasn't been to the doctor yet. Finding time is not a problem. But the Pap smear process sounds pretty embarrassing to Selma. Nonetheless, she tells younger women at work that a Pap smear might save their lives. When a colleague complains that it hurts a little, Selma tells her she's being weak.	72.4	6.4
Having a mammogram	Leila has raised money for the Cancer Council before. So she knows about how mammograms can detect lumps and lower the risk of dying from breast cancer. A letter about having a mammogram arrived six months ago. Leila knows the test doesn't take long, but the idea of finding a problem is scary. So is the thought of having treatment for even a small lump. She delays making the booking because the last time she felt ashamed and slightly uncomfortable.	70.6	6.7
Having a PSA test	Huy knows all about prostate cancer. He worries about it sometimes, but thinks being tested might make him worry more. He's heard that PSA tests can detect prostate cancer that has no symptoms. But he's confused about whether it's helpful to detect a prostate cancer that has no symptoms. Plus, he has always hated needles. And his schedule is fuller than ever since he retired. He'd probably visit his GP for a chat about it if he had more time.	76.7	5.3
Having a digital rectal examination	Marco's doctor said next check-up, he'd give Marco a digital rectal examination. The thought of having prostate cancer and not knowing is a bit of a concern. But Marco reckons he'd still be worried even after the test. He thinks he'll feel ashamed and it might hurt. He tells himself that the hassle is nothing compared to finding prostate cancer late when treatment is so much worse. Still, he's been putting off going to the doctor for two years now.	74.8	6.1

FRE = Flesch Reading Ease, FKGL = Flesch-Kincaid Grade Level.

Table 53

Prediction of smoking cessation from attitudes and health thinking style

Standardised predictors	Smoking cessation (likelihood of having quit)	
	B (SE)	Exp(B) [95% C.I.]
Step 1	Nagelkerke R^2 = .07 $\chi^2(4) = 14.13$	
(constant)	1.87 (0.17)	6.50
Health rat	0.38 (0.16)	1.46* [1.06, 2.00]
Health int	-0.18 (0.17)	0.84 [0.60, 1.17]
Explicit att	0.29 (0.17)	1.33† [0.97, 1.84]
Implicit att	0.23 (0.14)	1.26 [0.95, 1.67]
Step 2	Nagelkerke R^2 = .11 $\chi^2(12) = 21.38$* $\Delta\,\chi^2(8) = 7.25$	
(constant)	1.92 (0.18)	6.85
Health rat	0.43 (0.18)	1.54* [1.08, 2.19]
Health int	-0.17 (0.18)	0.84 [0.60, 1.19]
Explicit att	0.26 (0.18)	1.30 [0.91, 1.86]
Implicit att	0.19 (0.19)	1.20 [0.84, 1.73]
Exp att x HR	0.01 (0.16)	1.01 [0.75, 1.38]
Imp att x HI	0.16 (0.19)	1.17 [0.81, 1.68]
Exp att x HI	0.16 (0.18)	1.17 [0.83, 1.65]
Imp att x HR	-0.01 (0.15)	0.99 [0.74, 1.31]
Exp att x HR x HI	0.14 (0.14)	1.15 [0.88, 1.52]
Imp att x HR x HI	-0.05 (0.15)	0.95 [0.71, 1.28]
HR x HI	-0.07 (0.17)	0.94 [0.67, 1.32]
Exp att x Imp att	-0.30 (0.18)	0.74‡ [0.52, 1.05]

Note. HR = health rationality; HI = health intuition.

† p = .080

‡ p = .087

N = 328. Participants who never smoked excluded.

Table 54

Prediction of FOBT screening from attitudes and health thinking style

Standardised predictors	FOBT (likelihood of having ever participated)	
	B (SE)	Exp(B) [95% C.I.]
Step 1	Nagelkerke R^2 = .27 $\chi^2(4)$ = 74.98***	
(constant)	1.27 (0.15)	3.57
Health rat	0.18 (0.14)	1.19 [0.90, 1.58]
Health int	0.15 (0.15)	1.17 [0.87, 1.56]
Explicit att	1.07 (0.15)	2.92*** [2.16, 3.94]
Implicit att	0.09 (0.13)	1.09 [0.84, 1.41]
Step 2	Nagelkerke R^2 = .29 $\chi^2(12)$ = 81.37*** $\Delta \chi^2(8)$ = 6.39	
(constant)	1.34 (0.15)	3.80
Health rat	0.23 (0.16)	1.25*** [0.91, 1.72]
Health int	0.18 (0.16)	1.20 [0.87, 1.65]
Explicit att	1.08 (0.16)	2.96 [2.17, 4.02]
Implicit att	0.06 (0.15)	1.06 [0.79, 1.42]
Exp att x HR	-0.06 (0.16)	0.95 [0.69, 1.30]
Imp att x HI	-0.15 (0.18)	0.86 [0.61, 1.22]
Exp att x HI	0.02 (0.19)	1.02 [0.70, 1.48]
Imp att x HR	-0.23 (0.16)	0.79 [0.58, 1.08]
Exp att x HR x HI	0.13 (0.17)	1.14 [0.82, 1.60]

Standardised predictors	FOBT (likelihood of having ever participated)	
	B (SE)	Exp(B) [95% C.I.]
Imp att x HR x HI	-0.33 (0.18)	0.72† [0.50, 1.03]
HR x HI	-0.01 (0.17)	0.99 [0.71, 1.37]
Exp att x Imp att	0.06 (0.15)	1.06 [0.79, 1.42]

Note. HR = health rationality; HI = health intuition.

† p = .075

N = 365.

Table 55

Prediction of female-specific cancer screening from attitudes and health thinking style

Standardised predictors	Pap smear (likelihood of having ever participated)		Mammogram (likelihood of having ever participated)	
	B (SE)	Exp(B) [95% C.I.]	B (SE)	Exp(B) [95% C.I.]
Step 1	Nagelkerke R^2 = .16 $\chi^2(4)$ = 39.27***		Nagelkerke R^2 = .32 $\chi^2(4)$ = 26.45***	
(constant)	2.07 (0.17)	7.88	2.47 (0.40)	11.87
Health rat	0.45 (0.15)	1.57** [1.16, 2.12]	0.05 (0.33)	1.06 [0.55, 2.03]
Health int	-0.02 (0.16)	0.98 [0.72, 1.32]	0.80 (0.38)	2.23* [1.07, 4.65]
Explicit att	0.53 (0.16)	1.71** [1.26, 2.31]	1.49 (0.39)	4.42*** [2.04, 9.56]
Implicit att	0.45 (0.13)	1.56** [1.22, 2.01]	0.27 (0.29)	1.31 [0.74, 2.31]
Step 2	Nagelkerke R^2 = .21 $\chi^2(8)$ = 14.41 $\Delta\chi^2(12)$ = 53.68***		Nagelkerke R^2 = .34 $\chi^2(8)$ = 1.64 $\Delta\chi^2(12)$ = 28.09	
(constant)	2.16 (0.18)	8.64	2.60 (0.45)	13.49
Health rat	0.38 (0.19)	1.46* [1.02, 2.10]	-0.21 (0.51)	0.81 [0.30, 2.22]
Health int	0.13 (0.18)	1.14 [0.80, 1.61]	0.87 (0.53)	2.39 [0.84, 6.79]

Standardised predictors	Pap smear (likelihood of having ever participated)		Mammogram (likelihood of having ever participated)	
	B (SE)	Exp(B) [95% C.I.]	B (SE)	Exp(B) [95% C.I.]
Explicit att	0.53 (0.17)	1.70** [1.21, 2.37]	1.59 (0.44)	4.90***[2.07, 11.57]
Implicit att	0.41 (0.16)	1.51** [1.12, 2.04]	0.33 (0.42)	1.40 [0.61, 3.18]
Ex att x HR	-0.29 (0.18)	0.75 [0.52, 1.06]	-0.49 (0.46)	0.61 [0.25, 1.52]
Imp att x HI	0.15 (0.14)	1.16 [0.88, 1.53]	-0.27 (0.53)	0.76 [0.27, 2.15]
Exp att x HI	0.01 (0.19)	1.01 [0.70, 1.48]	0.09 (0.46)	1.09 [0.44, 2.71]
Imp att x HR	0.21 (0.15)	1.23 [0.91, 1.67]	-0.19 (0.45)	0.83 [0.34, 1.99]
Exp att x HR x HI	-0.31 (0.16)	0.74† [0.53, 1.02]	0.04 (0.61)	1.04 [0.31, 3.46]
Imp att x HR x HI	-0.16 (0.14)	0.85 [0.66, 1.12]	0.22 (0.35)	1.25 [0.63, 2.49]
HR x HI	0.07 (0.16)	1.07 [0.77, 1.47]	-0.03 (0.58)	0.97 [0.31, 3.04]
Exp att x Imp att	-0.11 (0.16)	0.90 [0.66, 1.21]	-0.07 (0.32)	0.94 [0.51, 1.73]

Note. HR = health rationality; HI = health intuition.

† p = .063

N = 441 for Pap smear model; N = 135 for mammogram model.

Table 56

Prediction of male-specific cancer screening from attitudes and health thinking style

Standardised predictors	PSA test (likelihood of having ever participated)		DRE (likelihood of having ever participated)	
	B (SE)	Exp(B) [95% C.I.]	B (SE)	Exp(B) [95% C.I.]
Step 1	Nagelkerke R^2 = .23 $\chi^2(4)$ = 26.50***		Nagelkerke R^2 = .19 $\chi^2(4)$ = 27.07***	
(constant)	1.99 (0.28)	7.60	0.86 (0.18)	2.36

Standardised predictors	PSA test (likelihood of having ever participated)		DRE (likelihood of having ever participated)	
	B (SE)	Exp(B) [95% C.I.]	B (SE)	Exp(B) [95% C.I.]
Health rat	-0.36 (0.24)	0.70 [0.43, 1.13]	-0.07 (0.17)	0.94 [0.67, 1.31]
Health int	0.15 (0.25)	1.16 [0.72, 1.88]	0.27 (0.20)	1.30 [0.89, 1.91]
Explicit att	0.94 (0.24)	2.55** [1.60, 4.06]	0.89 (0.20)	2.44*** [1.63, 3.63]
Implicit att	0.46 (0.20)	1.58* [1.06, 2.34]	-0.13 (0.18)	0.88 [0.62, 1.26]
Step 2	Nagelkerke R^2 = .27 $\chi^2(12)$ = 31.91** $\Delta\ \chi^2(8)$ = 5.41		Nagelkerke R^2 = .20 $\chi^2(12)$ = 28.83** $\Delta\ \chi^2(8)$ = 1.76	
(constant)	1.99 (0.28)	7.31	0.88 (0.20)	2.41
Health rat	-0.19 (0.30)	0.83 [0.46, 1.50]	-0.11 (0.19)	0.90 [0.62, 1.30]
Health int	0.12 (0.29)	1.12 [0.63, 1.99]	0.28 (0.21)	1.32 [0.88, 1.99]
Explicit att	0.91 (0.27)	2.48** [1.46, 4.21]	0.96 (0.23)	2.62*** [1.68, 4.10]
Implicit att	0.41 (0.31)	1.50 [0.82, 2.76]	-0.10 (0.21)	0.91 [0.60, 1.36]
Ex att x HR	0.45 (0.32)	1.57 [0.84, 2.92]	-0.15 (0.23)	0.86 [0.55, 1.34]
Imp att x HI	-0.09 (0.27)	0.92 [0.54, 1.55]	-0.08 (0.24)	0.92 [0.58, 1.48]
Exp att x HI	-0.10 (0.38)	0.91 [0.43, 1.91]	0.18 (0.25)	1.20 [0.73, 1.96]
Imp att x HR	0.22 (0.35)	1.24 [0.63, 2.45]	-0.06 (0.19)	0.94 [0.64, 1.38]
Exp att x HR x HI	0.09 (0.38)	1.09 [0.52, 2.30]	0.07 (0.26)	1.07 [0.64, 1.78]
Imp att x HR x HI	-0.06 (0.35)	0.94 [0.48, 1.85]	0.04 (0.27)	1.04 [0.62, 1.76]
HR x HI	0.01 (0.31)	1.01 [0.55, 1.87]	-0.06 (0.21)	0.95 [0.62, 1.43]
Exp att x Imp att	-0.42 (0.32)	0.66 [0.36, 1.22]	0.01 (0.18)	1.01 [0.71, 1.43]

Note. HR = health rationality; HI = health intuition.

N = 184.

CHAPTER 7. DISCUSSION.

7.1. Summary and synthesis of findings

Participation in health behaviour is influenced by individual differences in processing and attempts to improve participation require careful consideration of how these differences exert influence both generally and for specific behaviours. The overarching purpose of this thesis was to explore the relationship of thinking style to participation in health behaviours among two samples of Australian adults utilising cross-sectional methods. Specifically, the dissertation reports the outcomes of four studies that tested for direct correlations between thinking style and health behaviour (Chapter 3); explored whether people adapt their thinking style when thinking about health (Chapter 5, with a preparatory study documented in Chapter 4); and testing proposed interactions between thinking style and attitudes in the prediction of health behaviour (Chapter 6).

7.1.1. Thinking style as a predictor of men's participation in cancer screening.

The first paper presented in this thesis tested whether thinking style predicted participation in cancer screening via utilisation of faecal occult blood testing, the PSA test or digital rectal examination. Structural equation modelling revealed a small relationship between thinking style and digital rectal examinations ($r = .11$, $p = .016$) only. Men who reported a higher preference for rational processing were slightly more likely to report having this type of cancer screening in the past than those reporting a lower preference for rational processing. No relationship was observed on individual differences in experientiality and preference for digital rectal examinations, or between either of the thinking style variables and the other forms of screening. Despite the limited nature of the relationships observed, the association of rationality with digital rectal examinations provided the impetus for further exploration of health behaviour and thinking style relationship.

7.1.2. The REIm-13: a brief measure of thinking style.

In the time since Study 1 data collection was planned, a new measure of thinking style became available. The updated version, the Rational-Experiential Multimodal Inventory (REIm; Norris & Epstein, 2011) introduced a multimodal conceptualisation of experientiality, which comprised the three facets of intuition, imagination and emotionality. The sophisticated new experientiality scale offered the possibility that relationships with behaviour could be better detected. However, the REIm did not have a published short form. A valid and reliable short form was required for the development (in Chapter 5) of a scale measuring health thinking style, which would likewise be brief.

The task of Chapter 4 was to produce a valid, short form of the REIm for use in subsequent studies. Establishing that the health thinking style measure was based on an existing, valid measure was an important step. The short form that was produced, the REIm-13, proved to be valid (based on robust correlations between the full and short subscales, and replication of the original scale's four-factor structure) and reliable (with acceptable test-retest correlations and internal consistency). Moreover, associations with age, gender, and personality variables followed patterns established by the original scale, further supporting the validity of the REIm-13.

7.1.3. Health thinking style: A new scale shows incremental validity in predicting health behaviour.

Although the traditional view of thinking style is that it applies to all thinking a person does (Epstein et al., 1996), recent work showed that people report using type 1 and type 2 processes to different degrees across various domains of life, such as mate choice, holiday planning, and medical decisions (Pachur & Spaar, 2015). The development of a scale measuring thinking style specific to thinking about health therefore appeared useful for two reasons. The first reason was that it would provide new insight about the concept of thinking style, and the degree to which people adapt the processing to different areas of their life (in this case, providing evidence by focusing on the health domain specifically). Secondly, if it emerged that people reported a distinct thinking style for the health domain, then a health thinking style scale could potentially offer improved prediction of health behaviours compared to that offered by existing measures, subsequently adding to knowledge about the drivers of health behaviour.

In Chapter 5, the REIm-13 was modified so that each item related to health. The aim was to create a measure of health thinking style, to see whether people differed from their trait thinking style (i.e. that measured by the REIm-13) when it came to health; and following on from this, to explore whether health thinking style predicted health behaviour more effectively than trait thinking style. The measure was valid and reliable once two subscales of experientiality (which did not appear to translate well to health-related thinking) were removed, leaving the core facet of health intuition. Health rationality and health intuition showed different relationships with the trait thinking style variables from which they were derived: health rationality was more strongly predicted by health importance than it was by trait rationality, whereas trait intuition was the strongest predictor of health intuition. Importantly, health thinking style was shown to have incremental validity over thinking style for the prediction of health behaviours. Health thinking style predicted unique variance in diet quality, faecal occult blood test participation and Pap smear participation after controlling for trait thinking style.

7.1.4. Health thinking style as a moderator of the relationship between implicit and explicit attitudes and health behaviour: a dual process approach.

Health thinking style was found to predict health behaviour better than general thinking style, but little evidence existed as to why thinking style predicts some variance in health behaviour. One possible mechanism was explored in the final paper: the moderation of explicit and implicit attitudes about the behaviour. Given that health thinking style reflects a person's preference for type 1 and 2 processing, which includes implicit and explicit attitudes respectively, the influence of attitudes may be increased or reduced by the corresponding health thinking preference. Explicit attitudes and implicit attitudes are important predictors of health behaviour (albeit interest in implicit attitudes being comparatively recent). Any finding that sheds light on the conditions under which they are more (or less) influential can potentially improve health-related communication and interventions, with positive results for individual and population health outcomes.

The health thinking style scale developed in the Chapter 5 was utilised in Chapter 6 along with new measures of implicit attitudes about health behaviours (produced for this research and detailed in the methodology overview, section 2.3.1.3.5, page 55). The aim was to test whether health rationality moderated the influence of explicit attitudes on health behaviour, and whether health intuition moderated the influence of implicit attitudes on health behaviour, in line with the pattern seen in previous research. However, of the eight behaviours tested, interaction between health thinking style and attitudes was only detected in the model predicting diet quality; furthermore, the interactions were in the reverse direction to those hypothesised. When health rationality or health intuition were low, the congruent form of attitude was more strongly linked to diet quality. Both thinking style variables and explicit attitudes were found to have a significant three-way interaction: the strongest link between explicit attitudes and diet quality was amongst intuitive participants (low health rationality and high health intuition). Because those with higher scores on the thinking style variables seemed to report healthier behaviour, the weaker effect of attitudes on behaviour was attributed to these individuals' greater capacity to behave healthily irrespective of attitudes. The possibility that the REI-Health captures health self-efficacy was also noted.

7.2. Strengths

In Study 2, the online survey format facilitated the recruitment of a large sample (N = 920) due to the ease with which a URL can be promoted and the convenience of completion (at the participant's leisure, and at a location of choice). Additionally, the ability to offer an incentive (the chance to win a graphics tablet) is likely to have boosted numbers. A strength of both studies was that the samples were from the general community. This contrasts with much health psychology research that relies upon university students or other convenience samples that have a limited range of ages and education levels. Therefore, notwithstanding certain limitations discussed below, the results are likely more generalizable than would be the case with a university sample.

Study 2 contributed to psychology and health psychology research by reviving or adapting previously published measures, and in this way leveraging previous work to build scientific knowledge. Putting the infrequently-used implicit attitude measures to use in the measurement of implicit attitudes about health behaviours (Vargas et al., 2004) was not overly successful, but identified a potential limit to their usefulness: they may be best suited to measuring attitudes about more global constructs such as dishonesty, or for constructs for which social desirability may be important. On the other hand, the reduction of the REIm (Norris & Epstein, 2011) into a brief measure, the REIm-13, produced a valid and reliable scale that may facilitate more widespread multimodal measurement of experientiality. Furthermore, the adaptation of the REIm (via the REIm-13) to focus on health thinking style builds on a foundation of existing research about thinking style to shine light on a new area with potential benefits for the study of health behaviour.

7.3. Problems encountered and potential limitations

Due to the fact that participation in Study 1 required significant effort on the part of participants (completion of two surveys and return by mail), the sample used in Chapter 3 was highly motivated and health conscious. This was indicated by the rate of participation in the mailed faecal occult blood tests being double the rate of the Australian population's participation in the National Bowel Cancer Screening Program. Although an attempt was made to avoid this problem in Study 2 by attracting a wider range of participants via prizes and targeted letterbox drops, the sample was, nonetheless, highly affluent (albeit less so than the Study 1 sample) and health conscious. In addition, whereas non-participation in the Study 1 surveys could be reported in Chapter 3, the lack of a predefined sampling frame for Study 2 means that the total number of people exposed to promotional materials (via printed, online and email promotion) is unknown, and therefore the non-participation rate is unknown for Chapters 4, 5, and 6.

In Study 2, the 13 items chosen for the short-form of the REIm were included in the first survey, whereas the full 42-item REIm was only included in the second survey. This was due to the length of the first survey and concerns about fatigue-induced participant attrition. However, as a result, test-retest reliability could only be assessed for the subset of 13 items chosen *a priori* (because only these items were included in both surveys), and there was no possibility of adding additional items to the short form to improve validity. Furthermore, also due to concerns about participant burden, only the same 13 items were translated for inclusion in the REI-Health. Given that two facets (health-imagination and health-emotionality) were removed because of poor compliance with factor structure, it would have been beneficial if extra, redundant, REI-Health items had been included in both surveys. If test-retest reliability could be examined for extra items, perhaps the health-emotionality and health-imagination scales could have been salvaged through addition or substitution of items.

The implicit attitude measures did not perform as hoped, nor did they perform as well as the exemplars on which they were based (Vargas et al., 2004). The small amounts of explained variance in some health behaviours became non-significant after controlling for explicit attitudes. This may be because the attitude objects (i.e. healthy diet, quitting smoking, PSA testing) were more specific than those that formed the focus of the original study (i.e. honesty, religiosity, political persuasion). Additionally, despite the fact that the partially-structured measures appeared both promising and interesting to adapt, it might have been wise to include a different means for capturing implicit attitudes via self-report for one behaviour (perhaps only for a subgroup of participants) so that the results could be compared. A good candidate would have been the word association technique developed by Peters and Slovic (1996) and used in relation to smoking by Marks et al. (2008). In this technique, participants are asked to list the first thoughts that come into their head in relation to a certain topic. Next participants are asked to rate the positivity of each thought, and these ratings are combined to produce an indicator of the positivity or negativity of associations. This measure can be included in a survey, and thus Chapter 6 could feasibly be replicated with this measure instead of the implicit attitude measures used; however, the request to generate associations may be more taxing for participants than providing ratings in response to a scenario (considering each participant must complete the measure up to six times).

Interestingly, it has been reported that measures of implicit associations (such as the implicit association test by Greenwald et al., 1998) can fail to predict behaviour if the associations and behaviour are measured one week apart instead of in the same session (Richetin & Perugini, 2008). The authors explained this finding by citing the changing accessibility of implicit associations, and the fact that completing an associative measure may make the implicit attitude salient — therefore it is possible that even if implicit attitudes are relatively stable, events in everyday life could affect their accessibility to measurement. In the present research, some of the health behaviours that participants were asked to self-report occurred an unknown length of time before they completed the survey. Cancer screening behaviours or quitting smoking could have occurred at any point in a participant's past (for instance a person may have quit smoking or completed a single faecal occult blood test several decades ago). On the other hand, physical activity was assessed using the preceding week, and the diet quality items asked participants to report on the previous day. Admittedly, the few instances of behaviour being predicted by implicit attitude were scattered across behaviours with different possible temporal ranges, but without knowing how long ago smoking or screening behaviours occurred there is no way to assess or control for the effect of time since behaviour on the predictive validity of the implicit attitude measures.

7.4. Significance of this research

The REIm (Norris & Epstein, 2011) offered greater depth of understanding about the preference for experiential thinking. The brief REIm-13 presented in Chapter 4 should be a useful contribution to thinking style research, enabling a sophisticated measurement of experientiality when time is short or participant burden is already high. This may facilitate further research to extend current knowledge about the adaptive and beneficial aspects of type 1 processing, and the outcomes for individuals with a preference for it.

In their investigation of the link between thinking style (and health thinking style) and health behaviour, Chapters 3 and 5 add to knowledge in a little-researched area. The few previous findings revealed links between thinking style and health behaviours such as herbal remedies, prayer, and homeopathy (Thomson et al., 2014), soft drink consumption (Richetin et al., 2007), hand-washing (Sladek et al., 2008), wheat avoidance (Golley et al., 2015) and smoking (Brown & Bond, 2015; Marks et al., 2008). Chapter 3 provided the first evidence that thinking style is related to important cancer screening behaviours, finding that digital rectal examination participation was predicted by higher rationality. Chapter 5 linked diet quality, pap smear participation and faecal occult blood test participation to higher health rationality, with higher health intuition predicting faecal occult blood test participation.

The finding that people report a health thinking style that is distinct from their trait thinking style raises questions for the conceptualisation of thinking style. Specifically, there is a question as to whether there is truly a ‘trait’ or general thinking style, or whether processing types are chosen on the fly as a result of situational demands, attitudes (for instance the perceived importance of the situation or task) or other factors, as suggested by previous research (Novak & Hoffman, 2009; Pachur & Spaar, 2015; Phillips et al., 2016). A reasonable proposal, supported by Chapter 5, is that trait thinking style is relatively stable, but people deviate from their trait thinking style in consistent ways for certain domains. Additionally, the poor performance of the emotionality and imagination subscales after translation to relate to health may indicate that these types of thinking are less routinely associated with health, whereas perhaps if translated to other domains these subscales would prove to be valid.

Although others have measured differences in thinking styles across domains (see Pachur & Spaar, 2015), the study documented in Chapter 5 is the first to create and validate a purpose-designed scale for measuring health thinking style. Consequently, Chapters 5 and 6 are also the first works using these health thinking style variables to predict health behaviour. The fact that some unique variance was predicted in three behaviours (with health thinking style outperforming trait thinking style), and that the explained variance was of a similar magnitude to demographic predictors, indicates that health rationality and health intuition may be useful to health psychology research going forward.

The research reported in Chapter 6 was designed based on proposals that implicit attitudes and explicit attitudes align with dual-process models of cognition (Gawronski & Bodenhausen, 2006), and that thinking style taps preferences for thinking in a manner largely consistent with these models (Evans & Stanovich, 2013). Amidst the surprising results in Chapter 6, the most noteworthy outcome might be that doubt was cast on the proposed pattern of attitude moderation by thinking style that has been advanced previously (Conner et al., 2007; Richetin et al., 2007). As in other work (Marks et al., 2008), in one instance (diet quality) explicit attitudes were moderated by both health rationality and health intuition simultaneously, although not in the same manner. The finding that attitudes better predicted diet quality at lower levels of the congruent health thinking style variable has, to my knowledge, not been documented previously. To the extent that a correlational study can be applied to the understanding of processing, these findings support the presence of interaction between type 1 and type 2 processes, such as is proposed in the Reflective-Impulsive Model (discussed in the Introduction; also see Strack & Deutsch, 2004).

7.5. Implications

The research described in this thesis has ramifications for understanding the interactions between thinking style, attitudes, and health behaviour. Variance in some health behaviours was predicted by trait thinking style and health thinking style. Previously, few studies had explored the relationship of thinking style to health behaviour. Although the reasons for the reported relationships are yet to be fully understood, the ability to predict any variance in health behaviour is potentially of use to researchers in health psychology or public health.

Our understanding of thinking style and the way it interacts with attitudes has also been challenged. The conception of thinking style dating back to the REI's inception (Epstein et al., 1996) posits a pair of general, trait-like preferences. The research in this dissertation does not refute this but, along with other findings (i.e. Novak & Hoffman, 2009; Pachur & Spaar, 2015), adds a layer of complexity by suggesting that people are also attuned to the requirements of the situation at any given time, and may adapt their choice of processing to fit the task or domain of life. Furthermore, the idea that the influence of implicit attitudes over health behaviour is reduced by low preference for type 1 thinking (and likewise for explicit attitudes and type 2 preference) has been questioned by the results from Chapter 6 where low preference for a processing type was associated with a stronger association between attitudes and diet quality. Certainly, further work is required to confirm this finding, but it presents a contradiction to other findings (e.g. Conner et al., 2007) which may in the end add to knowledge about thinking style and attitudes.

7.6. Further research

Some of the issues discussed in the Limitations section give rise to methodological suggestions for future research. For instance, future studies using health thinking style should also measure health competence in order to understand health rationality and health intuition better. Additionally, in studies using implicit attitudes to predict infrequent or episodic behaviours (such as smoking cessation, or cancer screening), the time elapsed since the most recent instance of behaviour should be controlled for, or used to group or filter participants, to enhance the prediction of those behaviours.

In regards to the measurement of implicit attitudes, the usefulness of self-report measures that can be included in surveys remains unchanged, particularly given the popularity of surveys as a data collection tool and the continued interest in dual-process models of cognition. Therefore, despite the lack of behavioural prediction achieved by the 'partially structured' implicit attitude measures, more work on such measures is warranted — perhaps applying them at a broader level than specific behaviours — to truly determine their utility. If such measures can be refined to capture implicit attitudes as effectively as other measures such as word association (e.g. Peters & Slovic, 1996) or computer programs using time to indicate strength of association between concepts (e.g. Greenwald et al., 1998), they would be a useful tool for psychology research, particularly that done using survey methodology.

The questions raised about thinking style deserve further investigation. As the forgoing studies found that people report a different set of preferences for health-related thinking than general thinking, and other research has also found different preferences across various domains of life (Pachur & Spaar, 2015), a productive next step would be to clarify the level of specificity at which people report altering their approach. Though the domain-specific approach has now been implemented successfully twice, future research must explore whether it is the domains themselves or values attached to them that drive the shifts in ways of thinking. For instance, a person may begin to think more effortfully about cancer screening not because they view the task as health-related, but because they view it as personally relevant or important (as suggested in the Elaboration Likelihood Model of persuasion; Petty & Briñol, 2012). Indeed, perceived importance of health was a predictor of health rationality in Chapter 5. Therefore, it would be constructive to explore whether changes in thinking type are related to more to categories, or more to the attitudes and values regarding categories, situations, tasks or behaviours.

One question about the behavioural prediction of the REI-Health is whether the fact that behaviour was self-reported in Study 2 confounds the relationship between health thinking style and behaviour. For instance, the accuracy and truthfulness of behaviour reporting may be related to factors that are themselves associated with the health thinking style. One major example is health importance, which could feasibly affect a person's reporting of their health behaviour. However, in Chapter 5, health importance was measured and, while it was related to health thinking style, variance in behaviour was still explained after controlling for it. Nonetheless, other factors may have a confounding effect. The REI-Health should be used in the prediction of objectively measured behaviour, for instance, a healthy versus unhealthy snack choice such as that employed by Conner et al. (2007), asking participants to wear pedometers, an offer to participate in FOBT screening, or perhaps the choice of stairs versus a lift when required to shift to a different floor during an experiment. Additionally, there would be scope in such a study to measure and/or manipulate the extent to which people think effortfully about these health decisions, and therefore to explore how well the REI-Health can predict this.

Accumulated research has concluded that people higher in experientiality prefer information to be delivered in pictorial format (Bakker, 1999), using emotional appeals (Vidrine et al., 2007), with minimal detail (Williams-Piehota et al., 2003) and employing trusted communicators (Cacioppo et al., 1996) whereas those higher in rationality prefer more detailed empirical information (Vidrine et al., 2007). The REI-Health offers a new way to measure type 1 and 2 thinking in relation to health, so health communications using the formats listed above should be tested with a sample whose health thinking style is also measured, to confirm and refine previous findings. An interesting extension would be to design a health communication tool such as a brochure, and embed differing information in more 'type 1 friendly' and 'type 2 friendly' formats. By asking participants to report on what they learned from the brochure, it would be possible to determine whether health thinking style predicts the information formats that are preferred or relied upon in health-related communications. It has previously been pointed out that health information should be structured so as to appropriately engage both type 1 and 2 processes in order to capitalise on the strengths and counter the weaknesses of each (de Vries et al., 2013) and greater understanding of the effectiveness of 'dual channel' communication may help produce more effective health communications.

7.7. Conclusion

The work presented in this dissertation provides insights into thinking style, health attitudes and health behaviour — three areas that attract substantial research interest in their own right, but the nexus between them has received limited attention. The results reported here support a more complex picture of thinking style, in which people have trait-like preferences for type 1 and type 2 thinking, but may flexibly adapt their use of each thinking type when it comes to health-related thinking. Furthermore, thinking style (both at the trait and health-specific levels) was established as a possible predictor of health behaviour, explaining small amounts of variance in digital rectal examination participation in one sample, and in another sample explaining some variance in diet quality, faecal occult blood test participation and pap smear participation. Finally, results showing counterintuitive interactions between attitudes and thinking style in predicting diet quality suggest a need for further research into how the types of thinking and types of attitudes operate. Primary and secondary prevention of non-communicable disease relies upon improving the scientific understanding of health behaviour. The body of this thesis builds (and at times complicates) this knowledge, as well as presenting new psychometric tools and suggesting avenues for further inquiry.

APPENDIX A. STUDY 1: GENSPEC BASELINE SURVEY.

Selected pages from the Genspec baseline survey are shown on the following pages. Only those containing items that were used in Study 1 are included. The items below provided data for Study 1:

- Q2
- Q27
- Q30
- Q110
- Q163
- Q165
- Q168.

Section 1- Screening for bowel cancer with a home stool test

Screening for bowel cancer involves having a test to check if the disease is present before you experience any symptoms. A home stool test kit (also known as a Faecal Occult Blood test, or FOBT) is used to collect small samples of your stool (bowel motion) at home. These samples are sent to a laboratory to be tested for the presence of blood that may not be visible to the human eye.

Q1. Before this test was described above, had you ever heard of a home stool test?

① Yes

② No → skip to Section 3 on page 7

Q2. Have you ever used a home stool test to screen for bowel cancer?

① Yes

② No

③ Unsure/don't know

Q3. Have you thought about using a home stool test in the future (either again or for the first time)?

① Yes

② No → skip to Section 2 over the page

③ Unsure/don't know → skip to Section 2 over the page

Q4. Which of the following best describes your thoughts about doing a home stool test in the future (either again or for the first time)?

① I intend to do a home stool test in the future

② I am not sure if I will do a home stool test in the future

③ I do not intend to do a home stool test in the future

Section 4- Experience with other types of cancer screening tests

In Australia, there are different ways that men can screen for prostate cancer: One method is a Prostate Specific Antigen (PSA) blood test that measures the level of PSA in your blood. PSA is produced by your prostate and a high level of this may indicate the possibility of prostate cancer. Your doctor would prescribe this test for you and further tests, such as a biopsy, would be required to confirm a cancer diagnosis if PSA levels were too high.

Q27. Have you ever screened for prostate cancer with a PSA test as described above?

① Yes

② No → skip to Question 30

③ Unsure/Don't Know → skip to Question 30

Q28. When was your most recent PSA test?

① A year ago or less

② More than one but not more than five years ago

③ More than five but not more than 10 years ago

④ More than 10 years ago

Q29. How satisfied were you with the overall experience of your most recent PSA test?

Please answer in relation to the overall experience of having the PSA test including; arranging the appointment, preparing for the test, completing the test and receiving your results.

Very Unsatisfied	Unsatisfied	Neither Satisfied or Unsatisfied	Satisfied	Very Satisfied
①	②	③	④	⑤

A different way to check for prostate cancer is with a Digital Rectal Examination (DRE). A DRE would be performed by your doctor who would insert a gloved finger into your rectum to feel the prostate gland for signs of abnormalities like prostate cancer. Further tests, such as a biopsy, would be required to confirm a cancer diagnosis if necessary.

Q30. Have you ever screened for prostate cancer with a DRE as described above?

① Yes

② No → skip to Question 33

③ Unsure/Don't Know → skip to Question 33

Q31. When was your most recent DRE?

① A year ago or less

② More than one but not more than five years ago

③ More than five but not more than 10 years ago

④ More than 10 years ago

Q32. How satisfied were you with the overall experience of your most recent DRE?
Please answer in relation to the overall experience of having the DRE, including arranging the appointment, preparing for the test, completing the test and receiving your results.

Very Unsatisfied	Unsatisfied	Neither Satisfied or Unsatisfied	Satisfied	Very Satisfied
①	②	③	④	⑤

Q33. What is your current smoking status?

① Current smoker

② Former smoker

③ Never smoked → skip to Section 5 over the page

There are several ways to screen for signs of lung cancer. One way involves a special type of X-ray of the chest called a CT scan. This scan usually takes about two minutes and does not cause any physical discomfort or pain. For this, you lie on a table which then moves through the scanner, which is shaped like a large open doughnut. The test is performed in a medical imaging clinic by a trained radiologist. Further testing would be required to confirm lung cancer diagnosis if necessary.

Q34. If you were provided with an opportunity to screen for lung cancer using the test described above, how likely is it that you would do the test?

Very Unlikely	Unlikely	Neither Likely or Unlikely	Likely	Very Likely
①	②	③	④	⑤

Section 6- Interactions with health care professionals

The following pages include questions about your interactions with health care professionals, please read and answer ALL of them.

Q110. Approximately how many times do you think you have visited a doctor within the last 12 months?

① Not at all
② Once
③ Twice
④ Three times
⑤ Four or more times

Q111. Do you have a regular doctor? For example, someone that you try and see most times that you need medical advice?

① Yes
② No

Q112. Which of the following best describes your reasons for visiting a doctor? Fill in as many options as you like.

O To obtain scripts/prescriptions
O Advice/education/counselling for a medical concern or general enquiry
O For ongoing management of a chronic/specific health condition
O For an immunisation
O For a general health check
O For treatment of a wound
O Other (Please specify)..

Q113. Has a doctor ever recommended that you use a home stool test to screen for bowel cancer?

① Yes
② No
③ Unsure/don't know

Section 10- Background information

In this final section, please either write in a response or colour the appropriate circle that best describes you. Please be assured that your answers here, and throughout the survey, will remain strictly confidential.

Q163.What is your date of birth? __ __ **Day** __ __ **Month** __ __ __ __ **Year**

Q164.What is your current employment status?

① Full-time employed
② Part-time employed
③ Unemployed
④ Retired
⑤ Home duties/Home carer

Q165.What is the highest level of education you have completed? (For example, if you finished high school in year 10 then your highest level of education is junior secondary education)

Primary School (finished year 7)	①	Diploma/Advanced Diploma	⑤
Junior Secondary School (finished year 10)	②	Bachelor Degree	⑥
Senior Secondary School (finished year 12)	③	Graduate Diploma/Certificate	⑦
Technical certificate	④	Postgraduate Degree	⑧

Q166.Were you born in Australia?

① Yes ⟶ skip to question 168
② No

Q167.How many years have you lived in Australia? __ __ **Years**

Q168.Do you speak a language other than (or in addition to) English at home?

① Yes
② No

Q169.Do you have private health insurance?

① Yes, both extras and hospital cover
② Yes, hospital cover only
③ Yes, extras cover only
④ No

APPENDIX B. STUDY 2: GENSPEC ENDPOINT SURVEY.

Selected pages from the Genspec endpoint survey are shown on the following page. Only the page containing items that were used in Study 1 are included. The items below provided data for Study 1:

- Q79 – Q88.

Section 3 - Decision Making

The following is a list of things that might be important when making a decision about whether to use a bowel cancer screening test. Please rate how important ALL of the following are to you.

	Not at all important	Slightly important	Moderately important	Important	Very important
Q74. That the test is free	①	②	③	④	⑤
Q75. That I do not need to travel to do the test	①	②	③	④	⑤
Q76. That my doctor is involved in the testing process	①	②	③	④	⑤
Q77. That I am comfortable with the sampling procedure	①	②	③	④	⑤
Q78. That the test will find bowel cancer if I have it	①	②	③	④	⑤

Please rate ALL of the following statements about your feelings, beliefs and behaviours using the scale below.

	Completely false	Partially false	Neither true or false	Partially true	Completely true
Q79. I don't like to have to do a lot of thinking	①	②	③	④	⑤
Q80. I try to avoid situations that require thinking in depth about something	①	②	③	④	⑤
Q81. I prefer to do something that challenges my thinking abilities rather than something that requires little thought	①	②	③	④	⑤
Q82. I prefer complex to simple problems	①	②	③	④	⑤
Q83. Thinking hard and for a long time about something gives me little satisfaction	①	②	③	④	⑤
Q84. I trust my initial feelings about people	①	②	③	④	⑤
Q85. I believe in trusting my hunches	①	②	③	④	⑤
Q86. My initial impressions of people are almost always right	①	②	③	④	⑤
Q87. When it comes to trusting people I can usually rely on my "gut feelings"	①	②	③	④	⑤
Q88. I can usually feel when a person is right or wrong even if I can't explain how I know	①	②	③	④	⑤

APPENDIX C. STUDY 2: HABIT STUDY PROMOTION.

Figure 12. Promotional flyers.

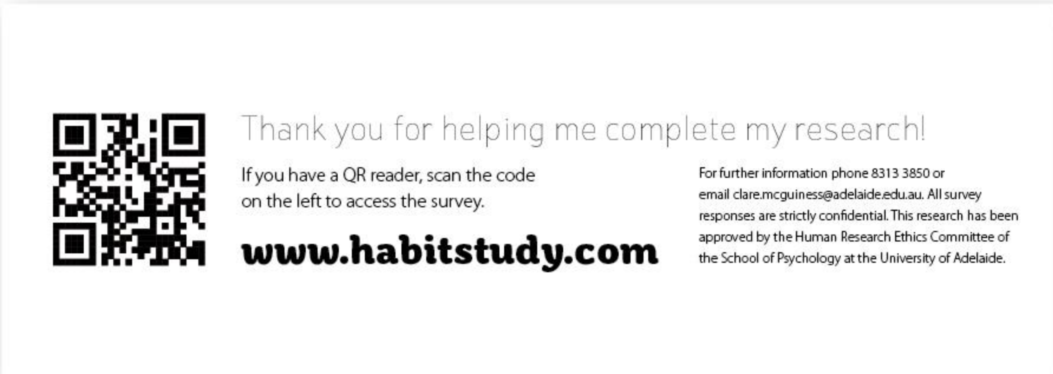


Figure 13. Promotional poster.

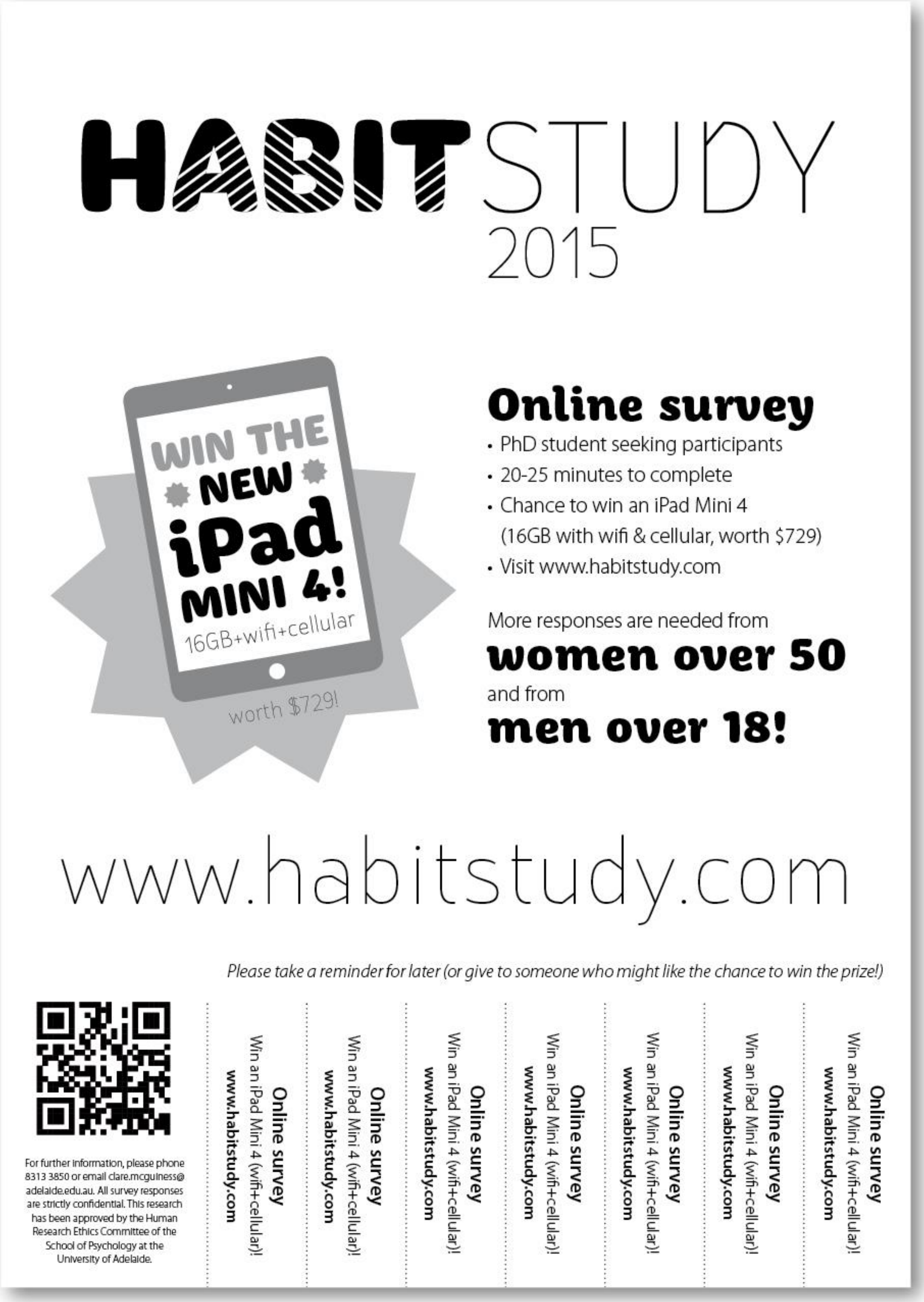


Figure 14. Promotion in email sent to Foundation 49 newsletter subscribers.

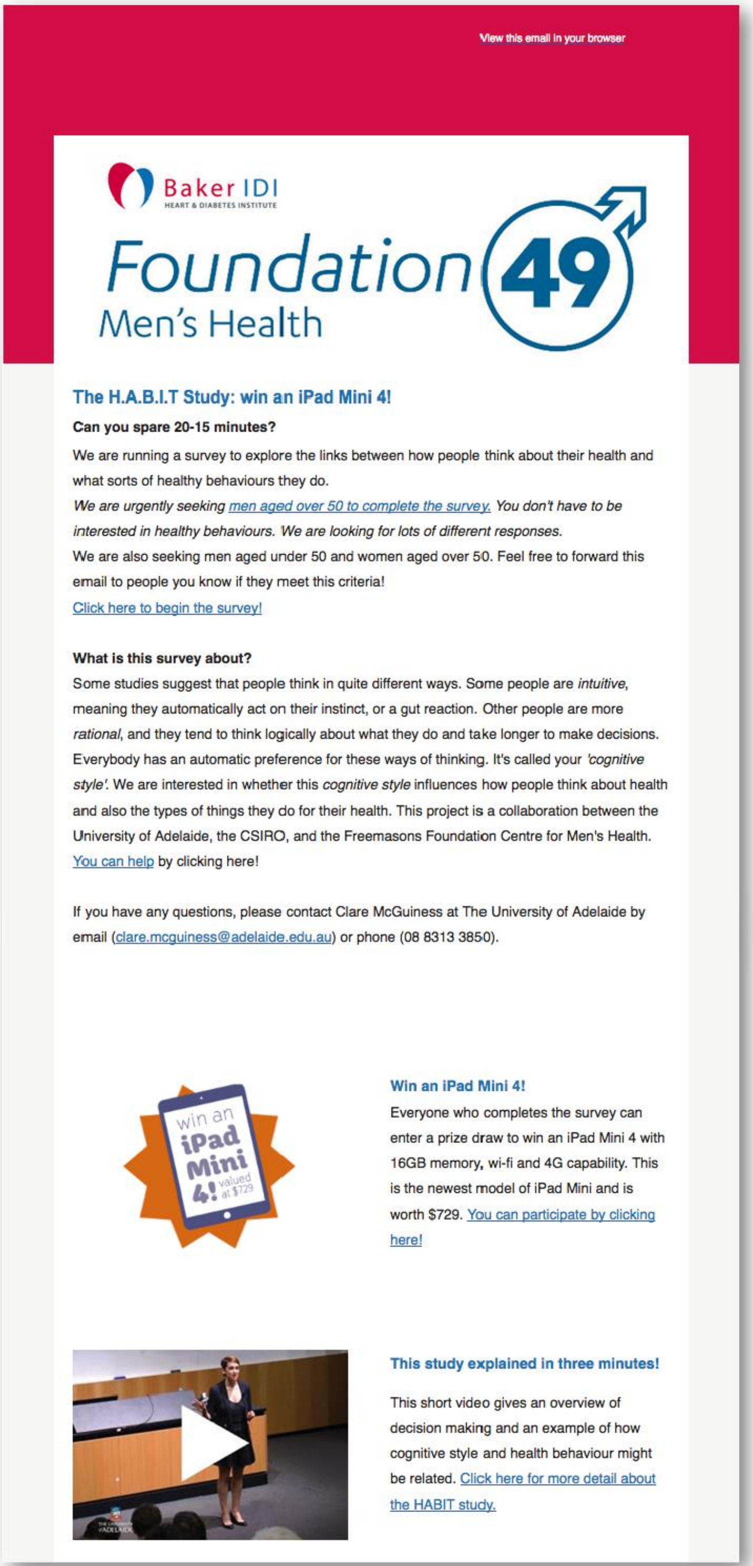
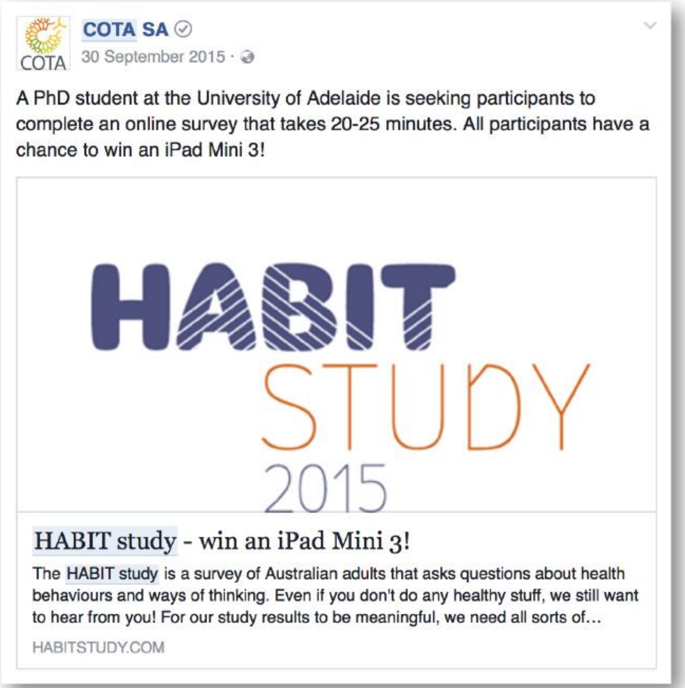
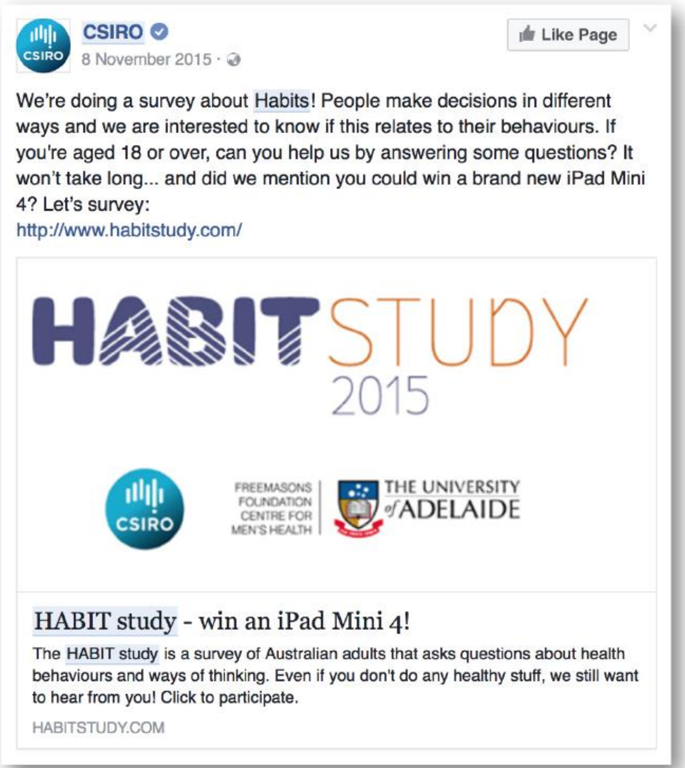


Figure 15. Promotion on the Facebook pages of Council of the Ageing South Australia and the Commonwealth Scientific and Industrial Research Organisation.





APPENDIX D. STUDY 2: HABIT STUDY T1 SURVEY.

The HABIT study T1 survey is shown on the following pages.

The HABIT study

PROJECT TITLE: Health and ways of thinking
PRINCIPAL INVESTIGATOR: Prof Deborah Turnbull
STUDENT RESEARCHER: Clare McGuiness
STUDENT'S DEGREE: PhD

Dear Participant,
You are invited to participate in the research project described below.

iPad Mini draw: To thank you for your time, all participants who complete the survey are eligible to enter a random draw for an iPad Mini 4 (16GB; wifi and cellular) valued at $729. **This is the NEW iPad Mini released in September 2015!** To enter the draw, you must provide your details on the last page of the survey. You will have the chance to receive a second entry by agreeing to be contacted for a follow-up study.

Please note that the survey is only open to Australian residents, and as such, only Australian residents are eligible to win the iPad (the prize will not be mailed to an address outside Australia).

What is the project about?
Questions will focus on your thoughts about, and participation in, various health behaviours. There will also be some questions about ways of thinking and personality. All responses are completely confidential, and your honest responses are appreciated.

Who is undertaking the project?
This project is being conducted by Mrs Clare McGuiness. This research will form the basis for the degree of PhD at the University of Adelaide under the supervision of Prof. Deborah Turnbull, Prof. Carlene Wilson, and Dr Ian Zajac. Scholarship support has been received from CSIRO, The Freemasons Foundation Centre for Men's Health, and the Australian Government.

Why am I being invited to participate?
We are seeking Australian residents aged over 18 to participate.

What will I be asked to do?
To participate, complete the survey on the following pages.

How much time will the project take?
The survey is expected to take between 20 and 30 minutes to complete.

Are there any risks associated with participating in this project?
Other than the inconvenience of giving up your time, it is not expected that participating in this survey will cause any discomfort or distress.

If you do find that completing the survey brings up worries or concerns, we recommend utilising one of the following excellent resources:

- BeyondBlue, 1300 22 4636 or www.beyondblue.org.au: advice and support for anxiety and depression
- Lifeline, 13 11 14 or www.lifeline.org.au: crisis support and suicide prevention
- The Cancer Council helpline, 13 11 20: a free, confidential telephone information and support service run by your state's Cancer Council

If you have any health-specific worries or questions, the best person to speak to is your doctor.

What are the benefits of the research project?
While participation provides no immediate benefit to you, it is our hope that this research will aid in the understanding of the ways people think about healthy behaviours.

Can I withdraw from the project?
Participation in this project is completely voluntary. You can stop completing the survey at any time by closing the browser window or tab. If you want to ensure that data you have already entered is deleted from our servers, please contact Clare McGuiness on (08) 8313 3850.

What will happen to my information?
Survey data will be stored on secure servers and only the researchers will have access. Contact details will be stored in a separate database to survey responses, linked only by a

common identification number. Although there will eventually be a PhD thesis, research articles and conference presentations written using the data, no individual participants will be identified. At the end of the survey you will have the opportunity to request a basic summary of the overall project findings be provided by email.

Who do I contact if I have questions about the project?

In the first instance, please contact: Clare McGuiness on (08) 8313 3850.

Other researchers:
Professor Deborah Turnbull (08) 8313 1229
Professor Carlene Wilson (08) 7221 8473
Dr Ian Zajac (08) 8303 8875.

What if I have a complaint or any concerns?
The study has been approved by the Human Research Subcommittee in the School of Psychology, University of Adelaide. If you have questions or problems associated with the practical aspects of your participation in the project, or wish to raise a concern or complaint about the project, then you should consult the Principal Investigator. Contact Paul Delfabbro (Chair of the Human Research Subcommittee) on phone +61 8 8313 4936 or by email to paul.delfabbro@adelaide.edu.au if you wish to speak with an independent person regarding concerns or a complaint, the University's policy on research involving human participants, or your rights as a participant. Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If I want to participate, what do I do?
By clicking the 'Next' button below, you indicate your consent to be included in our study, and the survey will begin.

Yours sincerely,
Mrs Clare McGuiness, Prof Deborah Turnbull, Prof Carlene Wilson, and Dr Ian Zajac.

To participate, please read the statements below and indicate whether you give your consent.

1. I have been informed of, and understand, the proposed research.
2. I have been informed that information provided will be kept confidential.
3. I understand that I am free to withdraw consent at any time (I can stop filling out the survey and/or contact the researchers to request my data be deleted).

If you have read and understood the information above, and give your consent to be included in this research, please click 'Next' to begin.

A little about you

Please tell us your date of birth using the three following boxes.

1. Please enter your <u>year</u> of birth: *

Year: [ ]

2. Please select your <u>month</u> of birth: *

- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

3. Please enter the <u>day</u> of the month on which you were born: *

Day: [ ]

4. Are you an Australian resident? *

- Yes
- No

A little about you

5. In which post code do you usually live? *

6. What is your gender? *

- Female
- Male
- Different identity

Later in the survey, depending on your age group, we may ask questions about cancer screening tests that are related to male or female biological sex.

7. You may choose to complete questions on:

- Prostate cancer screening
- Breast and cervical cancer screening
- None of the above are relevant to me (skip the prostate, breast, and cervical cancer screening questions)

8. What is your current marital status? *

- Never married
- Widowed
- Divorced
- Separated but not divorced
- Married / de facto relationship
- Prefer not to answer

9. Were you born in Australia or another country? *

- Born in another country
- Born in Australia

10. Do you speak a language other than English at home? *

- Yes
- No

11. How well do you speak English? *

- Very well
- Well
- Not well

12. What is the highest level of education you have completed? *

- Did not go to school
- Year 8 or below
- Year 9 or equivalent
- Year 10 or equivalent
- Year 11 or equivalent
- Year 12 or equivalent
- TAFE or Trade certificate
- Diploma or Associate degree
- Bachelor degree
- Postgraduate qualification (e.g. Grad Dip, Masters, PhD)

13. What is your current employment status? (If more then one option applies, choose the one that represents the *greatest portion* of your income.) *

- In paid employment
- Unemployed
- Retired
- Carer or home duties
- Student
- Receiving pension
- Other (please specify)

14. Approximately how many times have you visited a doctor in the last 12 months? *

- ○ I have not been to the doctor in the past 12 months
- ○ Once
- ○ Twice
- ○ Three times
- ○ Four or more times

15. How would you rate your overall health at the present time? *

Very poor	Poor	Fair	Good	Very good
○	○	○	○	○

16. At the present time, how important is your health in your life? *

Not at all important	Slightly important	Moderately important	Very important	Extremely important
○	○	○	○	○

Health vignettes

Survey tips:

1. *You do not think too hard about any one question.*
2. *Sometimes no response option will completely match your opinion; simply choose the one that is closest.*
3. *If you have trouble using the survey on a mobile device or tablet, you can use the bar above to save it and continue on a computer.*
4. *The survey takes 15-25 minutes. Depending on age and gender you may be exempted from answering some questions. If you notice the progrss bar jump forward a large amount, you have just skipped past one or more pages.*

Over the next few pages, you will be presented with a series of short descriptions of different people. Please read the description and then provide ratings on the sliders following it, based on the small amount of information you have been given.

We are interested in your first impressions and there are no right or wrong answers

Health vignettes

Mary says she has nowhere she can do exercise. But really, she has never enjoyed exercising at all. Her doctor said she should get more active to lower her risk of disease, so she signed up at a nearby gym. But Mary dislikes exercising in public. Her weight troubles her and because of this she hates to wear gym clothes. She often finds herself at home watching TV rather than going to the aerobics classes that she signed up for.

To give a rating, either drag the slider (circle) along the bar, or select any point on the bar.

17. Please rate Mary's **determination** (i.e. overcoming barriers) when it comes to exercising: *

Low High

18. Please rate Mary's **wisdom** (i.e. doing what is beneficial) when it comes to exercising: *

Low High

19. Please rate how **health-conscious** Mary is (i.e. looking after her health) when it comes to exercising: *

Low High

Health vignettes

James knows that his wife and kids would be really pleased if he quit smoking for good. But he doesn't think they understand how hard it is to quit, because they've never been addicted. He's cut down a bit over the past couple of years. He says he doesn't think that it makes a difference to his health. He hates wasting money and is known to be thrifty, but his cigarettes feel like something he can't live without, just now.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

20. Please rate James's **determination** (i.e. overcoming barriers) when it comes to quitting smoking: *

Low High

21. Please rate James's **wisdom** (i.e. doing what is beneficial) when it comes to quitting smoking: *

Low High

22. Please rate how **health-conscious** James is (i.e. looking after his health) when it comes to quitting smoking: *

Low High

Health vignettes

Jay feels like no matter what he eats, he's always overweight. But when it's so much effort to buy and prepare healthy foods, he often just can't be bothered. He's always so tired by dinner time so he craves something tasty and easy like fast food. He recently found out that he is at higher than average risk of heart disease. Since then he feels he has made an effort, such as starting to order his coffees with skim milk.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

23. Please rate Jay's **determination** (i.e. overcoming barriers) when it comes to healthy eating: *

Low High

24. Please rate Jay's **wisdom** (i.e. doing what is beneficial) when it comes to healthy eating: *

Low High

25. Please rate how **health-conscious** Jay is (i.e. looking after his health) when it comes to healthy eating: *

Low High

Health vignettes

Months ago, the government mailed Terry a home stool test. He thought this was a good program that would save lives. Ignoring his embarrassment, he put the test in his family's busy kitchen as a reminder. Doing the test would stop him worrying about bowel cancer. He thinks if cancer is found early the treatment won't be as awful. Yet he still can't bring himself to collect his stool samples even on those days when he has plenty of time.

Home stool test (also known as Faecal Occult Blood Test or FOBT): A test to screen for bowel cancer. You collect samples of two or more bowel movements on a stick, brush or card, and mail the samples off for processing.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

26. Please rate Terry's **determination** (i.e. overcoming barriers) when it comes to early detection of bowel cancer: *

Low High

27. Please rate Terry's **wisdom** (i.e. doing what is beneficial) when it comes to early detection of bowel cancer: *

Low High

28. Please rate how **health-conscious** Terry is (i.e. looking after his health) when it comes to early detection of bowel cancer: *

Low High

Health vignettes

When Selma's colleague needed large amounts of chemotherapy for cervical cancer that was found late, Selma said she'd begin having Pap smears every two years. But she hasn't been to the doctor yet. Finding time is not a problem. But the Pap smear process sounds pretty embarrassing to Selma. Nonetheless, she tells younger women at work that a Pap smear might save their lives. When a colleague complains that it hurts a little, Selma tells her she's being weak.

Pap smear: A test to screen for cervical cancer. A doctor takes a sample of cells from the cervix.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

29. Please rate Selma's **determination** (i.e. overcoming barriers) when it comes to early detection of cervical cancer: *

Low High

30. Please rate Selma's **wisdom** (i.e. doing what is beneficial) when it comes to early detection of cervical cancer: *

Low High

31. Please rate how **health-conscious** Selma is (i.e. looking after her health) when it comes to early detection of cervical cancer: *

Low High

Health vignettes

Leila has raised money for the Cancer Council before. So she knows about how mammograms can detect lumps and lower the risk of dying from breast cancer. A letter about having a mammogram arrived six months ago. Leila knows the test doesn't take long, but the idea of finding a problem is scary. So is the thought of having treatment for even a small lump. She delays making the booking because the last time she felt ashamed and slightly uncomfortable.

Mammogram: A test to screen for breast cancer. A radiographer uses a machine to take x-rays of each breast.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

32. Please rate Leila's **determination** (i.e. overcoming barriers) when it comes to early detection of breast cancer: *

Low High

33. Please rate Leila's **wisdom** (i.e. doing what is beneficial) when it comes to early detection of breast cancer: *

Low High

34. Please rate how **health-conscious** Leila is (i.e. looking after her health) when it comes to early detection of breast cancer: *

Low High

Health vignettes

Huy knows all about prostate cancer. He worries about it sometimes, but thinks being tested might make him worry more. He's heard that PSA tests can detect prostate cancer that has no symptoms. But he's confused about whether it's helpful to detect a prostate cancer that has no symptoms. Plus, he has always hated needles. And his schedule is fuller than ever since he retired. He'd probably visit his GP for a chat about it if he had more time.

PSA test (Prostate Specific Antigen test): A test to screen for prostate cancer. A blood sample is taken using a needle, and then it is sent to a lab.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

35. Please rate Huy's **determination** (i.e. overcoming barriers) when it comes to early detection of prostate cancer: *

Low High

36. Please rate Huy's **wisdom** (i.e. doing what is beneficial) when it comes to early detection of prostate cancer: *

Low High

37. Please rate how **health-conscious** Huy is (i.e. looking after his health) when it comes to early detection of prostate cancer: *

Low High

Health vignettes

Marco's doctor said next check-up, he'd give Marco a digital rectal examination. The thought of having prostate cancer and not knowing is a bit of a concern. But Marco reckons he'd still be worried even after the test. He thinks he'll feel ashamed and it might hurt. He tells himself that the hassle is nothing compared to finding prostate cancer late when treatment is so much worse. Still, he's been putting off going to the doctor for two years now.

Digital rectal examination: A test to screen for prostate cancer. A doctor inserts a gloved finger into your rectum to feel the prostate.

To give a rating, either drag the slider (circle) with your mouse, or click at any point along the bar.

38. Please rate Marco's **determination** (i.e. overcoming barriers) when it comes to early detection of prostate cancer: *

Low High

39. Please rate Marco's **wisdom** (i.e. doing what is beneficial) when it comes to early detection of prostate cancer: *

Low High

40. Please rate how **health-conscious** Marco is (i.e. looking after his health) when it comes to early detection of prostate cancer: *

Low High

Ways of thinking

41. Please select the option that best applies to you, below. Don't spend too much time thinking about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I am not very good at solving problems that require careful logical analysis	○	○	○	○	○
When I'm sad, it's often a very strong feeling	○	○	○	○	○
I trust my initial feelings about people	○	○	○	○	○
I enjoy reading things that evoke visual images	○	○	○	○	○
Emotions don't really mean much: they come and go	○	○	○	○	○
When I have a strong emotional experience, the effect stays with me for a long time	○	○	○	○	○
I can clearly picture or remember some sculpture or natural object (not alive) that I think is very beautiful	○	○	○	○	○
I enjoy intellectual challenges	○	○	○	○	○
I often go by my instincts when deciding on a course of action	○	○	○	○	○
Reasoning things out carefully is not one of my strong points	○	○	○	○	○
I enjoy problems that require hard thinking	○	○	○	○	○
I don't think it is a good idea to rely on one's intuition for important decisions	○	○	○	○	○
I enjoy imagining things	○	○	○	○	○

Ways of thinking

42. Please select the option that best applies to you.
Remember, you don't need to think for too long about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Photographs of illness and disease don't have any impact on me	○	○	○	○	○
I'm not the best at reasoning complex health issues out carefully	○	○	○	○	○
When a decision may affect my health, I think hard about it	○	○	○	○	○
When the health issues of someone I know (or a health story on television) affects me emotionally, I remember for a long time	○	○	○	○	○
I find my emotions seem to overpower my good intentions about acting healthily	○	○	○	○	○
My imagination helps me to understand my health choices and their consequences	○	○	○	○	○
When making an important health decision, I don't believe you should rely on gut reactions	○	○	○	○	○
I prefer health professionals to explain things to me in a way that helps me visualise them	○	○	○	○	○
I think about strategies for improving my health	○	○	○	○	○
I trust my initial feelings about health matters	○	○	○	○	○
I'm not one to spend time pondering my health	○	○	○	○	○
My instincts know what's best for me	○	○	○	○	○
My emotions don't provide any useful guidance in health matters	○	○	○	○	○

Personality

43. How well do the following statements describe your personality?

I tend to think of myself as someone who... *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
... is reserved	○	○	○	○	○
... is generally trusting	○	○	○	○	○
... tends to be lazy	○	○	○	○	○
... is relaxed, handles stress well	○	○	○	○	○
... has few artistic interests	○	○	○	○	○
... is outgoing, sociable	○	○	○	○	○
... tends to find fault with others	○	○	○	○	○
... does a thorough job	○	○	○	○	○
... gets nervous easily	○	○	○	○	○
... has an active imagination	○	○	○	○	○
... is considerate and kind to almost everyone	○	○	○	○	○

Bowel cancer screening

Please tell us about your use of, and thoughts about, cancer screening tests. If you are unfamiliar with any of the names, see the descriptions above each set of questions.

Home stool test (also known as Faecal Occult Blood Test or FOBT):
A test to screen for bowel cancer. You collect samples of two or more bowel movements on a stick, brush or card, and mail the samples off for processing.

44. Have you ever completed a home stool test? *

- Yes, in the past 2 years
- Yes, more than 2 years ago
- No
- Unsure

45. What led to your most recent home stool test? *

- I received it in the mail
- I requested it from my doctor or purchased it
- My doctor suggested it as a general check-up
- My doctor suggested it because I had a symptom or health problem
- It was required to follow up a previous result/diagnosis
- Other
- Unsure or don't remember

46. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A home stool test will help me not worry as much about bowel cancer.	○	○	○	○	○
A home stool test is embarrassing.	○	○	○	○	○
Finding bowel cancer early will save my life.	○	○	○	○	○
Collecting a stool sample to do a home stool test does not bother me at all.	○	○	○	○	○
Treatment for bowel cancer may not be as bad if it is found early.	○	○	○	○	○
I do not have the time to do a home stool test.	○	○	○	○	○

47. Which of the following best describes your thoughts about doing a home stool test in future (either again or for the first time)? *

- ○ I intend to do a home stool test in the future
- ○ I am not sure if I will do a home stool test in future
- ○ I do not intend to do a home stool test in the future

Cervical cancer screening

Please tell us about your use of, and thoughts about, cancer screening tests. If you are unfamiliar with any of the names, see the descriptions above each set of questions.

Pap smear:
A test to screen for cervical cancer. A doctor takes a sample of cells from the cervix.

---

48. Have you ever had a Pap smear? *

- Yes, in the past 2 years
- Yes, more than 2 years ago
- No
- Unsure

49. What led to your most recent Pap smear? *

- I received a reminder in the mail
- I requested it
- My doctor suggested it as a general check-up
- I had a symptom or health problem
- It was required to follow up a previous result/diagnosis
- Other
- Unsure or don't remember

50. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I think that having a regular Pap smear is the best way for cervical cancer to be diagnosed early.	○	○	○	○	○
Having a Pap smear takes too much time.	○	○	○	○	○
Having regular Pap smears will decrease my chances of dying from cervical cancer.	○	○	○	○	○
Having a Pap smear causes no discomfort whatsoever.	○	○	○	○	○
If cervical cancer was found at a regular Pap smear its treatment would not be so bad.	○	○	○	○	○
It is embarrassing to show my private parts to have a Pap smear.	○	○	○	○	○

51. Which of the following best describes your thoughts about having a Pap smear in future (either again or for the first time)? *

- ○ I intend to have a Pap smear in the future
- ○ I am not sure if I will have a Pap smear in future
- ○ I do not intend to have a Pap smear in the future

Breast cancer screening

Mammogram:
A test to screen for breast cancer. A radiographer uses a machine to take x-rays of each breast.

52. Have you ever had a mammogram? *

- Yes, in the past 2 years
- Yes, more than 2 years ago
- No
- Unsure

53. What led to your most recent mammogram? *

- I received an invitation in the mail
- I requested it
- My doctor suggested it as a general check-up
- My doctor suggested it because I had a symptom or health problem
- It was required to follow up a previous result/diagnosis
- Other
- Unsure or don't remember

54. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Having a mammogram is the best way for me to find a very small lump in my breast.	○	○	○	○	○
Having a mammogram is too embarrassing.	○	○	○	○	○
Having a mammogram will decrease my chances of dying from breast cancer.	○	○	○	○	○
Having a mammogram is too painful.	○	○	○	○	○
If I find a lump through a mammogram, my treatment for breast cancer may not be as bad.	○	○	○	○	○
Having a mammogram is easy to fit into my schedule.	○	○	○	○	○

55. Which of the following best describes your thoughts about having a mammogram in future (either again or for the first time)? *

- ○ I intend to have a mammogram in the future
- ○ I am not sure if I will have a mammogram in future
- ○ I do not intend to have a mammogram in the future

Prostate cancer screening

Please tell us about your use of, and thoughts about, cancer screening tests. If you are unfamiliar with any of the names, see the descriptions above each set of questions.

PSA test (Prostate Specific Antigen test):
A test to screen for prostate cancer. A blood sample is taken using a needle, and then it is sent to a lab.

56. Have you ever had a PSA test? *

- Yes, in the past 2 years
- Yes, more than 2 years ago
- No
- Unsure

57. What led to your most recent PSA test? *

- I requested it from my doctor
- My doctor suggested it as a general check-up
- My doctor suggested it because I had a symptom or health problem
- It was required to follow up a previous result/diagnosis
- Other
- Unsure or don't remember

58. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Having a PSA test would mean I won't worry as much about prostate cancer.	○	○	○	○	○
Giving the blood sample for a PSA test would be uncomfortable.	○	○	○	○	○
Having a PSA test would allow me to find prostate cancer early.	○	○	○	○	○
Having a PSA test is quick and convenient.	○	○	○	○	○
Treatment for prostate cancer is more successful if it is detected early by PSA testing.	○	○	○	○	○
Having a PSA test will make me worry about prostate cancer.	○	○	○	○	○

59. Which of the following best describes your thoughts about having a PSA test in future (either again or for the first time)? *

- ○ I intend to have a PSA test in the future
- ○ I am not sure if I will have a PSA test in future
- ○ I do not intend to have a PSA test in the future

Digital rectal examination (DRE):
A test to screen for prostate cancer. A doctor inserts a gloved finger into your rectum to feel the prostate.

60. Have you ever had a digital rectal examination? *

- ○ Yes, in the past 2 years
- ○ Yes, more than 2 years ago
- ○ No
- ○ Unsure

61. What led to your most recent digital rectal examination? *

- ○ I requested it from my doctor
- ○ My doctor suggested it as a general check-up
- ○ I had a symptom or health problem
- ○ It was required to follow up a previous result/diagnosis
- ○ Other
- ○ Unsure or don't remember

62. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Having a digital rectal examination would mean I won't worry as much about prostate cancer.	○	○	○	○	○
A digital rectal examination is embarrassing.	○	○	○	○	○
Having a digital rectal examination would allow me to find prostate cancer early.	○	○	○	○	○
Having a digital rectal examination is unpleasant.	○	○	○	○	○
Having a digital rectal examination can help to find prostate cancer early when treatment is not as bad.	○	○	○	○	○
Having a digital rectal examination is a convenient way to find prostate cancer.	○	○	○	○	○

63. Which of the following best describes your thoughts about having a digital rectal examination in future (either again or for the first time)? *

- ○ I intend to have a digital rectal examination in the future
- ○ I am not sure if I will have a digital rectal examination in future
- ○ I do not intend to have a digital rectal examination in the future

Smoking

In this section of the questionnaire you will be asked about current and previous smoking behaviour. These questions refer to all forms of smoking Tobacco (manufactured cigarettes, hand-rolled cigarettes, pouch tobacco, pipes etc).

Please answer in relation to tobacco smoking only.

64. Please select which of the following options best describes your smoking behaviour. *

- I am a current smoker of cigarettes/tobacco
- I am an ex-smoker of cigarettes/tobacco
- I have never smoked cigarettes or tobacco

65. Have you ever smoked cigarettes regularly, and at least one cigarette per day? *

- Yes
- No

66. What age were you when you first started smoking regularly? *

67. What age were you when you quit smoking completely, and have not smoked since? *

68. During the time you've smoked, did you ever quit for 3 months or more?

- Yes
- No

69. Adding all times you quit for 3 months or more, for how many years and months in total did you quit before starting again?

Ex-smokers should not include the time after you stopped smoking completely: only times when you took up smoking again after the quit attempt.

My 'quit' periods add up to: *

Years

Months

70. For the periods in which you smoked regularly, please specify how many of these items you smoked per day, on average. *

Manufactured cigarettes per day:

Hand-rolled cigarettes per day:

Tobacco pipes per day:

71. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Quitting smoking makes a person feel healthier.	○	○	○	○	○
Addiction makes it hard to quit smoking.	○	○	○	○	○
Quitting smoking saves a person money.	○	○	○	○	○
Non-smokers can easily understand what it's like to quit smoking.	○	○	○	○	○
If a person quits smoking it makes people they care about happy.	○	○	○	○	○
Smokers feel lost without cigarettes.	○	○	○	○	○

72. Which of the following best describes your thoughts about smoking cigarettes in the future (either again or for the first time)? *

○ I intend to smoke cigarettes in the future

○ I am not sure if I will smoke cigarettes in the future

○ I do not intend to smoke cigarettes in the future

73. Which of the following best describes your thoughts about quitting smoking in the future (either again or for the first time)? *

○ I intend to quit smoking in the future

○ I am not sure if I will quit smoking in the future

○ I do not intend to quit smoking in the future

Physical activity

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives.

The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Vigorous activity

Think about all the *vigorous* activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time

Examples:

- heavy lifting
- digging
- aerobics
- fast bicycling
- jogging
- organised sports such as football or netball

74. During the last 7 days, on how many days did you do vigorous physical activities?

If none, enter 0 (zero). *

Days per week:

75. How much time did you usually spend doing *vigorous* physical activities on *one* of those days? *

Hours per day:

Minutes per day:

Moderate activity

Think about all the *moderate* activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

Examples:

- recreational swimming
- dancing
- social or doubles tennis
- golf
- household tasks like cleaning windows or raking leaves
- pushing a stroller
- carrying light loads
- bicycling at a regular pace

76. During the last 7 days, on how many days did you do moderate physical activities? *Do not include walking.*

If none, enter 0 (zero). *

Days per week:

77. How much time did you usually spend doing *moderate* physical activities on *one* of those days? *

Hours per day:

Minutes per day:

Walking

Think about the time you spent *walking* in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

78. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

If none, enter 0 (zero). *

Days per week:

79. How much time did you usually spend *walking* on *one* of those days? *

Hours per day:

Minutes per day:

Sitting

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

80. During the last 7 days, how much time did you spend *sitting* on a *week day*?

Do not include sitting on weekends.
*

Hours per day:

Minutes per day:

81. Please select the option that best applies: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Being active makes me attractive to others.	○	○	○	○	○
I would rather watch TV or read than do something active.	○	○	○	○	○
Exercising regularly lowers my chance of developing certain diseases.	○	○	○	○	○
I have all the equipment I need to be able to exercise and an appropriate area in which to do it.	○	○	○	○	○
I think being active is something fun and enjoyable to do.	○	○	○	○	○
I feel embarrassed when I exercise around other people.	○	○	○	○	○

82. Which of the following best describes your thoughts about being physically active *over the next week*? *

- ○ I intend to be physically active on most days over the next week
- ○ I am not sure if I will be physically active on most days over the next week
- ○ I do not intend to be physically active on most days over the next week

Diet

Thank you for your answers so far! This page contains the final set of survey questions.
(Don't forget to leave your details on the next page to enter the iPad draw.)

Lastly, we would like to ask about your diet. First we will focus on *what you ate yesterday* and then we will ask about your *habits more generally*.

Note: If yesterday's diet was very unusual for you (for example, you were fasting for medical or religious reasons) choose a more normal day to recall, or tell us about your 'average' day.

First, thinking about what you ate and drank yesterday...

83. How many serves of fruit did you eat yesterday?
One serve = 1 medium fruit e.g. apple or 2 small fruit e.g. kiwi or 1 cup tinned fruit *

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 or more

84. How many serves of vegetables and legumes did you eat yesterday?
One serve = 1/2 cup cooked vegetables or 1 cup salad vegetables *

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 or more

85. How many serves of breads and cereals did you eat yesterday?
One serve = 1 slice bread or 1/2 cup cooked rice or pasta *

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 or more

86. Of all bread you ate yesterday, how much was *wholemeal* or *wholegrain*?
If you did not eat any bread, leave blank.

[ ] %

87. Do you eat meat? *

- Yes
- No

88. How many serves of meat (and meat alternatives) did you eat yesterday?
One serve = 1/2 cup cooked meat 1 cup tofu, legumes, or beans or 2 large eggs *

0 1 2 3 4 5 6 or more

89. Of all meat (and meat alternatives) you ate yesterday, how much was *lean*?
If you did not eat any meat or meat alternatives, leave blank.

[ ] %

90. How many serves of dairy products did you consume yesterday?
One serve= 1 cup milk or milk alternative, 2 slices cheese, 3/4 cup yoghurt *

0 1 2 3 4 5 6 or more

91. What type of milk did you consume, mostly? *

- Low-fat or skim
- Whole/full-fat
- Did not consume milk

92. How many glasses of water did you drink yesterday? *

glasses

93. How many glasses of fluids *other than water* did you drink yesterday? (Include juice, soft drink, tea, coffee, alcoholic beverages, and any drink apart from water.) *

glasses

Now, thinking about your dietary habits in general...

94. How many standard drinks of alcoholic beverages do you usually consume in a week? *

95. In general: *

	Never/rarely	Sometimes	Usually	Always
How often do you trim the fat from the meat you eat?	○	○	○	○
How often do you add salt when cooking?	○	○	○	○
How often do you add salt at the table?	○	○	○	○

96. In general: *

	Never/rarely	Once a week or less	Several times a week	Once per day	More than once per day
How often do you consume items with added sugar? (Includes: confectionary, sugar-sweetened soft drinks and cordials, fruit drinks, vitamin waters, energy and sports drinks)	○	○	○	○	○
How often would you eat high fat foods and snacks? (Includes biscuits, cakes, pastries, pies, processed meats, commercial burgers, pizza, fried foods, potato chips, crisps and other savoury snacks)	○	○	○	○	○

97. Please select the option that best applies to you: *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Eating healthy foods and snacks helps me look good.	○	○	○	○	○
I just do not care about eating fruits and vegetables every day.	○	○	○	○	○
Eating healthy foods lowers my chance of developing certain diseases.	○	○	○	○	○
I never crave unhealthy foods.	○	○	○	○	○
Eating healthy foods gives me energy and helps me to be physically active.	○	○	○	○	○
Fresh healthy foods are not easily available.	○	○	○	○	○

98. Which of the following best describes your thoughts about eating healthily *tomorrow*? *

- ○ I intend to eat healthily tomorrow
- ○ I am not sure if I will eat healthily tomorrow
- ○ I do not intend to eat healthily tomorrow

Enter to win an iPad Mini 4 (16GB with wifi and cellular) valued at $729!

An important note regarding **prostate cancer screening**.

We asked a number of questions regarding your thoughts about, and past participation in, prostate cancer screening (e.g. whether you have had a PSA test or digital rectal examination in the past two years). We would like to make clear that while our study reports on these topics, **it is NOT our intention to imply that regular prostate cancer screening is appropriate for all men**.

The current situation with screening for prostate cancer is more complex than with screening for other forms of cancer, such as bowel cancer. Please see below for some current information about prostate cancer screening from Cancer Council Australia, and visit this page for further information.

"The tests most commonly used to aid early detection of prostate cancer are the prostate specific antigen (PSA) blood test and digital rectal examination. Neither test, used separately or in tandem, is accurate enough to distinguish potentially fatal cancers from benign tumours. Both tests also miss harmful cancers.

While some studies suggest PSA reduces mortality on a population basis, the test picks up large numbers of cancers that would have caused no symptoms or harm in the patient. This is known as overdiagnosis. Overdiagnosis of prostate cancer can lead to unnecessary treatments that have side effects such as sexual impotence, urinary incontinence and bowel problems.

Men concerned about prostate cancer should talk to their doctor and make an informed choice about whether to have one of the tests designed to find early signs of prostate cancer, in view of the potential risks and benefits."

---

99. Could you please tell us where you heard about this survey?

- University email: Staff News
- University email: Health Sciences Executive Dean's News
- Freemasons Foundation newsletter
- Freemasons meeting or other
- A flyer in my letterbox
- A public notice
- Via COTA website or social media
- Interview on Radio Adelaide
- Foundation 49 email
- Google search
- Word of mouth
- CSIRO website, Twitter or Facebook
- Other

100. You selected *other*. Could you tell us using the text box below, where you heard about the survey? Thank you!

101. Would you like to enter the draw to win an iPad Mini 3 (16GB with wifi and cellular) valued at $659?

- Yes
- No

To enter the draw to win an iPad Mini 4 (16GB with wifi and cellular) valued at $729, please enter your details below. A winner will be randomly drawn on 1 December 2015. These details will ONLY be used for the purposes of the prize draw, unless you give us specific permission to contact you by email for a follow-up study (details below).

Note: In the event that the winner cannot be contacted within 14 days using the details provided, the prize will be forfeited and the competition re-drawn.

*

Name:

Phone number:

Email:

Get a second entry in the iPad draw to increase your chance of winning! See below.

Can we contact you to participate in a follow-up study? Each participant who agrees to be contacted for a possible follow-up study and provides their email address receives an additional entry into the iPad draw.

Please check that the email address you have provided above is correct.

The follow-up study will be conducted in the next couple of years if it is required. You can decide whether to participate once you receive the invitation. The offer of an extra competition entry does not oblige you to take part in the follow-up research.

- Yes, you may invite me to participate in a follow-up study using the email address I provided above.
- No

Can we contact you to participate in a follow-up study?

The follow-up study will be conducted in the next couple of years if it is required. You can decide whether to participate once you receive the invitation. Agreeing to be contacted again does not oblige you to take part in the follow-up research.

- ○ Yes, you may invite me to participate in a follow-up study.
- ○ No

Please provide an email address we can use to contact you about a follow-up study sometime in the next year or two. This address will ONLY be used for the purposes of inviting you to participate in a follow-up study.

Your name: ________

Email: ________

Thank You!

Thank you very much for participating!

A reminder that if completing the survey has brought up worries or concerns, we recommend visiting one of the following excellent resources:

- BeyondBlue, 1300 22 4636 or www.beyondblue.org.au: advice and support for anxiety and depression
- Lifeline, 13 11 14 or www.lifeline.org.au: crisis support and suicide prevention
- The Cancer Council helpline, 13 11 20: a free, confidential telephone information and support service run by your state's Cancer Council

If you have any health-specific worries or questions, the best person to speak to is your doctor.

If you have questions regarding the survey or research, please contact:

Clare McGuiness
School of Psychology, The University of Adelaide
(08) 8313 1850
clare.mcguiness@adelaide.edu.au .

APPENDIX E. STUDY 2: HABIT STUDY T2 SURVEY.

The HABIT study T2 survey is shown on the following pages.

The HABIT2 study

Identity confirmation

1. Identity confirmation.

Are you the person who identified as [contact("first name")] in the previous survey?

- Yes
- No

A little about you

2. How would you rate your overall health at the present time? *

Very poor	Poor	Fair	Good	Very good
○	○	○	○	○

3. At the present time, how important is your health in your life? *

Not at all important	Slightly important	Moderately important	Very important	Extremely important
○	○	○	○	○

Ways of thinking

4. Please select the option that best applies to you, below. Don't spend too much time thinking about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I trust my initial feelings about people	○	○	○	○	○
I enjoy learning by doing something, instead of figuring it out first	○	○	○	○	○
Using logic usually works well for me in figuring out problems in my life	○	○	○	○	○
When I'm sad, it's often a very strong feeling	○	○	○	○	○
I try to avoid situations that require thinking in depth about something	○	○	○	○	○
I enjoy intellectual challenges	○	○	○	○	○
I don't like to have to do a lot of thinking	○	○	○	○	○
I'm not a very spontaneous person	○	○	○	○	○
I have a logical mind	○	○	○	○	○
I like to rely on my intuitive impressions	○	○	○	○	○

Ways of thinking

5. Please select the option that best applies to you, below. Don't spend too much time thinking about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I tend to use my heart as a guide for my actions	○	○	○	○	○
When I'm happy, the feeling is usually more like contentment than like exhilaration or excitement	○	○	○	○	○
Art is really important to me	○	○	○	○	○
I enjoy imagining things	○	○	○	○	○
I have favorite poems and paintings that mean a lot to me	○	○	○	○	○
I don't react emotionally to scary movies or books as much as most people do	○	○	○	○	○
I don't think it is a good idea to rely on ones intuition for important decisions	○	○	○	○	○
I almost never think in visual images	○	○	○	○	○
When I travel or drive anywhere, I always watch the landscape and scenery	○	○	○	○	○
For me, descriptions of actual people's experiences are more convincing than discussions about "facts"	○	○	○	○	○

Ways of thinking

6. Please select the option that best applies to you, below. Don't spend too much time thinking about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Everyday experiences often evoke strong feelings in me	○	○	○	○	○
I'd rather be upset sometimes and happy sometimes, than always feel calm	○	○	○	○	○
I enjoy problems that require hard thinking	○	○	○	○	○
Emotions don't really mean much: they come and go	○	○	○	○	○
I am much better at figuring things out logically than most people	○	○	○	○	○
Things that make me feel emotional don't seem to affect other people as much	○	○	○	○	○
I tend to describe things by using images or metaphors, or creative comparisons	○	○	○	○	○
Reasoning things out carefully is not one of my strong points	○	○	○	○	○
My emotions don't make much difference in my life	○	○	○	○	○
Sometimes I like to just sit back and watch things happen	○	○	○	○	○
I prefer complex to simple problems	○	○	○	○	○

Ways of thinking

7. Please select the option that best applies to you, below. Don't spend too much time thinking about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
My anger is often very intense	○	○	○	○	○
I am not very good in solving problems that require careful logical analysis.	○	○	○	○	○
Knowing the answer without understanding the reasoning behind it is good enough for me	○	○	○	○	○
I generally don't depend on my feelings to help me make decisions	○	○	○	○	○
I enjoy reading things that evoke visual images	○	○	○	○	○
I often go by my instincts when deciding on a course of action	○	○	○	○	○
I can often tell how people feel without them having to say anything	○	○	○	○	○
I identify strongly with characters in movies or books I read	○	○	○	○	○
I can clearly picture or remember some sculpture or natural object (not alive) that I think is very beautiful	○	○	○	○	○
I am not a very analytical thinker	○	○	○	○	○
When I have a strong emotional experience, the effect stays with me for a long time	○	○	○	○	○

Ways of thinking

8. Please select the option that best applies to you.
Remember, you don't need to think for too long about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Photographs of illness and disease don't have any impact on me	○	○	○	○	○
I'm not the best at reasoning complex health issues out carefully	○	○	○	○	○
When a decision may affect my health, I think hard about it	○	○	○	○	○
When the health issues of someone I know (or a health story on television) affects me emotionally, I remember for a long time	○	○	○	○	○
I find my emotions seem to overpower my good intentions about acting healthily	○	○	○	○	○
My imagination helps me to understand my health choices and their consequences	○	○	○	○	○
When making an important health decision, I don't believe you should rely on gut reactions	○	○	○	○	○
I prefer health professionals to explain things to me in a way that helps me visualise them	○	○	○	○	○
I think about strategies for improving my health	○	○	○	○	○

Ways of thinking

9. Please select the option that best applies to you.
Remember, you don't need to think for too long about any one question. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I trust my initial feelings about health matters	○	○	○	○	○
I'm not one to spend time pondering my health	○	○	○	○	○
My instincts know what's best for me	○	○	○	○	○
My emotions don't provide any useful guidance in health matters	○	○	○	○	○
I prefer detailed rather than simplified health information	○	○	○	○	○
If I start a new health behaviour, I tend to just 'dive in' rather than spend time planning	○	○	○	○	○
People's personal stories about health issues make me think about my own health	○	○	○	○	○
Compared to other people, I seem to get more emotional about my health and health issues	○	○	○	○	○

Ways of thinking

10. Please select the option that best applies, below.
Also, please note that although some of the questions seem similar to one another, they differ in important ways. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.	○	○	○	○	○
I keep my emotions to myself.	○	○	○	○	○
When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.	○	○	○	○	○
When I am feeling positive emotions, I am careful not to express them.	○	○	○	○	○
When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.	○	○	○	○	○
I control my emotions by not expressing them.	○	○	○	○	○
When I want to feel more positive emotion, I change the way I'm thinking about the situation.	○	○	○	○	○
I control my emotions by changing the way I think about the situation I'm in.	○	○	○	○	○
When I am feeling negative emotions, I make sure not to express them.	○	○	○	○	○
When I want to feel less negative emotion, I change the way I'm thinking about the situation.	○	○	○	○	○

Health vignettes

11. Please rate Mary's **determination** (i.e. overcoming barriers) when it comes to exercising: *

Low High

12. Please rate Mary's **wisdom** (i.e. doing what is beneficial) when it comes to exercising: *

Low High

13. Please rate how **health-conscious** Mary is (i.e. looking after her health) when it comes to exercising: *

Low High

Health vignettes

14. Please rate James's **determination** (i.e. overcoming barriers) when it comes to quitting smoking: *

Low High

15. Please rate James's **wisdom** (i.e. doing what is beneficial) when it comes to quitting smoking: *

Low High

16. Please rate how **health-conscious** James is (i.e. looking after his health) when it comes to quitting smoking: *

Low High

Health vignettes

17. Please rate Jay's **determination** (i.e. overcoming barriers) when it comes to healthy eating: *

Low High

18. Please rate Jay's **wisdom** (i.e. doing what is beneficial) when it comes to healthy eating: *

Low High

19. Please rate how **health-conscious** Jay is (i.e. looking after his health) when it comes to healthy eating: *

Low High

Prize draw

20. Would you like to enter the prize draw for a $100 Coles Myer gift card?
The winner will be notified using the email address to which the follow-up study invitation was sent.

- ○ Yes
- ○ No

APPENDIX F. EXPLICIT ATTITUDE ITEMS.

Table F1

Sources for explicit attitude items and revisions undertaken: health-related lifestyle choices

	Original item	Source	New/revised item	Notes
Healthy eating benefits	Eating healthy foods and snacks helps me look good.	Items from the Motivators of and Barriers to Health-Smart Behaviors Inventory (MB-HSBI), Healthy Foods and Snacks–Motivators subscale, that loaded on the Benefits factor (Tucker et al., 2011)	-	
	Eating healthy foods keeps my body in shape.		Eating healthy foods lowers my chance of developing certain diseases.	Rewritten to differentiate from previous item and align with preventive focus of other behaviours
	Eating healthy foods helps me to be physically active.		Eating healthy foods gives me energy and helps me to be physically active.	Added energy reference to align with commonly promoted benefits.
Healthy eating barriers	I just do not care about eating fruits and vegetables every day.	MB-HSBI items from Healthy Foods and Snacks–Barriers subscale (Tucker et al., 2011)	-	
	Fresh healthy foods are not easily available.		-	
	I get cravings for unhealthy foods.		I never crave unhealthy foods.	Reversed phrasing.
Quitting smoking benefits	-		Quitting smoking makes a person feel healthier.	New items written using known benefits of quitting smoking (Quit Victoria, 2016).
	-		Quitting smoking saves a person money.	

	Original item	Source	New/revised item	Notes
	-		If a person quits smoking it makes people they care about happy.	
Quitting smoking barriers	Being addicted to cigarettes	Barriers to Cessation Scale (Macnee & Talsma, 1995)	Addiction makes it hard to quit smoking.	Rewritten to format of current survey.
	Lack of understanding from family and significant others about what it is like to quit smoking		Non-smokers can easily understand what it's like to quit smoking.	Rewritten to format of current survey. Reversed phrasing.
	Feeling lost without cigarettes		Smokers feel lost without cigarettes.	Rewritten to format of current survey.
Physical activity benefits	I think being active is something fun and enjoyable to do.	MB-HSBI items from Physical Activity–Motivators subscale (Tucker et al., 2011)	-	
	Being active makes me attractive to others.		-	
	My doctor has told me that my risk of death/disease is greater if I do not exercise.		Exercising regularly lowers my chance of developing certain diseases.	Removed reference to source of information, focusing instead on knowing this information.
Physical activity barriers	I would rather watch TV or play video games than do something active.	MB-HSBI items from Physical Activity–Barriers subscale (Tucker et al., 2011)	I would rather watch TV or read than do something active.	Replaced video games with reading to appeal to a broader range of participants.
	I do not have the equipment I need to be able to exercise. I do not have a place to exercise where I feel safe.		I have all the equipment I need to be able to exercise and an appropriate area in which to do it.	Combined two similar barriers to cover a wider range of exercises, as not all forms of exercise need equipment. Reversed phrasing.

	Original item	Source	New/revised item	Notes
	I feel embarrassed when I exercise around other people.		-	

Table F2

Sources for explicit attitude items and revisions undertaken: screening behaviours

	Original item	Source	New/revised item	Notes
Faecal occult blood test benefits	Finding bowel cancer early will save my life.	Items from (Rawl et al., 2001) Benefits subscale as revised by (Zajac et al., 2016).	-	
	A home stool test will help me not worry as much about bowel cancer.		-	
	The treatment for bowel cancer may not be as bad if the cancer is found early.		-	
Faecal occult blood test barriers	I do not have the time to do a home stool test	Items from (Rawl et al., 2001) Barriers subscale as revised by (Zajac et al., 2016).	-	
	Collecting a stool sample to do a home stool test would be unpleasant for me.		Collecting a stool sample to do a home stool test does not bother me at all.	Reversed phrasing.
	A home stool test is embarrassing.		-	

	Original item	Source	New/revised item	Notes
Pap smear benefits	I think that having a regular Pap Smear Test is the best way for cervical cancer to be diagnosed early	Health Belief Model Scale for Cervical Cancer and Pap Smear Test (Guvenc et al., 2011)	-	
	Having regular Pap Smear Tests will decrease my chances of dying from cervical cancer		-	
	If cervical cancer was found at a regular Pap Smear Test its treatment would not be so bad		-	
Pap smear barriers	Having a Pap Smear Test takes too much time	Health Belief Model Scale for Cervical Cancer and Pap Smear Test (Guvenc et al., 2011)	-	
	Having a Pap Smear Test is too painful		Having a Pap smear causes no discomfort whatsoever.	Reversed phrasing.
	I would be ashamed to lie on a gynaecologic examination table and show my private parts to have a Pap Smear Test		It is embarrassing to show my private parts to have a Pap smear.	Simplified wording.
Mammo-gram benefits	Having a mammogram is the best way for me to find a very small lump.	Susceptibility, Benefits, and Barriers Scale for Mammography Screening	Having a mammogram is the best way for me to find a very small lump in my breast.	Clarified meaning.

	Original item	Source	New/revised item	Notes
	Having a mammogram will decrease my chances of dying from breast cancer.	(Champion, 1999), Benefits subscale.	-	
	If I find a lump through a mammogram, my treatment for breast cancer may not be as bad.		-	
Mammo-gram barriers	Having a mammogram is too embarrassing.	Susceptibility, Benefits, and Barriers Scale for Mammography Screening (Champion, 1999), Barriers subscale.	-	
	Having a mammogram is too painful.		-	
	Having a mammogram takes too much time.		Having a mammogram is easy to fit into my schedule.	Reversed phrasing.
PSA test benefits	Having a PCa test would mean I won't worry as much about PCa.	Attendance for Prostate-Specific Antigen Screening Tests Health Behaviour Scale (Avery et al., 2012)	Having a PSA test would mean I won't worry as much about prostate cancer.	Aligned terminology to current survey.
	Having a PCa test would allow me to find PCa early.		Having a PSA test would allow me to find prostate cancer early.	Aligned terminology to current survey.
	Treatment for PCa is more successful the earlier it is detected.		Treatment for prostate cancer is more successful if it is detected early by PSA testing.	Aligned terminology to current survey.

	Original item	Source	New/revised item	Notes
PSA test barriers	Having a PCa blood test (PSA) would be painful.	Attendance for Prostate-Specific Antigen Screening Tests Health Behaviour Scale (Avery et al., 2012)	Giving the blood sample for a PSA test would be uncomfortable.	Clarified and aligned wording.
	Having a PCa test would take too much time/be inconvenient.		Having a PSA test is quick and convenient.	Aligned terminology to current survey. Reversed phrasing.
	Having a PCa test will make me worry about PCa.		Having a PSA test will make me worry about prostate cancer.	Aligned terminology to current survey.
Digital rectal exam. benefits	-		Having a digital rectal examination would mean I won't worry as much about prostate cancer.	New item adapted from other screening items.
	-		Having a digital rectal examination would allow me to find prostate cancer early.	New item adapted from other screening items.
	-		Having a digital rectal examination can help to find prostate cancer early when treatment is not as bad.	New item adapted from other screening items.
Digital rectal exam. barriers	-		A digital rectal examination is embarrassing.	New items adapted from other screening items. Barriers of shame and fear of the procedure reported in Naccarato et al. (2011).
	-		Having a digital rectal examination is unpleasant.	
	-		Having a digital rectal examination is a convenient way to find prostate cancer.	Inconvenience item based on other screening items. Reversed phrasing.

APPENDIX G. ADDITIONAL ANALYSES USING IMPLICIT ATTITUDES.

Correlations between attitude measures

Table G1

Correlations between explicit and implicit measures of attitudes about healthy eating

		2	3	4	5	6	7	8
1	Implicit barriers	.06	.07*	.07*	-.79***	.01	-.04	-.05
2	Exp. barriers 1		.00	.38**	-.08*	-.22***	-.41***	-.40***
3	Exp. barriers 2			.01	-.06	.20***	.16***	.03
4	Exp. barriers 3				-.05	-.05	-.18***	-.21***
5	Implicit benefits					-.01	.08*	.07
6	Exp. benefits 1						.41***	.46***
7	Exp. benefits 2							.44***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 865. Spearman's rho reported due to skewed implicit attitude data.

Table G2

Correlations between explicit and implicit measures of attitudes about smoking cessation

		2	3	4	5	6	7	8
1	Implicit barriers	.02	-.03	-.04	-.61***	-.12***	-.09**	-.12***
2	Exp. barriers 1		.25***	.23***	.02	.15***	.27***	.15***
3	Exp. barriers 2			.17***	.04	.03	.15***	.00
4	Exp. barriers 3				.05	.08*	.07*	.16***
5	Implicit benefits					.15***	.14***	.15***
6	Exp. benefits 1						.35***	.36***
7	Exp. benefits 2							.30***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 884. Spearman's rho reported due to skewed implicit attitude data.

Table G3

Correlations between explicit and implicit measures of attitudes about being physically active

		2	3	4	5	6	7	8
1	Implicit barriers	.10**	.08*	.16***	-.63***	-.04	-.10**	-.08*
2	Exp. barriers 1		.14***	.40***	-.12***	-.03	-.10**	-.51***
3	Exp. barriers 2			.21***	-.09**	-.27***	-.39***	-.33***
4	Exp. barriers 3				-.08*	-.06	-.18***	-.44***
5	Implicit benefits					-.01	.03	.11**
6	Exp. benefits 1						.39***	.23***
7	Exp. benefits 2							.36***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 874. Spearman's rho reported due to skewed implicit attitude data.

Table G4

Correlations between explicit and implicit measures of attitudes about using FOBTs

		2	3	4	5	6	7	8
1	Implicit barriers	.10*	.06	.18***	-.58***	-.01	-0.01	-0.03
2	Exp. barriers 1		.66***	.47***	-.16**	-.22***	-.27***	-.26***
3	Exp. barriers 2			.43***	-.11*	-.28**	-.39***	-.40***
4	Exp. barriers 3				-.13**	-.30***	-.29***	-.29***
5	Implicit benefits					.06	.00	.03
6	Exp. benefits 1						.35***	.28***
7	Exp. benefits 2							.54***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 395. Spearman's rho reported due to skewed implicit attitude data.

Table G5

Correlations between explicit and implicit measures of attitudes about Pap smears

		2	3	4	5	6	7	8
1	Implicit barriers	.19***	-.04	.10*	-.41***	-.12**	-.09*	-.06
2	Exp. barriers 1		.13**	.27***	-.33***	-.40***	-.33***	-.07
3	Exp. barriers 2			.29***	-.16***	-.09	-.05	-.21***
4	Exp. barriers 3				-.09*	-.15**	-.02	-.07
5	Implicit benefits					-.03	.01	-.01
6	Exp. benefits 1						.56***	.17***
7	Exp. benefits 2							.25***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 493. Spearman's rho reported due to skewed implicit attitude data.

Table G6

Correlations between explicit and implicit measures of attitudes about mammograms

		2	3	4	5	6	7	8
1	Implicit barriers	.33***	.23**	.30***	-.55***	-.16*	-.18*	-.20*
2	Exp. barriers 1		.43***	.39***	-.25**	-.44***	-.43***	-.24**
3	Exp. barriers 2			.30***	-.12	-.22**	-.23**	-.10
4	Exp. barriers 3				-.22**	-.26**	-.36***	-.29***
5	Implicit benefits					.13	.11	.15
6	Exp. benefits 1						.59***	.35***
7	Exp. benefits 2							.55***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 160. Spearman's rho reported due to skewed implicit attitude data.

Table G7

Correlations between explicit and implicit measures of attitudes about PSA tests

		2	3	4	5	6	7	8
1	Implicit barriers	-.01	.07	.07	-.67***	-.03	-.15*	-.15*
2	Exp. barriers 1		.49***	.30***	-.03	-.22**	-.22**	-.23***
3	Exp. barriers 2			.32***	-.09	-.43***	-.56***	-.47***
4	Exp. barriers 3				-.09	-.39***	-.37***	-.40***
5	Implicit benefits					.09	.13	.13
6	Exp. benefits 1						.59***	.51***
7	Exp. benefits 2							.63***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 229. Spearman's rho reported due to skewed implicit attitude data.

Table G8

Correlations between explicit and implicit measures of attitudes about DREs

		2	3	4	5	6	7	8
1	Implicit barriers	-.08	-.07	.01	-.71***	-.03	-.04	-.17*
2	Exp. barriers 1		.62***	.31***	-.01	-.01	-.09	.05
3	Exp. barriers 2			.33***	.03	-.14*	-.13	-.02
4	Exp. barriers 3				-.05	-.40***	-.53***	-.44***
5	Implicit benefits					.05	.03	.14*
6	Exp. benefits 1						.56***	.56***
7	Exp. benefits 2							.62***
8	Exp. benefits 3							

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$. N = 229. Spearman's rho reported due to skewed implicit attitude data.

Regressions predicting behaviour and intentions from continuous variables

Table G9

Prediction of diet quality from implicit attitudes about healthy eating

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.01
Constant (SE)	120.24 (0.85)	114.80 (2.60)	111.98 (2.76)
Implicit barriers	-.05	-	-
Implicit benefits	-	.06†	-
Implicit health-cons.	-	-	.10**

Notes. N=843. ** $p < .01$. Hyphen indicates variable not included in model.

† $p = .070$

Table G10

Prediction of healthy eating intentions from implicit attitudes about healthy eating

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.01	.02	.01
Constant (SE)	2.86 (0.02)	2.59 (0.07)	2.66 (0.07)
Implicit barriers	-.10**	-	-
Implicit benefits	-	.13**	-
Implicit health-cons.	-	-	.08*

Notes. N = 732. ** p <.01, * p < .05. Hyphen indicates variable not included in model.

Table G11

Prediction of years spent smoking from implicit attitudes about smoking cessation

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.23	.22	.22
Constant (SE)	-4.54 (2.54)	2.10 (3.69)	5.40 (4.16)
Age	.46***	.46***	.48***
Implicit barriers	.14*	-	-
Implicit benefits	-	-.09†	-
Implicit health-cons.	-	-	-.13*

Notes. Amongst those who were ever regular smokers; N = 270. *** p < .001, * p < .05.

Hyphen indicates variable not included in model.

† p = .086

Table G12

Prediction of quitting intentions from implicit attitudes about smoking cessation

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.02	.00	.00
Constant (SE)	0.15 (0.15)	2.62 (0.29)	2.65 (0.34)
Implicit barriers	-.12	-	-
Implicit benefits	-	.07	-
Implicit health-cons.	-	-	.05

Notes. Amongst current smokers; N = 43. Hyphen indicates variable not included in model.

Table G13

Prediction of physical activity from implicit attitudes about physical activity

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.01
Constant (SE)	3990.29 (178.19)	2625.48 (618.82)	2283.73 (617.62)
Implicit barriers	-.05	-	-
Implicit benefits	-	.07*	-
Implicit health-cons.	-	-	.09*

Notes. N = 870. * $p < .05$. Hyphen indicates variable not included in model.

Table G14

Prediction of physical activity intentions from implicit attitudes about physical activity

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.00
Constant (SE)	2.66 (0.03)	2.60 (0.11)	2.41 (0.11)
Implicit barriers	-.04	-	-
Implicit benefits	-	.01	-
Implicit health-cons.	-	-	.07*

Notes. N = 739. * $p < .05$. Hyphen indicates variable not included in model.

Table G15

Prediction of FOBT screening status from implicit attitudes about FOBT

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.00
Constant (SE)	3.32 (0.06)	3.07 (0.14)	3.14 (0.16)
Implicit barriers	-.07	-	-
Implicit benefits	-	.08	-
Implicit health-cons.	-	-	.04

Notes. N = 365. Hyphen indicates variable not included in model.

Table G16

Prediction of FOBT screening intentions from implicit attitudes about FOBT

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.00
Constant (SE)	2.64 (0.05)	2.71 (0.10)	2.71 (0.12)
Implicit barriers	.06	-	-
Implicit benefits	-	-.01	-
Implicit health-cons.	-	-	-.01

Notes. N = 368. Hyphen indicates variable not included in model.

Table G17

Prediction of Pap smear screening status from implicit attitudes about Pap smears

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.04	.01	.02
Constant (SE)	3.59 (0.04)	3.35 (0.09)	3.10 (0.14)
Implicit barriers	-.20***	-	-
Implicit benefits	-	.08†	-
Implicit health-cons.	-	-	.14**

Notes. N = 441. ** *p* <.01. Hyphen indicates variable not included in model.

† *p* = .081

Table G18

Prediction of Pap smear screening intentions from implicit attitudes about Pap smears

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.01
Constant (SE)	2.71 (0.04)	2.77 (0.08)	2.95 (0.14)
Implicit barriers	.02	-	-
Implicit benefits	-	-.04	-
Implicit health-cons.	-	-	-.09†

Notes. N = 387. Hyphen indicates variable not included in model.

† *p* = .069

Table G19

Prediction of mammogram screening status from implicit attitudes about mammograms

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.02
Constant (SE)	3.60 (0.08)	3.32 (0.20)	2.99 (0.31)
Implicit barriers	-.07	-	-
Implicit benefits	-	.11	-
Implicit health-cons.	-	-	.16†

Notes. N = 135. Hyphen indicates variable not included in model.

† *p* = .060

Table G20

Prediction of mammogram screening intentions from implicit attitudes about mammograms

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.02	.03	.04
Constant (SE)	2.83 (0.06)	2.48 (0.14)	2.25 (0.21)
Implicit barriers	-.13	-	-
Implicit benefits	-	.18*	-
Implicit health-cons.	-	-	.21*

Notes. N = 141. * $p < .05$. Hyphen indicates variable not included in model.

Table G21

Prediction of PSA screening status from implicit attitudes about PSA testing

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.09	.04
Constant (SE)	3.59 (0.70)	2.78 (0.20)	2.89 (0.26)
Implicit barriers	-.04	-	-
Implicit benefits	-	.29***	-
Implicit health-cons.	-	-	.20**

Notes. N = 184. *** $p < .001$, ** $p < .01$. Hyphen indicates variable not included in model.

Table G22

Prediction of PSA screening intentions from implicit attitudes about PSA tests

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.04	.08	.06
Constant (SE)	2.86 (0.04)	2.25 (0.12)	2.20 (0.16)
Implicit barriers	-.21**	-	-
Implicit benefits	-	.28***	-
Implicit health-cons.	-	-	.24***

Notes. N = 223. *** $p < .001$, ** $p < .01$. Hyphen indicates variable not included in model.

Table G23

Prediction of DRE screening status from implicit attitudes about DRE

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.00
Constant (SE)	2.93 (0.08)	2.89 (0.23)	2.77 (0.28)
Implicit barriers	.07	-	-
Implicit benefits	-	.03	-
Implicit health-cons.	-	-	.06

Notes. N = 184. Hyphen indicates variable not included in model.

Table G24

Prediction of DRE screening intentions from implicit attitudes about DRE

	ß		
	Implicit barriers	Implicit benefits	Implicit health-cons.
r^2	.00	.00	.00
Constant (SE)	2.47 (0.06)	2.38 (0.16)	2.30 (0.20)
Implicit barriers	-.03	-	-
Implicit benefits	-	.03	-
Implicit health-cons.	-	-	.05

Notes. N = 223. Hyphen indicates variable not included in model.

Regressions predicting behaviour and intentions from dichotomous variables

Table G25

Prediction of diet quality from implicit attitudes about healthy eating

	Exp(B) [95% CI] for having Hi diet quality (rather than Lo diet quality)		
	Barriers to healthy eating	Benefits of healthy eating	Health-consciousness re. healthy eating
Model pseudo R^2	.01	.00	.01
Model fit	$\chi^2(1) = 4.13$*	$\chi^2(1) = .43$	$\chi^2(1) = 3.09$
Intercept (SE)	-0.14 (0.10)	0.04 (0.10)	0.12 (0.10)
Hi implicit barriers	0.76* [0.57,0.99]	-	-
Hi implicit benefits	-	1.09 [0.83,1.43]	-
Hi implicit health-consciousness	-	-	1.27 [0.97, 1.67]

Notes. N = 843. Nagelkerke's pseudo R-Square reported. * $p < .05$. Hyphen indicates variable not included in model.

Table G26

Prediction of healthy eating intentions from implicit attitudes about healthy eating

	Exp(B) [95% CI] for intending to eat healthily tomorrow		
	Barriers to healthy eating	Benefits of healthy eating	Health-consciousness re. healthy eating
Model pseudo R^2	.01	.03	.03
Model fit	$\chi^2(1) = 6.20$*	$\chi^2(1) = 12.56$**	$\chi^2(1) = 13.76$***
Intercept (SE)	-1.83 (0.15)	1.27 (0.12)	1.25 (0.13)
Hi implicit barriers	0.61* [0.41, 0.90]	-	-
Hi implicit benefits	-	2.04** [1.36, 3.04]	-
Hi implicit health-consciousness	-	-	2.10*** [1.41, 3.13]

Notes. N = 732. Nagelkerke’s pseudo R-Square reported. *** $p < .001$, ** $p <.01$, * $p < .05$.

Hyphen indicates variable not included in model.

Table G27

Prediction of smoking status from implicit attitudes about smoking cessation

	Exp(B) [95% CI] for being an ex-smoker (rather than a current smoker)		
	Barriers to quitting	Benefits of quitting	Health-consciousness regarding quitting
Model pseudo R^2	.03	.02	.02
Model fit	$\chi^2(1) = 5.08$*	$\chi^2(1) = 3.50$	$\chi^2(1) = 4.48$*
Intercept (SE)	1.41 (0.20)	1.49 (0.17)	2.09 (0.25)
Hi implicit barriers	0.50* [0.27, 0.92]	-	-
Hi implicit benefits	-	1.82 [0.96, 3.44]	-
Hi implicit health-consciousness	-	-	1.94* [1.04, 3.61]

Notes. N = 330. Including only those who reported being a ‘current’ or ‘ex’ smoker. Nagelkerke’s pseudo R-Square reported. * $p < .05$. Hyphen indicates variable not included in model.

[Insufficient N of current smokers to model quit intentions.]

Table G28

Prediction of physical activity from implicit attitudes about physical activity

	Exp(B) [95% CI] for having Hi physical activity (rather than Lo physical activity)		
	Barriers to exercise	Benefits of exercise	Health-consciousness regarding exercise
Model pseudo R^2	.00	.00	.00
Model fit	$\chi^2(1) = 0.37$	$\chi^2(1) = 0.37$	$\chi^2(1) = 0.17$
Intercept (SE)	-0.42 (0.10)	-.04 (0.10)	-0.03 (0.10)
Hi implicit barriers	0.92 [0.71, 1.20]	-	-
Hi implicit benefits	-	1.09 [0.83, 1.42]	-
Hi implicit health-consciousness	-	-	1.06 [0.81, 1.38]

Notes. N = 870. Nagelkerke's pseudo R-Square reported. Hyphen indicates variable not included in model.

Table G29

Prediction of physical activity intentions from implicit attitudes about physical activity

	Exp(B) [95% CI] for intending to be physically active in next week		
	Barriers to physical activity	Benefits of physical activity	Health-consciousness regarding physical activity
Model pseudo R^2	.01	.00	.01
Model fit	$\chi^2(1) = 2.87$	$\chi^2(1) = 2.24$	$\chi^2(1) = 3.88$*
Intercept (SE)	1.00 (0.12)	0.75 (0.11)	0.71 (0.11)
Hi implicit barriers	0.76 [0.55, 1.04]	-	-
Hi implicit benefits	-	1.28 [0.93, 1.75]	-
Hi implicit health-consciousness	-	-	1.38* [1.00, 1.89]

Notes. N = 734. Nagelkerke's pseudo R-Square reported. * $p < .05$. Hyphen indicates variable not included in model.

Table G30

Prediction of FOBT screening status from implicit attitudes about FOBT

	Exp(B) [95% CI] for having ever screened by FOBT (rather than never having screened)		
	Barriers to FOBT	Benefits of FOBT	Health-consciousness regarding FOBT
Model pseudo R^2	.02	.01	.00
Model fit	$\chi^2(1) = 4.39$*	$\chi^2(1) = 3.01$	$\chi^2(1) = 0.89$
Intercept (SE)	-0.77 (0.17)	-1.24 (0.18)	-1.14 (0.18)
Hi implicit barriers	0.61* [0.38, 0.97]	-	-
Hi implicit benefits	-	1.51 [0.95, 2.42]	-
Hi implicit health-consciousness	-	-	1.25 [0.78, 2.00]

Notes. N = 365. Nagelkerke's pseudo R-Square reported. * $p < .05$. Hyphen indicates variable not included in model.

Table G31

Prediction of FOBT screening intentions from implicit attitudes about FOBT

	Exp(B) [95% CI] for intending to have FOBT in future		
	Barriers to FOBT	Benefits of FOBT	Health-consciousness regarding FOBT
Model pseudo R^2	.00	.00	.01
Model fit	$\chi^2(1) = 0.98$	$\chi^2(1) = 0.80$	$\chi^2(1) = 2.60$
Intercept (SE)	1.29 (0.18)	1.05 (0.18)	0.97 (0.17)
Hi implicit barriers	0.77 [0.47, 1.28]	-	-
Hi implicit benefits	-	1.26 [0.76, 2.07]	-
Hi implicit health-consciousness	-	-	1.51 [0.91, 2.50]

Notes. N = 365. Nagelkerke's pseudo R-Square reported. Comparison group combines those who reported no intention and those who reported being unsure. Hyphen indicates variable not included in model.

Table G32

Prediction of Pap smear screening status from implicit attitudes about Pap smears

	Exp(B) [95% CI] for having ever screened by Pap smear (rather than never having screened)		
	Barriers to Pap smear	Benefits of Pap smear	Health-consciousness regarding Pap smear
Model pseudo R^2	.01	.04	.07
Model fit	$\chi^2(1) = 3.29$	$\chi^2(1) = 9.41$**	$\chi^2(1) = 16.37$***
Intercept (SE)	-1.60 (0.19)	-2.36 (0.24)	-2.59 (0.27)
Hi implicit barriers	0.60 [0.35, 1.05]	-	-
Hi implicit benefits	-	2.41** [1.35, 4.30]	-
Hi implicit health-consciousness	-	-	3.32*** [1.79, 6.15]

Notes. N = 441. Nagelkerke's pseudo R-Square reported. *** $p < .001$, ** $p <.01$. Hyphen indicates variable not included in model.

Table G33

Prediction of Pap smear screening intentions from implicit attitudes about Pap smears

	Exp(B) [95% CI] for intending to have Pap smear in future		
	Barriers to Pap smear	Benefits of Pap smear	Health-consciousness reg. Pap smear
Model pseudo R^2	.00	.00	.00
Model fit	$\chi^2(1) = 0.01$	$\chi^2(1) = 0.08$	$\chi^2(1) = 0.06$
Intercept (SE)	1.56 (0.19)	1.59 (0.20)	1.52 (0.20)
Hi implicit barriers	0.97 [0.56, 1.70]	-	-
Hi implicit benefits	-	0.93 [0.53, 1.61]	-
Hi implicit health-consciousness	-	-	1.07 [0.62, 1.86]

Notes. N = 348. Nagelkerke's pseudo R-Square reported. Comparison group combines those who reported no intention and those who reported being unsure. Hyphen indicates variable not included in model.

Table G34

Prediction of mammogram screening status from implicit attitudes about mammograms

	Exp(B) [95% CI] for having ever screened by mammogram (rather than never having screened)		
	Barriers to mammogram	Benefits of mammogram	Health-consciousness regarding mammogram
Model pseudo R^2	.02	.02	.04
Model fit	$\chi^2(1) = 1.12$	$\chi^2(1) = 1.15$	$\chi^2(1) = 2.94$
Intercept (SE)	-1.55 (0.33)	-2.12 (0.40)	-2.32 (0.43)
Hi implicit barriers	0.59 [0.22, 1.58]	-	-
Hi implicit benefits	-	1.71 [0.63, 4.66]	-
Hi implicit health-consciousness	-	-	2.40 [0.86, 6.76]

Notes. N = 135. Nagelkerke's pseudo R-Square reported. Hyphen indicates variable not included in model.

Table G35

Prediction of mammogram screening intentions from implicit attitudes about mammograms

	Exp(B) [95% CI] for intending to have mammogram in future		
	Barriers to mammogram	Benefits of mammogram	Health-consciousness reg. mammogram
Model pseudo R^2	.00	.00	.00
Model fit	$\chi^2(1) = 0.26$	$\chi^2(1) = 0.05$	$\chi^2(1) = 0.01$
Intercept (SE)	1.87 (0.38)	-1.79 (0.36)	1.75 (0.36)
Hi implicit barriers	0.77 [0.28, 2.11]	-	-
Hi implicit benefits	-	0.89 [0.33, 2.42]	-
Hi implicit health-consciousness	-	-	0.96 [0.35, 2.62]

Notes. N = 120. Nagelkerke's pseudo R-Square reported. Comparison group combines those who reported no intention and those who reported being unsure. Hyphen indicates variable not included in model.

Table G36

Prediction of PSA screening status from implicit attitudes about PSA testing

	Exp(B) [95% CI] for having ever screened by PSA test (rather than never having screened)		
	Barriers to PSA testing	Benefits of PSA testing	Health-consciousness re. PSA testing
Model pseudo R^2	.00	.01	.03
Model fit	$\chi^2(1) = 0.21$	$\chi^2(1) = 0.79$	$\chi^2(1) = 2.83$
Intercept (SE)	-1.58 (0.28)	-1.87 (0.31)	-2.11 (0.35)
Hi implicit barriers	0.83 [0.38, 1.84]	-	-
Hi implicit benefits	-	1.44 [0.64, 3.20]	-
Hi implicit health-consciousness	-	-	2.03 [0.87, 4.74]

Notes. N = 184. Nagelkerke’s pseudo R-Square reported. Hyphen indicates variable not included in model.

Table G37

Prediction of PSA screening intentions from implicit attitudes about PSA tests

	Exp(B) [95% CI] for intending to have PSA test in future		
	Barriers to PSA tests	Benefits of PSA tests	Health-consciousness re. PSA tests
Model pseudo R^2	.02	.10	.06
Model fit	$\chi^2(1) = 1.63$	$\chi^2(1) = 10.73$**	$\chi^2(1) = 6.01$*
Intercept (SE)	1.85 (0.30)	1.05 (0.24)	1.20 (0.24)
Hi implicit barriers	0.60 [0.27, 1.32]	-	-
Hi implicit benefits	-	4.08** [1.65, 10.10]	-
Hi implicit health-consciousness	-	-	2.83* [1.18, 6.75]

Notes. N = 187. Nagelkerke's pseudo R-Square reported. ** p <.01, * p < .05. Hyphen indicates variable not included in model.

Table G38

Prediction of DRE screening status from implicit attitudes about DRE

	Exp(B) [95% CI] for having ever screened by DRE (rather than never having screened)		
	Barriers to DRE	Benefits of DRE	Health-consciousness regarding DRE
Model pseudo R^2	.01	.01	.02
Model fit	$\chi^2(1) = 1.20$	$\chi^2(1) = 0.62$	$\chi^2(1) = 2.32$
Intercept (SE)	-0.53 (0.22)	-0.84 (0.24)	-0.97 (0.24)
Hi implicit barriers	0.71 [0.38, 1.31]	-	-
Hi implicit benefits	-	1.28 [0.69, 2.38]	-
Hi implicit health-consciousness	-	-	1.62 [0.87, 3.02]

Notes. N = 184. Nagelkerke’s pseudo R-Square reported. Hyphen indicates variable not included in model.

Table G39

Prediction of DRE screening intentions from implicit attitudes about DRE

	Exp(B) [95% CI] for intending to have DRE in future		
	Barriers to DRE	Benefits of DRE	Health-consciousness regarding DRE
Model pseudo R^2	.00	.00	.00
Model fit	$\chi^2(1) = 0.08$	$\chi^2(1) = 0.42$	$\chi^2(1) = 0.39$
Intercept (SE)	0.20 (0.21)	0.07 (0.21)	0.07 (0.21)
Hi implicit barriers	0.92 [0.51, 1.66]	-	-
Hi implicit benefits	-	1.22 [0.67, 2.20]	-
Hi implicit health-consciousness	-	-	1.21 [0.67, 2.18]

Notes. N = 178. Nagelkerke's pseudo R-Square reported. Hyphen indicates variable not included in model.

APPENDIX H. DIET QUALITY SCORING.

Table H1

Scoring for diet quality measure

Item	Response	All[1]	Females > 60	Females All	Males 18-60	Males All
Lastly, we would like to ask about your diet. First we will focus on what you ate yesterday and then we will ask about your habits more generally. *Note: If yesterday's diet was very unusual for you (for example, you were fasting for medical or religious reasons) choose a more normal day to recall, or tell us about your 'average' day.* *First, thinking about what you ate and drank yesterday...*						
How many serves of fruit did you eat yesterday? *One serve = 1 medium fruit e.g. apple or 2 small fruit e.g. kiwi or 1 cup tinned fruit*	0	0				
	1	5				
	2	10				
	3	10				
	4	10				
	5	10				
	6 or more	10				
How many serves of vegetables and legumes did you eat yesterday? *One serve = 1/2 cup cooked vegetables or 1 cup salad vegetables*	0	0				
	1	2.5				
	2	5				
	3	7.5				
	4	10				
	5	10				
	6 or more	10				
How many serves of breads and cereals did you eat yesterday?	0	0			0	
	1	2.5			1.67	
	2	5			3.33	
	3	7.5			5	

Item	Response	All[1]	Females > 60	Females All	Males 18-60	Males All
One serve = 1 slice bread or 1/2 cup cooked rice or pasta	4	10			6.66	
	5	10			8.33	
	6 or more	10			10	
Of all bread you ate yesterday, how much was wholemeal or wholegrain? *If you did not eat any bread, leave blank.*	Enter percentage	response ÷10 blank = 5				
Do you eat meat? [Included for survey logic only: question about trimming fat from meat is hidden if answer is 'no'.]	Yes No					
How many serves of meat (and meat alternatives) did you eat yesterday? *One serve = 1/2 cup cooked meat 1 cup tofu, legumes, or beans or 2 large eggs*	0	0				
	1	10				
	2	10				
	3	10				
	4	10				
	5	10				
	6 or more	10				
Of all meat (and meat alternatives) you ate yesterday, how much was lean? *If you did not eat any meat or meat alternatives, leave blank.*	Enter percentage	response ÷10 blank = 5				
How many serves of dairy products did you consume yesterday? *One serve= 1 cup milk or milk alternative, 2 slices cheese, 3/4 cup yoghurt*	0	0				
	1	5				
	2	10				
	3	10				
	4	10				
	5	10				

Item	Response	All[1]	Females > 60	Females All	Males 18-60	Males All
	6 or more	10				
What type of milk did you consume, mostly?	Low-fat or skim	10				
	Whole/full-fat	0				
	Did not consume milk	5				
How many glasses of fluids other than water did you drink yesterday? *(Include juice, soft drink, tea, coffee, alcoholic beverages, and any drink apart from water.)*	Enter number					
	0	0				
	1	1.25				
	2	2.5				
	3	3.75				
	4	5				
	5	6.25				
	6	7.5				
	7	8.75				
	8	10				
	>8	10				
How many glasses of water did you drink yesterday? [Used in combination with item above to calculate percentage of fluids consumed that were water]	Enter number (Glasses water ÷ (glasses water + glasses other)) × 100					
	< 50	result ÷ 5				
	≥ 50	10				
Now, thinking about your dietary habits in general...						
How many standard drinks of alcoholic beverages do you usually consume in a week?	≤ 7			10		10
	8			8.57		10
	9			7.14		10

Item	Response	All[1]	Females > 60	Females All	Males 18-60	Males All
	10			5.71		10
	11			4.28		10
	12			2.85		10
	13			1.42		10
	14			0		10
	15			0		9.29
	16			0		8.58
	17			0		7.86
	18			0		7.15
	19			0		6.43
	20			0		5.72
	21			0		5.00
	22			0		4.29
	23			0		3.57
	24			0		2.86
	25			0		2.14
	26			0		1.43
	27			0		0.71
	≥ 28			0		0
In general: How often do you trim the fat from the meat you eat?	Never/rarely	10				
	Sometimes	5				
	Usually	0				
	Always	0				
	[Skipped due to not eating meat]	5				
How often do you add salt when cooking?	Never/rarely	10				
	Sometimes	5				
	Usually	0				
	Always	0				

Item	Response	All[1]	Females > 60	Females All	Males 18-60	Males All
How often do you add salt at the table?	Never/rarely	10				
	Sometimes	5				
	Usually	0				
	Always	0				
How often do you consume items with added sugar? *(Includes: confectionary, sugar-sweetened soft drinks and cordials, fruit drinks, vitamin waters, energy and sports drinks)*	Never/rarely	10	10			
	Once a week or less	10	10			
	Several times a week	10	10			
	Once per day	10	5			
	More than once per day	0	0			
How often would you eat high fat foods and snacks? *(Includes biscuits, cakes, pastries, pies, processed meats, commercial burgers, pizza, fried foods, potato chips, crisps and other savoury snacks)*	Never/rarely	10				
	Once a week or less	10				
	Several times a week	10				
	Once per day	5				
	More than once per day	0				
Total	Sum all 16 scored items					/160

Notes. Instructions to participants are shown in italics. Notes in square brackets not included in survey. Although the optimal number of serves differs between foods, the response options are consistent so as not to indicate what the optimal response might be.

1. Coding scheme applies either a) to all participants, or b) to all participant other than the subgroups with alternate schemes listed.

APPENDIX I. CHAPTER 3 PUBLICATION.

The published version of Chapter 3 is shown on the following pages. Publication details:

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Article

Thinking Style as a Predictor of Men's Participation in Cancer Screening

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Abstract

Men's participation in cancer screening may be influenced by their thinking style. Men's need for cognition (NFC) and faith in intuition were measured to explore whether they varied by demographic variables or predicted screening behavior. Australian males (n = 585, aged 50-74 years) completed surveys about past screening and were subsequently offered mailed fecal occult blood tests (FOBTs). Demographic predictors included age, socioeconomic status, educational attainment, and language spoken at home. The screening behaviors were self-reported prostate cancer screening (prostate-specific antigen testing and digital rectal examinations [DREs]), and colorectal cancer screening (self-reported FOBT participation and recorded uptake of the FOBT offer). Analysis comprised principal component analysis and structural equation modelling. NFC was positively related to demographic variables education, socioeconomic status, and speaking English at home. Faith in intuition was negatively related to educational attainment. NFC predicted variance in self-reported DRE participation (r = .11, p = .016). No other relationships with thinking style were statistically significant. The relationship of NFC to DRE participation may reflect the way certain attributes of this screening method are processed, or alternatively, it may reflect willingness to report participation. The relationship of thinking style to a range of healthy behaviors should be further explored.

Keywords

digital rectal exam, PSA testing, health promotion and disease prevention, social determinants of health, behavioral research

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Health psychology interventions designed to encourage healthy behaviors have traditionally targeted rational processes. For example, they have targeted constructs such as knowledge about severity of a health problem and beliefs about the benefits of action (Rosenstock, 1974), information seeking and evaluation (Prochaska & Velicer, 1997), intentions to act (Ajzen, 1991) and self-efficacy (Bandura, 1998). Some researchers have begun to focus on how processes other than those that are rational might influence health behavior (Friese, Hofmann, & Wiers, 2011; Sheeran, Gollwitzer, & Bargh, 2013). While rational processing is conscious and effortful, involves working memory capacity, and relies on algorithmic thinking, another type—experiential processing—operates at high speed, autonomously (triggered by stimuli), and independently of working memory (Epstein, Pacini, Denes-Raj, & Heier, 1996; Evans & Stanovich, 2013, provide an in-depth discussion of the broader area of dual-process models of cognition).

People differ in the extent to which they rely on rational processing and experiential processing. These stable individual differences have been labelled *thinking style* (Epstein, 2003). A self-report measure (the

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Rational-Experiential Inventory [REI; Epstein et al., 1996) has been developed to capture the preference for rational processing (need for cognition [NFC]) and preference for experiential processing (faith in intuition [FI]; Epstein et al., 1996). It is possible that stable individual differences in processing preference could influence health behavior. For instance, the personality variable conscientiousness has been linked to increased preventive health behavior (Bogg & Roberts, 2004; Takahashi, Edmonds, Jackson, & Roberts, 2013). With scant research conducted to date on the subject, the purpose of this article is to begin exploring the influence of thinking style on preventive health behavior.

Higher NFC has been associated with constructs of potential benefit to health decision making, including better information recall (Cacioppo, Petty, Feinstein, Blair, & Jarvis, 1996), higher internal locus of control (Fletcher, Danilovics, Fernandez, Peterson, & Reeder, 1986), and better probability judgments under pressure (Pacini & Epstein, 1999). Various studies have reported the effects of thinking style variables on the interpretation of health messages (Covey, 2014; Epstein, 2003; Fletcher et al., 1986; Furnham & Thorne, 2013), and it has been suggested that thinking style may moderate the effectiveness of health psychology interventions (Hofmann, Friese, & Wiers, 2008). Yet few studies have attempted to detect a link between thinking style and health behavior. Smoking, for one, has been linked to higher FI and lower NFC (Brown & Bond, 2015) and appropriate hand hygiene among doctors has been positively linked to FI but not NFC (Sladek, Bond, & Phillips, 2008).

There is some evidence of gender differences in thinking style, with NFC being slightly higher, and FI slightly lower, in men compared with women (Sladek, Bond, & Phillips, 2010). In men, NFC appears linked to identification with stereotypical masculine attributes (Osberg, 1987) that have been credited with both positive (Oster, McGuiness, Duncan, & Turnbull, 2014) and negative (Galdas, Cheater, & Marshall, 2005) implications for health behavior. The relationship of men's thinking style to their health behavior is undoubtedly complex, and may exacerbate or ameliorate the interplay of social, behavioral, and biological factors that drive adverse health outcomes for men. In Australia, the rate of male death from cancer is 1.6 times the rate for females (Australian Institute of Health and Welfare, 2012). The two leading causes of male cancer death are prostate cancer and colorectal cancer (Australian Bureau of Statistics, 2013a) and for both, routine screening tests are widely available (Cancer Council Australia, 2016a, 2016b). There remains much to learn about the factors that influence participation in screening for both cancers.

The efficacy of available screening tests differs between prostate cancer and colorectal cancer. For colorectal cancer screening, a test known as a fecal occult blood test (FOBT) detects minute amounts of blood in stool and has been reported to achieve a 15% relative risk reduction for colorectal cancer-specific mortality when used every 2 years (Hewitson, Glasziou, Irwig, Towler, & Watson, 2007). The case is less straightforward for prostate screening—whether via the prostate-specific antigen (PSA) test (which measures blood levels of a protein that may be elevated in the presence of prostate cancer) or digital rectal examination (DRE; in which a doctor manually checks for prostate abnormalities by inserting a gloved finger into the rectum; Cancer Council Australia, 2016a). Large randomized controlled trials have failed to identify any reduction of prostate cancer-specific mortality among men screened by PSA (relative risk: 1.00, confidence interval [CI] [0.86, 1.17]) despite the higher rate of detection among those screened (Ilic, Neuberger, Djulbegovic, & Dahm, 2013). Many cases of prostate cancer detected by PSA test or DRE never affect the man's health and would have gone unnoticed without screening (Australian Institute of Health and Welfare, 2013). Owing to concerns about overdiagnosis, a lack of evidence of reductions in mortality, potential harms of testing, and side effects of unnecessary treatment, screening at a population level is not recommended in Australia (National Health and Medical Research Council, 2013).

Despite the proven effectiveness of FOBT screening, only 34% of people who receive a free FOBT complete and return the kit—and although men have an overall higher risk of this disease, the participation rate for males (31.1%) is significantly and consistently lower than for females (35.7%; Australian Institute of Health and Welfare, 2014). Counterintuitively, screening participation rates appear higher for prostate cancer. In the United States, approximately 45% of men aged 64 to 79 years report receiving a PSA test in the past year (Drazer, Huo, Schonberg, Razmaria, & Eggener, 2011) and rates of participation are similar in Australia (Medicare Australia, 2015; Trevena, Rogers, Jorm, Churches, & Armstrong, 2013). While there is an evident need to increase participation in colorectal cancer screening, in regards to prostate cancer screening the objective is to facilitate men's decision making, preferably in concert with their general practitioner (GP; i.e., family doctor). After becoming thoroughly informed about PSA screening, men may indeed have less intention to participate than before (Thomas et al., 2014).

Nonetheless, in both cases, it is of great value to identify the factors that affect screening participation. The differing pathways to participating in these three cancer screening modalities provide a range of behaviors on which to explore the effects of thinking style. FOBTs may be purchased, provided by a doctor, or received in the mail via organized screening programs, but require the screener to complete several steps. On the other hand, PSA tests and DRE must be provided by a health professional and may be offered opportunistically or at the man's request.

It is also of value to know the contexts in which thinking style is of relevance; for instance, if it is known that certain demographic groups are less likely to prefer rational processing, then health campaigns can be targeted accordingly. The aims of the present study were firstly to determine whether there was an association between demographic factors and thinking style in men, and second, to test for a link between thinking style and participation in colorectal and prostate cancer screening. The variance in NFC and FI was analyzed using the demographic variables age, educational attainment, speaking a language other than English at home, and socioeconomic status (SES). The behavioral outcomes of interest were self-reported participation in three tests (FOBT, PSA, DRE), and for FOBT screening (which can be offered to participants via the mail), the actual completion and return of a mailed FOBT kit was also recorded.

Method

A subgroup of participants in a larger research trial (Duncan et al., 2013) formed the sample for this study. The parent study was a randomized controlled trial (Australian New Zealand Clinical Trials Registry: ACTRN12612001122842) using a 2 × 2 factorial design to assess the effectiveness of modified letters (targeted and nontargeted versions of advance notification and invitation to screen letters) in encouraging the use of a mailed FOBT. The research received approval from the Human Research Ethics Committee at The University of Adelaide, and the inclusion criteria were being male, aged between 50 and 74 years inclusive, and living at a standard residential address in the urban areas of five Australian states (New South Wales, Queensland, South Australia, Victoria, and Western Australia).

For the parent study, individuals randomly selected from the Australian Electoral Roll (N = 9,216) were randomly assigned to one of four trial arms (for further information, see Duncan et al., 2013). Random assignment was used once again to select 600 participants from each arm for inclusion in a subgroup that would be sent surveys before and after the intervention. This survey subgroup (of whom n = 585 remained in the final sample) is the focus of the present study. Although effects related to the targeted letters were observed in the rest of the parent study's sample, in the group considered herein, who completed surveys in advance of the screening offer, the intervention had no effect (Zajac et al., 2016) and so for the present study, the four trial arms are collapsed together.

The baseline survey was sent in October 2012. It was completed by 926 of the 2,400 men who were contacted (a 38.6% response rate) and eligible respondents (i.e., those who had not subsequently withdrawn or indicated screening was inappropriate) were mailed an FOBT screening kit in March 2013. In June 2013, a total of 854 endpoint surveys were sent to participants, of which 590 were completed (a 69.1% response rate). Participants indicated their consent to participate in the study by completing and mailing back the two surveys. Five cases with more than 50% of responses missing were deleted, leaving n = 585 participants with data available for analysis (Figure 1). Remaining missing REI responses were imputed using expectation maximization (Dempster, Laird, & Rubin, 1977).

Materials

The baseline survey contained questions about demographics and past screening. It was sent with an introductory letter (containing information about the research, researcher contact details, and complaints procedures) and a return envelope. Reminder letters were sent to men who had not responded after 3 weeks, and a second reminder with a replacement survey was sent after 6 weeks. Data collection ceased 16 weeks after the baseline survey was mailed out.

The bowel cancer screening kit contained an introductory letter, an FOBT (OC-Sensor by Eiken Chemical Co., Tokyo, Japan), an instruction sheet, a screening information booklet, a participation form, and a reply-paid padded envelope for sending the samples to a laboratory for processing. The FOBT is an immunochemical kit that requires collection of two stool samples and does not necessitate dietary changes. Reminders were sent to men who did not complete the FOBT 6 weeks following the mailing, and data collection ceased after 15 weeks.

The endpoint survey, which contained the REI, was sent to men who had completed the baseline survey and not withdrawn from the study, regardless of whether they had completed their FOBT. Reminder letters were sent to men who had not responded after 3 weeks, and a second reminder with a replacement survey was sent after 6 weeks. Data collection ceased 13 weeks after the endpoint survey was mailed out.

Data Analysis

To describe the sample, frequencies were reported as well as percentages, and means and standard deviations were calculated. Before addressing the research questions using structural equation models, it was necessary to check (and prudent to report) the structure of the REI. This was done by subjecting the items to principal component analysis (PCA) to detect the presence of the underlying factors predicted by the scale's theoretical

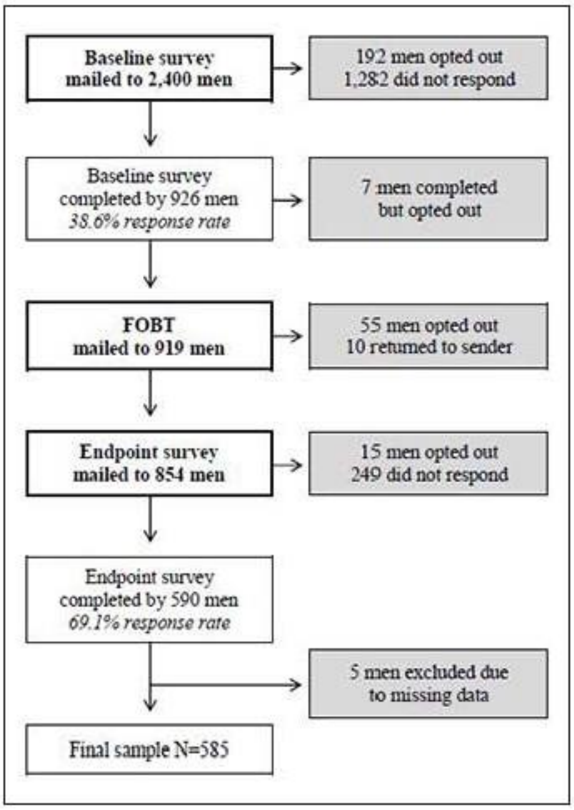

Figure 1. Participant flow.
Note. FOBT = fecal occult blood test.

background (i.e., NFC and FI). Structural equation modelling in AMOS was then used to explore the relationships of thinking style to demographic variables and screening behavior. Statistics were computed using IBM SPSS version 20, and structural equation models were run using the AMOS plugin.

Measures

Demographic Items (Baseline Survey). Participants were asked for their date of birth, highest education level and whether they spoke a language other than English at home (coded as 1 for "no" and 2 for "yes"). Participants' postcodes (obtained from the Electoral Roll) were used to indicate their SES, which was quantified by the Index of Relative Socioeconomic Advantage and Disadvantage. This indicator of socioeconomic advantage and disadvantage is compiled by the Australian Bureau of Statistics (2013b) using information on income, education, employment, occupations, and dwelling characteristics from the 2011 Australian Census. Each participant was assigned a score from 1 to 10 based on the decile of the Index of Relative Socioeconomic Advantage and Disadvantage distribution in which the postcode fell. Decile 1 represents the 10% of areas that are most disadvantaged and least advantaged, while Decile 10 represents the 10% of areas that are most advantaged and least disadvantaged. For example, postcodes in the 10th decile have the largest proportion of residents with above-average incomes, who are making high mortgage or rent payments, who are classified as professionals or managers, who have higher educational attainment, and who are living in houses with four or more bedrooms. Postcodes in the first decile have higher proportions of residents with low incomes, whose residences have no Internet connection, who have long-term health conditions or disabilities, who have completed less education, who are unemployed, or who are classified as laborers, machinery operators or drivers (Australian Bureau of Statistics, 2013b).

Frequency of GP Visits (Baseline Survey). As PSA tests and DREs are generally provided by a GP (i.e., family doctor) and men who visit their GP more frequently have greater chance of being offered or requesting them (Crowe, Wootten, & Howard, 2015), it was sensible to control for frequency of GP visits. An indicator of habitual GP attendance frequency was obtained by asking participants how many times they had visited their GP in the past year, with five response options from "not at all" to "four or more times."

Self-Reported Screening Data (Baseline Survey). Self-reported data regarding PSA tests (srPSA), DRE (srDRE), and FOBT (srFOBT) were collected via three survey questions asking men if they had ever used the screening method in question. Response options were "yes" (coded as 1), "no" (coded as 0), and "unsure/do not know" (participants choosing this response for a screening behavior were excluded from analyses for that behavior). The sensitivity of self-reported screening participation has been reported as 78% for FOBT, 71% for PSA test, and 74% for DRE participation, while specificity was 77%, 73%, and 60%, respectively (Rauscher, Johnson, Cho, & Walk, 2008). Recent results suggest self-reports of FOBT screening are an acceptably accurate representation of actual behavior (Lo, Waller, Vrinten, Wardle, & von Wagner, 2016).

Observed Screening Data. Observed FOBT screening data (oFOBT) was recorded by monitoring whether participants returned a completed FOBT to the laboratory for processing by the end of the intervention phase of the study (13 weeks after the screening kits were mailed out). Participation was coded as 1 and nonparticipation was coded as 0.

Table 1. Descriptive Statistics.

		Screening behavior: Participating percentage and count				Thinking style[a]: *M* (*SD*)	
Group	*n*	srPSA	srDRE	srFOBT	oFOBT	NFC	FI
Total sample	585	71.7, 411	59.9, 343	62.3, 345	80.3, 465	3.61 (0.74)	3.63 (0.69)
Age (years)							
50-54	111	59.1, 65	40.0, 44	63.9, 69	79.3, 88	3.71 (0.72)	3.56 (0.63)
55-59	131	70.0, 91	55.8, 72	73.2, 93	77.9, 102	3.63 (0.73)	3.65 (0.66)
60-64	137	72.1, 98	64.7, 88	37.4, 49	81.0, 111	3.61 (0.73)	3.64 (0.71)
65-69	116	80.9, 93	69.6, 80	74.3, 81	77.6, 90	3.50 (0.77)	3.70 (0.73)
70-75	84	78.0, 64	71.1, 59	67.1, 53	88.1, 74	3.64 (0.79)	3.55 (0.80)
Education							
School	175	65.5, 114	58.4, 101	57.4, 97	72.6, 127	3.37 (0.75)	3.77 (0.67)
Tertiary	253	73.0, 184	60.7, 153	68.0, 166	85.4, 216	3.61 (0.68)	3.57 (0.72)
Postgraduate	121	78.5, 95	59.5, 72	56.9, 66	75.2, 91	3.99 (0.72)	3.53 (0.68)
Language[b]							
Yes	96	56.3, 54	38.5, 37	54.9, 50	84.4, 81	3.31 (0.69)	3.51 (0.66)
No	464	74.7, 345	63.2, 292	63.5, 284	78.7, 365	3.68 (0.74)	3.65 (0.71)
SES decile[c]							
Lowest (1-3)	47	66.0, 31	53.2, 25	59.1, 26	89.4, 42	3.49 (0.70)	3.69 (0.64)
Middle (4-7)	147	66.0, 97	45.9, 67	58.9, 83	80.3, 118	3.43 (0.73)	3.69 (0.60)
Highest (8-10)	391	74.3, 286	65.5, 253	63.7, 239	78.5, 307	3.69 (0.74)	3.60 (0.72)

Note. srPSA = self-reported PSA participation; srDRE = self-reported DRE participation; srFOBT = self-reported FOBT participation; oFOBT = observed FOBT participation; NFC = need for cognition; FI = faith in intuition.
[a]Average response across five subscale questions after reverse coding three NFC items (reported in Table 2). [b]Language other than English spoken at home. [c]Decile 1 represents the 10% of suburbs with the lowest SES; Decile 10 represents the 10% of suburbs with the highest SES. Sample *n* = 585, *n* missing per cell varies; maximum = 56 (9.6% of respondents with postgraduate education did not respond to srFOBT question).

Rational-Experiential Inventory (Endpoint Survey). The REI (Epstein et al., 1996) measures thinking style as two independent variables, NFC (preference for rational processing) and FI (preference for experiential processing). A short-form questionnaire was used that included a five-question NFC scale (e.g., "I prefer complex to simple problems") and a five-question FI scale (e.g., "I trust my initial feelings about people"). Responses to each REI statement were indicated on a 5-point Likert-type scale from 1 (*completely false*) to 5 (*completely true*). Higher scores for a statement therefore represented higher identification with that attribute. Three NFC items were reverse phrased (e.g., "I do not like to have to do a lot of thinking") and required reverse-coding. The reliability of this short scale in Australian samples has been reported elsewhere (NFC $\alpha = .75$ and FI $\alpha = .86$ in a study by Golley, Corsini, Topping, Morell, & Mohr, 2015). In the present study, the NFC ($\alpha = .66$) and FI ($\alpha = .87$) scales both displayed acceptable internal reliability.

Because the baseline survey was already lengthy, and because the measurement of thinking style was not central to the parent study, the REI was administered in the endpoint survey. As NFC and FI are proposed to be stable processing preferences (Cacioppo et al., 1996; Epstein, 2003), the preceding survey and intervention materials received by participants would be unlikely to influence their responses on this measure.

Results

The eight response items of the educational attainment measure were combined into three roughly even groups: school, tertiary, and postgraduate attainment. The mean age of participants was 61.4 (*SD* = 6.7) years, most men had tertiary education or greater (175 school, 253 tertiary, 121 postgraduate attainment) and the majority (*n* = 464, 79.3%) did not speak a language other than English at home. Over half the sample (*n* = 312, 53.3%) resided in suburbs classified among the highest 20% in terms of SES. Responses to the REI and screening items for the sample and for demographic groups are reported in Table 1.

Structure of the REI

In the present study, the five NFC items (Cronbach's α = .66) and five FI items (Cronbach's α = .87) of the REI displayed acceptable internal reliability. To check the proposed REI structure in the study population, a PCA was performed with Oblimin rotation and Kaiser

Table 2. Pattern Matrix for REI Items.

	Component[a]		
REI item	FI	NFC+	NFC−
1. I do not like to have to do a lot of thinking.[b]			.877
2. I try to avoid situations that require thinking in depth about something.[b]			.893
3. Thinking hard and for a long time about something gives me little satisfaction.[b]			.692
4. I prefer to do something that challenges my thinking abilities rather than something that requires little thought.		.811	
5. I prefer complex to simple problems.		.866	
6. I trust my initial feelings about people.	.721		
7. I believe in trusting my hunches.	.804		
8. My initial impressions of people are almost always right.	.850		
9. When it comes to trusting people, I can usually rely on my "gut feelings."	.878		
10. I can usually feel when a person is right or wrong even if I cannot explain how I know.	.784		
Factor correlations			
NFC+	.15***	—	
NFC−	−.04	.17***	—

Note. n = 585. REI = Rational-Experiential Inventory; NFC = need for cognition; FI = faith in intuition.
[a]Extraction method: Principal component analysis. Rotation method: Oblimin with Kaiser Normalization. [b]Reverse coded.
***$p > .001$, two-tailed.

Normalization. This analysis suggested the presence of three components with eigenvalues greater than 1, which together explained 68.40% of the variance in the REI items. Results of this analysis are reported in Table 2. As can be seen, the five FI questions clustered on the one component, aptly named Faith in Intuition. However, for the NFC items, two separate components emerged. One of the components loaded on the reverse-phrased items, reinforcing previous suggestions that item polarity interferes with the measurement of NFC (Bors, Vigneau, & Lalande, 2006). Small correlations existed between the NFC+ (positively phrased NFC items) and NFC− (negatively phrased NFC items) components and between FI and NFC+ (Table 2).

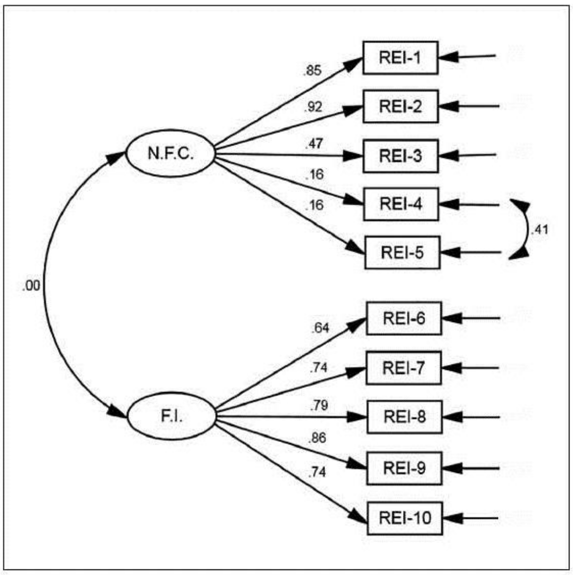

Figure 2. Latent structure of thinking style.
Note. n = 585. CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; NFC = need for cognition; FI = faith in intuition; REI = Rational-Experiential Inventory. $\chi^2(33) = 171.28$, $p < .001$, CFI = .94, RMSEA = .09, 90% CI [.07, .10] (significant at $p < .001$).

In preparation for the behavioral outcome models, the REI structure was generated using structural equation modelling. In an effort to retain the theoretical two-factor model, the residuals of the positively phrased NFC items which separated from other NFC items in the PCA were correlated. The fit of this two-factor model was considered reasonable and the model is shown as Figure 2, $\chi^2(33) = 171.28$, $p < .001$, comparative fit index (CFI) = .94, root mean square error of approximation (RMSEA) = .09, 90% CI [.07, .10]. Guided by cognitive-experiential self-theory (Epstein, 2003), the previous documentation of a methodological factor related to item valence (Bors et al., 2006), and the fact that the model provided a reasonable fit, the intended two-factor structure of the REI was adhered to. In line with original theory, the two factors NFC and FI were unrelated.

Association Between Thinking Style and Demographic Variables

To explore whether demographic variables accounted for unique variance in REI constructs, NFC and FI were regressed onto the demographic variables age, language, education, and SES. The fit of the initial model was acceptable, $\chi^2(72) = 271.58$, $p < .001$, CFI = .92, RMSEA = .07, 90% CI [.06, .08]. Given that SES and education levels are linked (Australian Bureau of Statistics, 2013b, 2013c), the model was further refined by allowing these to covary. Furthermore, paths that were not statistically significant were removed and this involved removing Age altogether as it did not predict either REI construct. These adjustments resulted in a significant improvement in fit, $\Delta\chi^2(10) = 46.75$, $p < .01$ and the final model had acceptable fit and is provided as Figure 3, $\chi^2(62) = 224.83$, $p < .001$, CFI = .93, RMSEA = .07, 90% CI [.06, .08]. Demographic variables were more strongly related to NFC, accounting for 11.6% of the variance, compared with FI, accounting for only 1.4% of the variance.

Association Between Thinking Style and Prostate Cancer Screening

To explore the influence of thinking style on prostate cancer screening behavior, screening variables (srPSA and srDRE) were regressed onto NFC and FI. In this model, demographic predictors of screening and number of GP visits in the past year were controlled for, given a plausible link between this and prostate screening behavior. The initial model—which allowed thinking style, demographics, and GP visit variables to covary freely with srPSA and srDRE—had acceptable fit, $\chi^2(96) = 285.70$, $p > .001$, CFI = .92, RMSEA = .06, 90% CI [.05, .07]. However, the model was refined by the removal of paths which were not statistically significant. This resulted in a slight decrease in fit but the change was not statistically significant, $\Delta\chi^2(14) = 12.37$, *ns*. The refined model had acceptable fit and is shown as Figure 4, $\chi^2(110) = 298.07$, $p > .001$, CFI = .92, RMSEA = .06, 90% CI [.05, .06]. As can be seen, NFC accounted for 1.2% of the variance in srDRE but did not relate to srPSA; FI was not related to either screening variable.

Association Between Thinking Style and Colorectal Cancer Screening

In a similar fashion to the model for prostate screening above, colorectal cancer screening variables (srFOBT and oFOBT) was regressed onto the thinking style variables. The initial model had acceptable fit, $\chi^2(92) = 250.76$, $p > .001$, CFI = .93, RMSEA = .06, 90% CI .05, .06]. However, thinking style variables and demographic variables failed to predict any variance in self-reported or observed FOBT screening. Thus, the model is not shown herein.

Discussion

This study sought to determine the relationships between thinking style, demographics, and cancer screening behaviors in men. The analyses indicated that NFC was positively related to educational attainment and SES and negatively related to speaking English at home. Education's positive relationship with NFC (Cacioppo et al., 1996) has been documented elsewhere and the positive link with SES is unsurprising given that education is an indicator of socioeconomic advantage (Australian Bureau of Statistics, 2013b). The slight negative relationship identified between education and FI has not been explored in detail; however, a previous study reported a weak negative association between FI and performance on Raven's Advanced Progressive Matrices (Liberali, Reyna, Furlan, Stein, & Pardo, 2012). These results suggest that health campaigns and interventions aimed at men with lower educational attainment or SES, or whose first language is not English, should allow for a lower preference for rational processing. This could include providing emotion-focused health information (Vidrine, Simmons, & Brandon, 2007), refining information so that it is less detailed, or incorporating advocacy by well-known individuals (Williams-Piehota, Schneider, Pizarro, Mowad, & Salovey, 2003).

Thinking style did not predict men's screening behavior in this sample, with one exception. NFC explained a very small amount of variance in self-reported DRE screening, even after controlling for frequency of doctor visits. FI, however, explained no variance. In other words, these results indicate that men who identified as tending to think effortfully were slightly more likely to report undergoing a DRE than men who disliked thinking hard, while it did not make a difference whether men trusted or distrusted their intuitions. An effect of thinking style on DRE participation has not been reported before.

Health behaviors toward which rational processes may be positive and experiential processes may be negative have been termed "hard to sustain" behaviors (Borland, 2014) and DRE appears to fit this categorization. Specifically, its positive consequences (such as prevention of harm from prostate cancer) are long term and best understood through rational processing, but the immediate and experientially processed aspects (such as shame, Naccarato, Reis, Matheus, Ferreira, & Denardi, 2011) are potentially negative. In this framework, it makes sense that a preference for rational processing would share variance with the decision to have a DRE, while a negative relationship with FI might be expected. The lack of any relationship with FI could indicate that factors evaluated by experiential processes were not uniformly negative (e.g., one may hold a positive implicit attitude toward following doctors' advice).

The other two screening behaviors would also be classed as hard to sustain, having long-term preventive health benefits and immediately aversive aspects of participation (needles and fecal matter). However, no effects were detected for PSA tests or FOBT. This leads us to consider

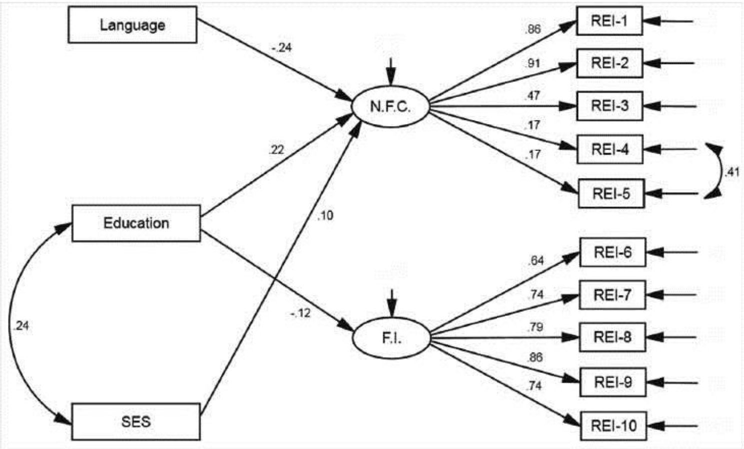

Figure 3. Demographic predictors of thinking style.
Note. n = 553. CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; NFC = need for cognition; FI = faith in intuition; REI = Rational-Experiential Inventory. $\chi^2(62) = 224.83$, $p < .001$, CFI = .93, RMSEA = .07, 90% CI [.06, .08]. All paths shown are significant at the $p < .001$ level, except for NFC ← SES and FI ← Education (significant at $p < .05$).

the level of involvement men have in their screening decisions: in order for thinking style to affect participation, a man must be making his own decision to undertake screening. The fact that men may be only minimally involved in the choice to have a PSA test (Slevin, Donnelly, Clarkson, English, & Ward, 1999) and may even be unaware one was carried out after blood was given (Chan, Vernon, Ahn, & Greisinger, 2004) suggests that thinking style cannot affect the screening decision-making process in some cases. Effects may be detectable for DRE participation because this is the most invasive, and arguably most volitional, of the two prostate screening methods.

Low involvement in the screening decision does not explain the lack of effects for FOBT, for which self-administration cannot occur without some effort. Although mailing kits, free of charge, to men's homes (in this study and the NBCSP) removes the need to purchase or request a kit, their completion remains highly volitional. This hard-to-sustain behavior would be expected to show influence from thinking style in a similar manner to DRE; indeed, effects may be detected in samples that are less homogenous in their FOBT screening participation.

Finally, an alternative explanation for the finding should also be considered, given the possibility of feelings such as shame regarding DRE (Naccarato et al., 2011). Men higher in NFC may simply have been more willing to report that they had been given a DRE.

Implications

It has previously been pointed out that health information should be structured so as to appropriately engage both forms of processing to capitalize on their strengths and counter their weaknesses (de Vries, Fagerlin, Witteman, & Scherer, 2013). The finding in this study that higher NFC in men tended to be linked to higher levels of education, higher SES, and English as a first language—but that little variance in FI was linked to demographic variables—reinforces this recommendation. Specifically, it suggests that health communications with elements geared toward experiential processing may be more equitable, because unlike rationally processed information, these elements would be expected to perform just as well with groups of lower SES, education, and whose first language is not English.

Strengths and Limitations

The research obtained a large sample of adults from the general population, and investigated the relationship between thinking style and cancer screening—an area about which little is known. Limitations of the study relate largely to issues with the REI and attributes of the sample. The presence in the original NFC scale (Cacioppo & Petty, 1982) of a second factor differentiated by reverse phrasing of questions, which places greater demand on verbal ability, has been documented in previous studies (Bors et al., 2006; Furnham & Thorne, 2013), and complicates the scale's construct validity. The possibility that the NFC scale is measuring something in addition to NFC reduces confidence in the relationships, or lack of, between NFC and the demographic and screening variables.

The current sample reported higher NFC and lower FI than participants in a large survey of Australian males and

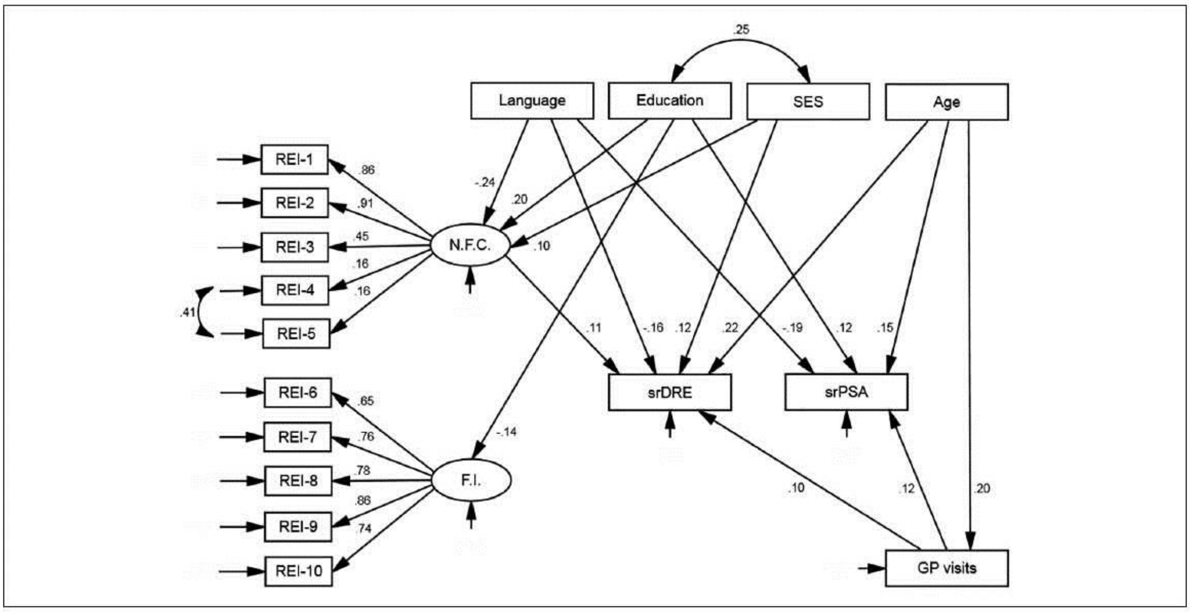

Figure 4. Demographic and thinking style predictors of self-reported prostate cancer screening by PSA and DRE.
Note. n = 548. CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; NFC = need for cognition; FI = faith in intuition; REI = Rational-Experiential Inventory; PSA = prostate-specific antigen; DRE = digital rectal examinations; srDRE = self-reported DRE participation; srPSA = self-reported PSA participation. $\chi^2(110) = 298.07$, $p > .001$, CFI = .92, RMSEA = .06, 90% CI [.05, .06]. All paths shown are significant at the $p < .001$ level, except for NFC ← SES, srDRE ← NFC and srDRE ← GP visits (significant at the $p < .05$ level) and FI ← Education, srPSA ← GP visits, srDRE ← SES and srPSA ← Education (significant at the $p < .01$ level).

females chosen at random from the Electoral Roll (in which mean NFC was 3.51 [0.82] and mean FI was 3.77 [0.74]; Golley et al., 2015). NFC has been reported to correlate with education level (Cacioppo et al., 1996) and given this sample had roughly four times the postgraduate education attainment rate of the same-aged Australian male population (Australian Bureau of Statistics, 2011), it is likely that the sample was also higher in NFC than the general population. Relatedly, NFC is positively related to participation in cognitively effortful activities (von Stumm, 2012) and thus, participants in this sample (who voluntarily completed two surveys) may have been more likely to do so because of their higher NFC. Additionally, the sample overrepresented individuals of high SES, and this is known to predict colorectal cancer screening participation (Singh et al., 2004).

A methodological limitation was that only men who responded to the baseline survey were provided with a mailed FOBT and the endpoint survey. Accordingly, the rate of observed FOBT return (80.3%) was roughly double the rate of participation by the nonsurvey group in the parent study (attributed to selection effects insofar as men who return surveys are likely to participate in screening; Zajac et al., 2016) and double the rate of male participation in the NBCSP (Australian Institute of Health and Welfare, 2014). A large study in which FOBT kits were mailed to Danish participants (without any preceding letter or survey) displayed uptake much closer to the parent study and the NBCSP than to the subgroup used for the present research, with 43.6% uptake among males (Frederiksen, Jorgensen, Brasso, Holten, & Osler, 2010). Thus, the sample is highly biased toward FOBT screening. High levels of NFC coupled with high screening participation estimates may have limited the effects detected herein, but the presence of any effect in such a sample indicates that investigation in broader samples is worthwhile. Notwithstanding these issues, the fact that NFC influences DRE participation is an interesting contribution.

Future Directions

The types of information men drew on in rational or experiential decision making about screening has been speculated about above, but these results can tell us nothing about the types of information drawn on by men with different thinking styles. For instance, experiential processing of attitudes toward prostate screening may have an antiscreening influence (e.g., "PSA tests are uncomfortable") or a proscreening influence (e.g., "PSA tests are effective"), or both. Following work suggesting that indicators of rational processing moderate the influence of rationally processed attitudes over behavior (and likewise for experiential processing and experientially processed attitudes; Conner, Perugini, O'Gorman, Ayres, &

Prestwich, 2007), future research should explore the relationship between thinking style and screening behavior in a manner that can account for rationally and experientially processed attitudes.

Factors not measured, such as context, affect, and features of the health behavior may privilege one form of processing over the other when making a decision. For instance, it is reasonable to accept that an individual may answer a general statement such as "I do not like to do a lot of thinking" as "completely true," when in fact they thought very hard about taking their last PSA test, perhaps due to personal experience or a recently viewed news story. This state versus trait distinction in relation to rational and experiential processing requires further exploration if processing types are to be targeted in future research or interventions. A measure of thinking style that is specific to health-related thinking would be useful for promoting screening and other healthy behaviors, and would add to the understanding of NFC and FI. Finally, although modest, the effects found lead us to suggest that it is worthwhile replicating these results and extending investigations to other health behaviors. Studying a range of health behaviors varying in frequency, difficulty, and level of individual control may provide a more nuanced understanding of the relationships between thinking style and health behavior.

Conclusions

NFC explained a small amount of variance in self-reported DRE participation. While the effect was very small, it is interesting given the lack of existing knowledge in this area, and suggests possibilities for further research. These findings form a springboard for future work, suggesting that research that is conducted with more diverse samples, and which includes other behaviors, is warranted to shed light on the relationship of thinking style to healthy behavior.

Declaration of Conflicting Interests

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