# Cognition associated with use of and belief in complementary and alternative medicine (CAM)

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# Contents

# Abstract

The use of and belief in the effectiveness of complementary and alternative medicine (CAM) is associated with two cognitive biases: over-reliance on intuitive thinking and ontological mistakes. This thesis reports five studies which explore the nature of these biases.

*Aims.* The aim of study 1 was to develop and test a valid and reliable measure of belief in the effectiveness of CAM and use of CAM (the Attitudes to Complementary and Alternative Medicine scale; ACAM). Studies 2-3 explored whether the previously reported relationship between CAM beliefs and intuitive thinking could be found when using performance measures (rather than just self-report measures) of thinking. Studies 4-5 tested the proposal that being able to spot ontological mistakes is a system 2, analytical process and that overlooking ontological mistakes is more likely when cognitive demands are high.

*Methods.* Studies 1-3 employed a mixture of self-report questionnaires and performance measures of thinking (the cognitive reflection test and base rate problems) in a survey methodology. Studies 4-5 employed experimental methods, and specifically a variation of the syllogistic belief bias paradigm.

*Results.* In study 1, a principal components analysis yielded four factors for the ACAM, each reflecting beliefs in the effectiveness of different categories of CAM (alternative whole medical systems, energy medicines, herbalism and natural products, mind and body approaches). The ACAM had good internal consistency and convergent validity. In study 2, psychology students' self-reported analytical thinking was negatively related to belief in CAM effectiveness. In study 3, self-reported intuitive thinking was positively related to CAM beliefs in a mixed sample of students and the general population. Performance measures of thinking style were not consistently related to CAM beliefs. In studies 4-5, it was found that ontological correctness biased responding when simultaneous processing demands were low, but when ontological statements were embedded in difficult reasoning problems, particularly those in which belief and logic conflicted, ontological correctness was less likely to bias responding.

*Conclusions.* These findings suggest that faith in CAM effectiveness depends not so much on the people's actual thinking style but rather on people's perception of their own thinking style. Furthermore, noticing ontological mistakes appears to be a system 2, analytical process which is more difficult to carry out when simultaneous reasoning competes for processing capacity. However, the ability to spot ontological mistakes is made easier following simple psychoeducational instructions. These findings improve our understanding of the cognitive factors which might underpin beliefs in the effectiveness of CAM and have implications for the design of health psychology interventions to improve people's health decision-making.

# Preliminary Chapter. A systematic review of the traits and cognitions associated with use of and belief in complementary and alternative medicine (CAM).

Running head: Traits, cognitions and CAM

Acknowledgements: Thank you for the assistance from Dr Tim Moss and Dr Victoria Galbraith

This chapter reports a systematic review as part of the assessment for the professional doctorate in health psychology. This systematic review has been assessed already but is included here for procedural reasons and also as its findings were used to develop the aims and predictions for the subsequent empirical work. Its inclusion therefore, helps to provide some context for the data collection which followed it. The theoretical links between the systematic review and the empirical work, as well as the process of moving from review to research design, are described in more detail in the next chapter (Chapter 1. Introduction).

Although the systematic review and empirical work are related, the review and the rest of the thesis are also designed to be read as discrete entities.

## Abstract

Purpose: A systematic review with narrative synthesis aimed to establish which personality traits and cognitions predicted use of and belief in complementary and alternative medicine (CAM).

Methods: Using key terms: ("complementary medicine" or "alternative medicine" or "holistic medicine") and (personality or psychological or cogniti* or trait or "individual differences"), papers (between 2000 and 2016) were identified from Medline, embase, HIMC, CAB abstracts international, CINAHL, AMED and Psychinfo. Manual searches on these topics were also conducted and key authors were contacted. Nineteen papers were selected for review.

Results: The trait openness to experience was weakly associated with CAM use. Intuitive thinking and ontological confusions were the most reliable cognitive predictors of CAM beliefs. Studies testing the role of cognitions in CAM use/belief were mostly on non-clinical samples, whilst studies on OtE and CAM use/belief were mostly on clinical patients. Quality of studies varied but unrepresentative samples, untested outcome measures, reliance on cross-sectional designs and simplistic statistical analysis were the most common flaws.

Conclusions: Intuitive thinking and ontological confusions are associated with CAM beliefs. Openness to experience is only weakly associated with use of CAM.

Key words: Complementary medicine, alternative medicine, traits, cognition, belief.

## Introduction

Complementary and alternative medicine (CAM) encompasses many treatments, outside conventional healthcare, including acupuncture, aromatherapy, chiropractic, healing, herbal medicine, homoeopathy, hypnosis, massage, meditation, nutritional therapy, reflexology, reiki, and yoga (Zollman & Vickers, 1999). Although there is no universal CAM definition, Ernst (2000) conceptualises it as diagnosis, treatment and/or prevention which provides an unmet need, or complements or diversifies orthodox medicine. CAM has become more popular in recent decades. In England, a large household survey showed that 44.0% of respondents have used CAM in their lifetime, 26.3% in the last 12 months and that 12.1% had consulted with a CAM practitioner within the preceding 12 months (Hunt, Coelho, Wider, Perry, Hung, Terry & Ernst, 2010). Metcalfe, Williams, McChesney, Patten & Jetté (2010) report similar rates for CAM practitioner visits in Canadians (12.4%) although this varied according to medical status: for example asthma patients used CAM more, whereas diabetes patients less frequently than the general population. According to Barnes, Bloom and Nahim (2008) nearly four out of 10 adults in the US report CAM use in the previous 12 months. The incidence of CAM use accelerated in the US during the 1990s: Eisenberg, Davis, Ettner, Appel, Wilkey, Van Rompay & Kessler (1998) reported a rise from 33.8% in 1990 up to 42.1% in 1997. A systematic review shows that the rates of CAM use are even

higher in East Asia (Harris, Cooper, Relton & Thomas, 2012). As the statistics show, CAM use is not universal, many choose not to use such treatments. This raises questions about what kind of people are most likely to believe in and use CAM.

### Health-related reasons for CAM use

Reasons for CAM use may depend on presence and type of medical condition. The most commonly reported motivations for CAM use are as remedies for chronic conditions (Eisenberg et al. 1998). Barnes et al. (2008) found that back, neck or joint pain, along with colds, anxiety and depression were frequently cited conditions treated with CAM in the US. In Europe, CAM use in cancer patients increases after diagnosis, often explained by patients as helping the body 'fight cancer' (Molassiotis, Fernadez-Ortega, Pud, Ozden, Scott, Panteli,... & Patiraki, 2005). CAM is used for less serious conditions, for health promotion and disease prevention in Japan (Yamashita, Tsukayama & Sugishita, 2002) and primarily for health maintenance in Singapore (Lim, Sadarangani, Chan & Heng, 2005).

### Demographic predictors of CAM use

In addition to health status, demographics are important predictors of CAM use. A systematic review shows that female and younger cancer patients - and in Western countries, those with higher incomes and more years of education - use CAM more. In Turkey and in Hawaii however, CAM use was linked with lower income (Verhoef, Balneaves, Boon & Vroegindewey, 2005), perhaps as it is less costly than orthodox medicine. A review of the general population and medical professionals (Frass, Strassl, Friehs, Müllner, Kundi & Kaye, 2012) supports these sex and income effects, but (in contrast to Verhoef et al., 2005) found higher CAM use in older people. A Taiwanese survey found that demographics differed depending on whether CAM use was for health maintenance (e.g. male, fewer years of education) or illness treatment (e.g. lower income) (Wu, Chou, Chen, Chen, Yeh & Lin, 2012). In their US review, Barnes et al. (2008) found that native American and white adults were more likely to use CAM than Asian and black adults.

### Psychological predictors of CAM use: beliefs and attitudes

In their review of beliefs associated with CAM use, Bishop, Yardley and Lewith (2007), found that a collaborative and participative approach to health as well as active coping, particularly in cancer and HIV patients, predicted CAM use. Perceptions of illness causality (e.g. diet, stress) also predicted CAM use, as did unconventional life philosophies (e.g. post-materialism) and spirituality. A subsequent review of CAM use in type 2 diabetes suggests beliefs and attitudes are more important predictors than demographics (Chang, Wallis & Tiralongo, 2012). In US HIV patients, negative attitudes to conventional antiretroviral medication predicted CAM use (Hsiao, Wong, Kanouse, Collins, Liu, Andersen,... & Wenger, 2003). CAM use/belief in CAM may also be more prevalent in those with a holistic philosophy (i.e. the connectedness of mind, body and spirit) toward health (Astin, 1998), with modern health worries or mistrust of

conventional science and orthodox medicine (Furnham, 2007; Jeswani & Furnham, 2010; Vincent & Furnham, 1996). CAM use/belief has also been shown to associate with belief in the paranormal (Jeswani & Furnham, 2010; Van den Bulck & Custers, 2009).

### Study aims

Previous reviews have explored CAM users' attitudes/beliefs and their demographics However there is no review on the cognitions (e.g. thinking style, reasoning bias, etc.) or personality traits which predict CAM use/beliefs, despite these factors having been explored in a number of empirical studies. Lindeman and colleagues propose that an intuitive reasoning style and ontological confusions predict CAM (Lindeman, 2011; Svedholm & Lindeman, 2013), and that cognitive factors predict CAM belief more powerfully than demographics (Lindeman, 2011). Others report that traits such as openness to experience (hereafter OtE; being imaginative, unconventional and willing to consider new ideas) characterise CAM users (e.g. Sirios & Gick, 2002). Paranormal beliefs are associated with personality and reasoning (Swami, Pietschnig, Stieger & Voracek, 2011; Rogers, 2014), as CAM belief and paranormal belief are correlated (Jeswani & Furnham, 2010) CAM too may have these psychological correlates.

The literature shows that traits and cognitive style have been studied in relation to both CAM use and CAM beliefs. The aim is a systematic review of research into cognitions and personality traits associated with use of or belief in CAM effectiveness. No such review has yet been conducted and there is a need to evaluate the quality of research in this area. There is a theoretical and empirical basis for this review to include both clinical and general population studies which measure both CAM beliefs and CAM use. This paper will not review research on demographics, nor studies of attitudes and beliefs which predict CAM use/beliefs (e.g. paranormal belief, health beliefs, beliefs about medicine, etc.) as these factors have already been the subject of systematic reviews.

## Method

### Search strategy and inclusion/exclusion criteria

Relevant studies were selected through searches of online databases (Medline, embase, HIMC, CAB abstracts international, CINAHL, AMED, Psychinfo), through manual searches of the reference lists of selected studies, by scanning article titles in key journals and by contacting key authors in the field. Database searches were carried out using the following key terms: ("complementary medicine" or "alternative medicine" or "holistic medicine") and (personality or psychological or cogniti* or trait or "individual differences"). Following de-duplication, 611 unique titles remained. Inclusion/exclusion criteria, for retaining papers for further scrutiny, were as follows: published in English between Jan 2000 and May 2016; non-expert population i.e. *not* qualified or trainee health professionals, *not* healthcare providers; *not* studies on

parents who advocate CAM for their children; studies which measure cognitions and/or traits; *not* studies measuring only beliefs and attitudes which predict CAM use/beliefs; *not* studies of demographics, transient affect, epidemiology, prevalence or effectiveness of CAM; quantitative *not* qualitative or reviews; the outcome measure was use of CAM or belief in CAM's effectiveness.

### Study selection

Two raters independently screened 611 titles against inclusion criteria, leaving 81 (κ=.8). Following abstract screening and reference list searching, 23 papers remained, inconsistencies between the raters were resolved collaboratively by referring to inclusion/exclusion criteria. After full-text screening, three were removed as they were conference presentations and one as it did not report relationships between CAM beliefs and traits/cognitions, leaving 19 papers. The study selection process is shown in Figure P1.

Figure P1 near here

### Data extraction

Data extracted from the included studies is displayed in Table P2. Only relationships or effects pertaining to the predictors of interest were recorded, effects relating to demographic or social variables, beliefs, transient affect or health status were ignored. When assessing the results of included studies, if the traits/cognitions had been entered into a regression or an alternative multifactorial analysis, beta values or odds ratios were extracted. If not, then simple correlations or group comparison data was recorded.

### Quality appraisal

Quality was assessed using the NICE Quality appraisal checklist for quantitative studies reporting correlations and associations (NICE, 2006; shown in Table P1). The NICE criteria rate studies on internal and external validity. The outcomes are: - few or no checklist criteria have been fulfilled; + some of the criteria are fulfilled, and where not fulfilled, or not adequately described, conclusions are unlikely to be altered; ++ all or most criteria are fulfilled, and where not, conclusions are very unlikely to alter. Some of the items on the checklist were not used in this review, as they related to experimental designs only, e.g. 'Selection of exposure and comparison group', 'Was follow-up time meaningful?'; or were not deemed relevant, e.g. 'Is the setting applicable to the UK?'. In Table P1, the first three items yield an overall external validity rating (far-right column of Table P1), the rest of the items derive the overall internal validity rating (second column from right). Included studies were independently rated by two of the authors as either low, medium or high in quality. High quality studies were those with at least ++ and + rating on the two overall categories of external and internal validity respectively. Medium quality studies were those with + and +, or with ++ and -. Low quality studies were those with + and - or with - and -.

Table P1 near here

### Data synthesis

Firstly a narrative analysis was carried out. The studies were categorised according to whether clinical or non-clinical samples, i.e. whether the participants were recruited because of a specific diagnosis. Clinical patients' motivations for CAM use may be different to those of non-patients. Patients may use CAM as a last resort, to sustain hope, to control symptoms (Verhoef et al., 2008). Non-patients may be motivated to use CAM for different reasons, such as prevention or wellbeing (Verhoef et al., 2008). Personality traits and cognitions were also examined separately. The trustworthiness of the analysis was assessed through discussion between the authors.

## Results

### Study Characteristics

With dates ranging from 2002 to 2014, the studies were conducted in the USA (k = 6), USA and various Asian countries (*k* = 1), Canada (*k* = 2), Finland (*k* = 4), Italy (*k* = 1), Japan (*k* = 1), Netherlands (*k* = 1), Poland (*k* = 1), Turkey (*k* = 1) and the UK (*k* = 1). Most studies (*k*=12) sampled on students or the general population, with the rest (*k* = 7) based on patient samples. In all but two of the clinical studies, samples comprised cancer patients. The smallest sample size was 49, but all other samples were ≥ 100, with most over 200 (*k* = 12), the largest being 3261 (study details shown in Table P2).

Table P2 near here

### Clinical studies: personality variables

The personality variables most commonly tested in clinical studies (three out of seven) were the big-five personality traits (e.g. John & Srivastava, 1999). Two of these studies (Hogan, 2006, rheumatology patients; Lo-Fo-Wong et al., 2012, cancer patients) report positive relationships between OtE and both provider-led and self-led CAM use (although in Hogan's study, this was a composite measure of both). Hogan (2006) found no relationship between beliefs about CAM effectiveness and OtE, even when testing simple correlations. Olchowska-Kotala (2013) reports a negative relationship with OtE, but the outcome was willingness to use CAM in hypothetical situations. Olchowska-Kotala (2013) speculates that cancer patients' CAM decisions are pragmatic and based on medical need and therefore OtE is not needed. However, this conflicts with the findings of Lo-Fo-Wong et al. (2012) who also used the same measure of the big-five as Olchowska-Kotala (2013) (the revised NEO personality inventory; Costa & McCrae, 1992). Olchowska-Kotala's (2013) study was also lower in quality compared to Hogan (2006) and Lo-Fo-Wong et al. (2012), primarily because of an unrepresentative and underpowered sample. All three studies used regression analysis, rather than simple correlations only and reported internal consistency in the outcome; the latter two studies also report some tests of validity. Therefore the corresponding findings of Hogan (2006) and Lo-Fo-Wong (2013) should be held in greater confidence. Olchowska-Kotala's (2013) was the only clinical study to have measured the other big-

five traits: extraversion and neuroticism were both positively related to willingness to use CAM; agreeableness and conscientiousness were unrelated to CAM use.

Measures of locus of control (LoC) featured in two studies. Sirois (2008) reported a positive relationship between perceived control over health and CAM use, and a negative relationship between CAM use and beliefs that health status is due to chance. Lo-Fo-Wong et al. (2012) found no such relationships, although differences between measures of LoC, patient population and nationality may explain this, particularly as previous literature shows that predictors of CAM vary across countries (e.g. Verhoef et al., 2005). Although both studies were rated high in quality, the all-female sample in Lo-Fo-Wong et al. (2012) may explain the conflicting findings, given that women are commonly reported in the literature as more likely to use CAM.

Two clinical studies report on trait anxiety. Takeda et al. (2012) show that CAM users were higher in trait anxiety. In contrast, Tarhan et al. (2011) report that CAM users had lower State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983) scores. However, as Tarhan et al. conflated the state anxiety and trait anxiety scores, their findings are difficult to interpret, particularly as Takeda et al. (2012) found that state anxiety scores showed the opposite relationship with CAM use to that of trait scores (i.e. CAM users had lower state anxiety). Disparity between the two studies may be attributed to quality: the Takeda et al. (2012) study was of high quality, whereas the Tarhan et al. (2011) study was deemed to be of low standard due to low internal (simple group comparisons instead of multifactorial) and external validity.

As no other traits featured in more than one clinical study, the reliability of their relationships is uncertain. However, some of these variables may be loosely categorized as 'coping'. Sense of coherence - to view life as understandable, manageable and meaningful (Antonovsky, 1993) - was positively associated with current and past CAM use (Bonacchi et al., 2014). Similarly, Hogan (2006) found resilience to be positively associated with both self-directed CAM use and belief in CAM effectiveness. However, a related concept – coping with the emotions brought about by illness, was reported by Sirois (2008) as negatively associated with CAM use. As all three studies were of high standard, these contradictions are apparently not due to quality, but may reflect differences in coping measures and/or differences in patient population and nationality. Sirois (2008) also found CAM use was related to positive reinforcement-based motivations.

### Clinical studies: cognitions

Cognitive style featured in only one clinical study. Olchowska-Kotsala (2013) measured self-reported thinking style with the Mind Types Checklist (Nosal, 1992). Emotion-based (intuitive, automatic) thinking and rational (deliberate, analytical) thinking were both positively related with willingness to use CAM, suggesting CAM use is related to two different cognitive styles. This requires replication as the study has questionable

external validity and was the only clinical study to test cognition. Other thinking styles failed to predict willingness to use CAM: namely typical (preference for simplistic, superficial thought) and creative thinking styles.

### Non-clinical studies: personality variables

Turning to non-clinical studies, again the big-five personality traits featured more commonly than any other. In four studies, OtE was positively associated (weakly to moderately) with CAM use (Honda & Jacobson, 2005; Lombart, 2002; Sirois & Gick, 2002; Won, 2014), in a fifth, OtE was associated weakly with *willingness* to use CAM (Smith et al. 2008). In Ho's (2012) study, a positive relationship between OtE and CAM beliefs was found in US students but not students from Asian countries. Furnham (2007), Hogan (2006) and Won (2014) reported no relationship between OtE and CAM beliefs. The studies reporting on OtE show a range of quality, with positive relationships evident in studies of high, medium and low standard. Amongst those reporting positive relationships, the Honda and Jacobson (2005) study was rated as highest, with a large, well-described representative sample and good internal validity too, with an outcome tested for content validity.

Regarding other big-five traits, extraversion was a positive predictor of CAM beliefs in Furnham's (2007) study, but a negative predictor of CAM use in Honda and Jacobson's (2005) study - the latter study was rated highest in quality. In other studies, extraversion was not a predictor of self-reported CAM use (Lombart, 2002; Sirois & Gick, 2002) or of willingness to use CAM (Smith et al., 2008). None of the other three big-five variables were predictors of CAM in non-clinical studies (Furnham, 2007, Honda & Jacobson, 2005; Lombart, 2002; Sirois & Gick, 2002; Smith et al., 2008) aside from agreeableness, which predicted CAM beliefs in Furnham (2007), albeit with a weak effect size. Furnham (2007) reports virtually the same (weak) effect sizes for extraversion ($r$=.15) and agreeableness ($r$=−.16) that Lombart (2002) reports for extraversion ($r$=−.16). Furnham's coefficients are statistically significant but not Lombart's, only because of the larger sample size in the former (n=243 as opposed to n=160).

Coping variables were related to CAM use in two non-clinical studies (Honda & Jacobson, 2005; LaCaille & Kuvaas, 2011). External coping (persistence in efforts to influence one's environment) was negatively associated with CAM use, and internal coping (positive reappraisals) was positively associated with CAM use (Honda & Jacobson, 2005). Another type of general internal coping – lowering aspirations – was not associated. The authors note that external coping may be more stable than internal coping and that the two types of coping may be associated with different types of CAM. Smith et al. (2008) failed to find an effect of future-focused optimism, a similar construct to now-focused positive reappraisal, as measured in Honda and Jacobson's (2005) study. LaCaille and Kuvaas (2011) found positive associations between CAM use and both active and support-seeking coping, whereas avoidant coping was positively associated with herbal supplement use specifically. Acceptance coping was not a

predictor. A concept which may serve as a coping strategy - spirituality (see Gall, Charbonneau, Clarke, Grant, Joseph & Shouldice, 2005) - was associated positively with willingness to use CAM by Smith et al. (2008). There is correspondence between Honda and Jacobson (2005) and LaCaille and Kuvaas (2011) on the importance of coping, but less support from Smith et al. (2008). The inconsistency here may be due to differences in outcome measure as well as predictor variables. However, the external validity of Smith et al. (2008) is weaker than that of Honda and Jacobson (2005), whose study is based on a large, representative, general population survey.

Locus of control was tested in two non-clinical studies: Sirois and Gick (2002) found neither internal nor external LoC as predictive of CAM use. Lombart (2002) also tested internal LoC and also failed to find a relationship with CAM use. One study noted a strong relationship between mood attention (awareness of one's feelings) and willingness to use CAM (Smith et al., 2008). No other traits were found to be predictors of CAM use/beliefs.

### Non-clinical studies: cognitions

Four non-clinical studies tested thinking style with the Rational-Experiential Inventory (Pacini & Epstein, 1999), which measures self-reported propensity for intuitive (rapid, instinctive) thinking and also rational (analytical, effortful) thought. Three of these studies (Lindeman, 2011; Saher & Lindeman, 2005; Svedholm & Lindeman, 2012) found positive relationships between intuitive thinking and beliefs about CAM effectiveness. One study (Won, 2014) found only a relationship between intuitive thinking and CAM use. None found an association between CAM beliefs and rational thought. Need for cognition (enjoying and seeking out effortful thought; see Cacioppo, Petty & Feng Kao, 1984) - a concept similar to Pacini and Epstein's (1999) rational thinking – was also found to be unrelated to CAM use by LaCaille & Kuvaas (2011).

Additionally, three studies reported (weak to moderate) positive relationships between beliefs about CAM effectiveness and ontological confusions (Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2012). Core ontological knowledge incorporates understanding of the distinctions between physical, biological and mental phenomena and the key characteristics which define such phenomena. For example, mental phenomena are the product of animate beings with intentionality, physical objects exist without intentionality but may move when affected by external forces, biological organisms have organic properties such as growth and healing. Subtle ontological confusions are common in CAM (Lindeman, 2011), such as mistaking processes as material substances, or describing processes (e.g. energy; Chen, 2007) as intentional - characteristics which such phenomena could not possibly possess. Of the four studies by Lindeman and colleagues, two were judged to have weaker external validity (Saher & Lindeman, 2005; Svedholm & Lindeman, 2012). Despite this, the

findings from the four Lindeman studies are consistent, which suggests that the results were robust enough to overcome the varying quality.

## Discussion

### Traits and cognitions associated with CAM use/belief

The factors most robustly associated with CAM use/belief were intuitive thinking and ontological confusions. Across clinical and non-clinical studies, OtE was only weakly related with CAM use and not at all with CAM beliefs. Intuitive thinking was also a consistent predictor of CAM beliefs, typically measured on Pacini and Epstein's REI (1999). This suggests CAM believers habitually use rapid, instinctive and automatic thought. Previous literature suggests that intuitive thinkers find it difficult to inhibit automatic responses, despite recognition that one is going against his/her more rational judgement (De Neys, Vartanian & Goel, 2008). Decisions about health are influenced by strong emotions (Chapman & Coups, 2006), and CAM use is associated with affect-laden decisions such as hope (see Verhoef et al., 2005) and risk (Rakovitch, Pignol, Chartier, Ezer, Verma, Dranitsaris & Clemons, 2005). Thus despite the availability of scientific evidence for orthodox medicine, CAM may be attractive because it appeals to emotions, and this suits those who reason intuitively, even when aware that rational judgement has been overlooked. The review does not suggest however, that those who believe in CAM are also typically non-rational. The finding here that intuitive and rational thinking are not opposites nor mutually exclusive is consistent with previous literature showing the independence of these two processing styles (Handley, Newstead & Wright, 2000).

In addition to reasoning, a further cognitive style – ontological confusions, also predicted CAM beliefs (Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2012). For example belief in CAM was associated with unscientific conceptions of energy (that it can live, grow, die, that it can represent emotions, can be good or bad, etc.), and was also associated with assigning intentionality to internal organs, purpose to inanimate objects, etc. (Lindeman & Saher, 2007). According to Lindeman (2011), common claims about the integrity of CAM often reflect ontological confusions. Such claims do not merely come with a lack of scientific evidence, they are unfalsifiable (for example the notion of good or bad energy). Svedholm and Lindeman (2012) argue that, in line with dual process theories (e.g. Evans & Stanovich, 2013) ontological mistakes can be held alongside scientifically valid conceptions.

Other traits and cognitions had less compelling support. It is impossible to conclude that any particular coping style is associated with CAM as the types of coping reported in the review vary greatly. Furthermore, in spite of the generally high quality of studies which tested coping (both clinical and non-clinical), its association with CAM was not supported in all studies and in one the relationship was negative. Locus of control also

failed to correlate with CAM. Inconsistency in the findings for LoC cannot necessarily be attributed to low quality but may be due to differences in methodology and population. Trait anxiety was only tested in two (clinical) studies, but the inconsistency of the findings here may be due to variations in methodological quality.

There were no systematic differences between clinical and non-clinical studies regarding the traits associated with CAM. However only one high quality clinical study tested CAM beliefs; thinking styles and ontological confusions were mainly tested in non-clinical studies. In contrast with the non-clinical research, one clinical study (Olchowska-Kotala, 2013) reported both rational and emotional thinking to be positively related to willingness to use CAM. This could suggest a different cognitive style for CAM-using patients to that of CAM-using non-patients, however this finding would need further replication and such conclusions are also tempered by the low external validity of Olchowska-Kotala's study. No clinical studies tested ontological confusions - suggesting an opportunity for future research.

### Critique of the literature

One difficulty with studies on cognitions and CAM is that evidence comes mainly from Lindeman and colleagues' research group. Perhaps because of this, these studies share other characteristics: non-clinical Finnish populations and measuring CAM beliefs not usage. Additionally these four studies vary in quality. Despite this criticism, Lindeman's studies on ontological confusions represent a highly innovative approach to understanding CAM beliefs and offer a promise for further research.

Most studies on intuitive and rational thinking employed the REI (Pacini & Epsten, 1999). This self-report measure is not a performance test of dual process thinking and does not correlate with common reasoning paradigms such as syllogisms or Wason's Selection task (Newstead, Handley, Harley, Wright & Farrelly, 2004). The purported relationship between intuitive thinking and CAM beliefs would be more compelling if demonstrated with performance measures used in the reasoning literature such as the cognitive reflection test, which examines one's ability to resist appealing automatic responses in favour of deliberate analytical reasoning (Toplak, West & Stanovich, 2011).

A prominent methodological failing in the literature reviewed here is that the universal adoption of cross-sectional, correlational designs, does not permit robust conclusions about causality. One could counter-argue that a causal relation in which CAM use or beliefs change one's traits or cognitions is implausible. However, this counter-argument may not always stand, as it is indeed possible that immersion in some CAM ideologies may foster generalised ontological confusions, such as intentionality in energy for example. Causal arguments would be more robust if experimental or longitudinal designs were adopted.

Outcome measures of CAM use and belief varied across studies reviewed here. In some studies, new measures were created and tested for reliability and validity, but in others, the outcome is merely a self-reported answer, and validity and reliability of the outcome is assumed but not tested. To ensure quality of future research, standardised, reliable and valid measures are needed, reflecting scores on both CAM use *and* belief.

Many studies in this review have neglected to incorporate important covariates which are known to predict CAM use/beliefs, such as demographic variables and other psychosocial factors. Furthermore, some studies reported only simple correlations, instead of entering factors into a regression model with other important predictors. With the regression method previously significant simple-correlations may diminish or disappear as only the most robust predictors remain associated with the outcome. Future studies should attempt to avoid this mistake in order to reduce the chances of type 1 errors.

### Future research

As found with other types of belief, CAM beliefs may associate with reasoning biases. For example, paranormal beliefs (which share variance with CAM beliefs, e.g. Jeswani and Furnham, 2010) correlate with intuitive thinking on the REI (Lindeman & Aarnio, 2007), but are also associated with misperception of randomness (Rogers, 2014). Delusional belief too is predicted by intuitive thinking on the REI (Freeman, Evans & Lister, 2012) but is also related to a jump-to-conclusions bias (Fine, Gardner, Craigie & Gold, 2007) and a liberal acceptance bias (Moritz, Woodward, Jelinek & Klinge, 2008).

Besides OtE, few other traits have emerged from this review as potential predictors of CAM use/belief. This may be because, aside from the big-five, relatively few traits have been repeatedly tested in the literature. Coping, trait anxiety and locus of control are plausible predictors of CAM. The inconsistent findings from the literature may reflect the shortage of good quality studies needed to fully establish reliable relationships.

Given that numerous demographic and psychological factors may be associated with CAM use/belief, more multifactorial studies are needed so that a comprehensive model of CAM use/belief can be established. Multi-factor models have been formulated to explain other types of belief, such as delusions (e.g. Galbraith & Manktelow, 2014) and paranormal belief (Lindeman & Aarnio, 2007). Existing models of health behaviours which differentiate between belief, motivation, intention and behaviour (e.g. self-determination theory, Deci & Ryan, 2011; theory of planned behaviour, Ajzen, 2011; health belief model, Norman & Brain, 2005) may provide a theoretical basis for testing conceptual models of CAM use/belief and for exploring in which situations beliefs and use coincide or diverge.

## Conclusions

We have reviewed the research literature to establish whether traits and cognitions predict use of and belief in CAM. Nineteen cross-sectional studies were selected. OtE was not associated with CAM beliefs; it was associated with CAM use in some studies, but the aggregated effect was weak. The other big-five traits were rarely related to CAM but other traits including LoC, trait anxiety or particular coping styles have been under-researched. Two types of cognitive style, intuitive thinking and ontological confusions were reliably associated with CAM beliefs. The studies were of varying quality, and the majority employed correlational designs. A greater understanding of the relationship between CAM use and CAM belief is also a priority for future research, and further work is needed to confirm whether the same traits and cognitions typify patients and non-patients.

## References (see final references list)

Table P1. The quality of the studies included in the review, assessed by the NICE Quality appraisal checklist for quantitative studies reporting correlations and associations (NICE, 2006).

| | 1.1 | 1.2 | 1.3 | 2.2 | 2.4 | 3.1 | 4.1 | 4.2 | 4.3 | 4.6 | **5.1Study results internally valid?** | **5.2 Findings generalisable to the source population (i.e. externally valid)?** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bonacchi et al. (2014) | ++ | + | ++ | ++ | ++ | − | + | + | + | + | + | ++ |
| Furnham (2007) | ++ | ++ | + | ++ | − | + | ++ | − | − | + | + | + |
| Ho (2012) | ++ | + | − | ++ | + | − | ++ | + | + | ++ | + | + |
| Hogan (2006) | | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| Honda & Jacobson (2005) | ++ | ++ | ++ | ++ | ++ | + | ++ | ++ | ++ | ++ | ++ | ++ |
| LaCaille & Kuvaas (2011) | + | + | ++ | ++ | + | − | ++ | + | + | ++ | + | + |
| Lindeman (2011) | ++ | ++ | + | ++ | ++ | + | + | ++ | ++ | ++ | ++ | ++ |
| Lindeman & Saher (2007) | ++ | + | - | ++ | − | ++ | + | - | - | + | + | + |
| Lo-Fo-Wong et al. (2012) | + | ++ | ++ | ++ | ++ | − | ++ | ++ | ++ | ++ | ++ | ++ |
| Lombart (2002) | ++ | − | − | ++ | − | − | ++ | + | ++ | + | + | − |
| Olchowska-Kotala (2013) | − | − | − | ++ | + | + | − | ++ | + | ++ | + | − |
| Saher & Lindeman (2005) | + | − | − | ++ | ++ | + | ++ | ++ | ++ | + | + | − |
| Sirois (2008) | ++ | + | + | ++ | ++ | − | ++ | ++ | ++ | ++ | ++ | + |
| Sirois & Gick (2002) | ++ | + | + | ++ | − | − | ++ | - | - | ++ | + | + |
| Smith et al. (2008) | ++ | − | − | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | − |
| Svedholm & Lindeman (2013) | + | NR | NR | ++ | − | + | + | - | - | + | + | − |
| Takeda et al. (2012) | ++ | + | + | ++ | ++ | − | ++ | ++ | ++ | ++ | + | + |
| Tarhan et al. (2011) | + | NR | + | ++ | − | − | ++ | − | − | ++ | − | − |
| Won, (2014) | ++ | + | + | ++ | ++ | + | + | ++ | ++ | ++ | ++ | + |

*Note*: 1.1 Source population well described?; 1.2 Eligible population or area representative of the source population or area?; 1.3 Selected participants or areas represent the eligible population or area?; 2.2 Selection of explanatory variables based on a sound theoretical basis?; 2.4 Likely confounding factors identified and controlled?; 3.1 Outcome measures and procedures reliable?; 4.1 Sufficiently powered?; 4.2 Multiple explanatory variables considered in the analyses?; 4.3 Analytical methods appropriate?; 4.6 Precision of association given or calculable? Is association meaningful?; 5.1Study results internally valid?; 5.2 Findings generalisable to the source population (i.e. externally valid)?; NR = not recorded.

Table P2, part 1. Summary of the studies included in the review.

| **Authors** | Bonacchi et al. | Furnham | Ho | Hogan | Honda & Jacobson | LaCaille & Kuvaas | Lindeman | Lindeman & Saher |
|---|---|---|---|---|---|---|---|---|
| **Year** | 2014 | 2007 | 2012 | 2006 | 2005 | 2011 | 2011 | 2007 |
| **Country** | Italy | UK | | USA | USA | USA | Finland | Finland |
| **Setting** | Secondary care, cancer | General public | US, Asia | Secondary care, rheumatology | US general population | College | General public | University/ school |
| **Population** | Italian cancer patients | UK general public | Population | US rheumatology patients | US general population | US College students | General public | Students |
| **Sample size** | 803 | 243 | 148 | 320 | 3032 | 370 | 1092 | 239 |
| **Study aims** | Demographic and psychological characteristics of CAM users | Whether personality, beliefs and attitudes predict beliefs/ attitudes to CAM and use of CAM | Predictors of attitudes to CAM | Relationships between self-reported health, personality variables and the use and effectiveness of CAM | Association between CAM use & personality, coping, social support | CAM use & associations with coping and self-regulatory styles, healthcare satisfaction | Compare cognitions, beliefs and demographic predictors of belief in CAM | Association between ontological confusions and superstitious beliefs (including CAM) |
| **Design** | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional |
| **Outcome measure** | Self-reported current and past use of CAM | Belief in efficacy of CAM, attitude to CAM, safety of CAM | Self-reported attitudes to alternative medicine | CAM use and ratings of effectiveness of CAM | Self-reported use of any CAM in past year | Self-reported use of CAM and herbals supplements in past year | Self-reported belief in CAM | Self-reported belief in efficacy of CAM |
| **Outcome measure tested for reliability and validity?** | Not tested | Content/ construct validity | Not tested | Internal reliability, discriminant validity | Content validity | Not tested | Internal consistency | Internal consistency |
| **Analysis** | Regression | Correlations | Regression | Regressions for total CAM use | Regression | Regression | Regression | Simple correlations |

Table P2, part 2. Summary of the studies included in the review.

| **Authors** | Bonacchi et al. | Furnham | Ho | Hogan | | | Honda & Jacobson | | LaCaille & Kuvaas | Lindeman | Lindeman & Saher |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cognitions/traits related to CAM use or belief** | Sense of coherence & past use of CAM (OR=1.6,) | Extraversion correlated with efficacy of CAM (*r*=.15) ,agreeableness correlated with safety (*r*=.16) | OtE, (American students, *β* = .276) | Total CAM use: absorption (*β* =.396); OtE (*β* =.259); | Practitioner-led CAM use: (OtE (*r*=.27); absorption (*r*=.27) | Self-CAM use: Resilience (*β* =.170); | Any CAM use: resilience (*β* =.136); positive affect (*β* =.138); | OtE, (OR=1.65); Extraversion (OR=0.65); Persistence (OR=0.67); Positive reappraisals predict some types of CAM. | CAM: Intrinsic self-regulatory style (OR =1.12); Active coping (OR= 1.11); Support seeking coping (OR= 1.07); Herbal: Avoidant coping (OR= 1.06); Active coping (OR= 1.11) | Intuitive thinking (*β*=.13; core knowledge confusions *(β*=.16) | Ontological confusions, correlations ranging from *r*=.31 to *r*=.75 |
| **Cognitions/traits NOT related to CAM use or belief** | SoC and current use of CAM | Neuroticism, OtE, conscientiousness (r<.15) | OtE (Asian students, *β* =.194) | Total CAM use: positive affect (*β* =.025); | CAM effectiveness: OtE (*r*=-.05); absorption (*r*=.07) | | | Agreeableness (OR=1.06); Neurot. (OR=0.88); Conscient. (OR=0.94); Pos. reappraisals (OR=1.20); Lowering aspirations (OR=0.86) | CAM use: Avoidant coping OR= 0.99; Acceptance coping OR= 0.93; Need for cognition OR=1.02; Various motiv. types OR=1.01 to OR=0.96; | / | / |

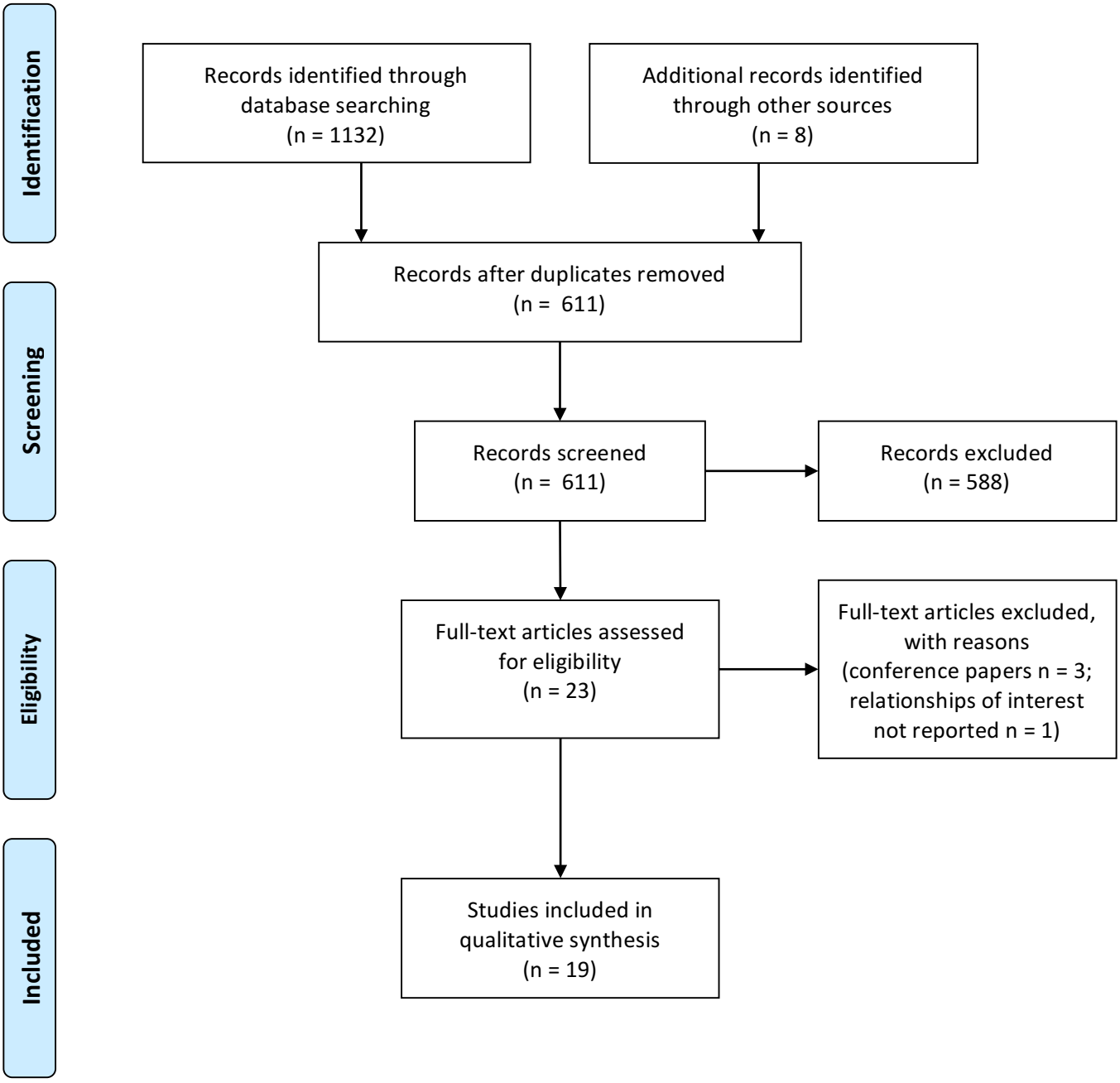
Table P2, part 3. Summary of the studies included in the review.

| **Authors** | Lo-Fo-Wong, et al. | Lombart, K. | Olchowska-Kotsala, | Saher, & Lindeman | Sirois | Sirois & Gick | Smith,et al. | Svedholm & Lindeman | Takeda et al. | Tarhanet al. | Won |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | 2012 | 2002 | 2013 | 2005 | 2008 | 2002 | 2008 | 2013 | 2012 | 2011 | 2014 |
| **Country** | Nether-lands | USA | Poland | Finland | Canada | Canada | USA | Finland | Japan | Turkey | USA |
| **Setting** | Secondary care, cancer | University, gen. public | Secondary care, cancer | School, university, gen. public | Online | Orthodox medicine health offices/clinics, compl. medicine health offices/clinics | University | Secondary school | Secondary care, cancer | Secondary care, cancer | Gen. public |
| **Population** | Dutch female breast cancer patients | Students, gen. public | Polish cancer patients | Students, gen. public in Finland | Arthritis, IBS, mixed chronic conditions patients | CAM users and non-CAM users | US undergrad. students | Secondary school students in Finland | Gynecologic cancer patients in Japan | Oncology patients in Turkey | Gen. public |
| **Sample size** | 176 | 160 | 49 | 3261 | 365 | 199 | 276 | 102 | 420 | 220 | 100 |
| **Study aims** | Socio-demographic, clinical, and psychological predictors of CAM use | Psychological and demographic correlates of perceived efficacy and use of unconventional therapies (UT) | Whether personality, cognitive preferences, and paranormal beliefs predict willingness to use CAM | Do intuitive thinking, paranormal beliefs, magical food/health beliefs, values and sex predict CAM beliefs. | Studying the socio-demographic, health-related, and psychosocial correlates of CAM use | Whether health beliefs, socio-demographic, medical, and personality factors predicted CAM use. | To study individual difference in personality in willingness to use CAM | Whether ontological confusions and cognitive style were associated with ratings of CAM effectiveness | Characteristics, perceptions and attitudes of cancer patients to Kampo medicines | Whether disease state, sociodemographics psychological conditions and QoL predict CAM use | Traits, thinking style, rel. with CAM use/belief |
| **Design** | Cross-sectional (correlational) and long'l | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Correlational, cross-sectional | Quasi experimental comparison, cross sectional | Correlational, cross-sectional | Correlational, cross-sectional; longitudinal | Quasi experimental comparison, cross-sectional | Quasi-experimental, cross-sectional | Correlational, cross-sectional |

Table P2, part 4. Summary of the studies included in the review.

| **Authors** | Lo-Fo-Wong et al. | Lombart | Olchowska-Kotsala | Saher & Lindeman | Sirois. | Sirois & Gick | Smith et al. | Svedholm & Lindeman | Takeda et al. | Tarhan et al. | Won |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Outcome measure** | Provider – directed CAM use, self-directed CAM, self-directed CAM use 6 moths follow-up. | Number of UT tried. | Willingness to use CAM in hypothetical situations. | Self-reported belief in efficacy of CAM. | Self-reported CAM use. | Self-reported CAM use (Orthodox medicine (non-CAM), new or infrequent CAM use, established CAM use). | Willingness to use CAM. | Ratings of CAM effectiveness. | Whether users, or non-users of Kampo/ dietary supplements | Self-reported CAM use. | Self-reported CAM use/ attitude to CAM. |
| **Outcome measure tested for reliability and validity?** | Int. consistency, content validity | Not tested. | Internal consistency | Internal consistency | Not tested. | Not tested. | Content validity and internal consistency. | internal consistency. | Not tested | Not tested. | Internal reliability, test-retest. |
| **Analysis** | Regression. | Regression. | Regression | Regression | Regression. | Comparisons. | Regression. | simple correlations | Multivariate risk ratio | Simple group comparisons. | |
| **Cognitions/traits related to CAM use or belief** | OtE & provider CAM, (OR=1.14), OtE & self-CAM 6 months (OR=1.11). | OtE ($\beta$=.296). | Emotionality ($\beta$=.48), Rationality ($\beta$=.45), Neuroticism ($\beta$=.47), Extra'n ($\beta$=.46), OtE ($\beta$= -.53). | Intuitive thinking $r$=.33 | Perceived health control (OR=1.47); reward motiv. (OR=1.56); health due to chance (OR=0.81); emotion coping (OR=0.65). | OtE scores higher in new & infrequent CAM users (M=6.44, SD=2.36) than non-CAM users, (M=5.20, SD=2.38). | OtE rel. CAM ($\beta$=.225); Spirituality rel. with CAM & spirituality- therapies ($\beta$=.274); mood attention ass with CAM & spirituality-therapies ($\beta$=.182). | Ontological confusions ($r$=.22); Intuitive thinking ($r$=.37). | Trait anxiety (risk ratio, 1.46) | / | Rel. to CAM use: OtE ($B$=.23); Emot. intell. ($B$=-.27; .20); Intuitive thinking ($B$=.22). Rel. to CAM attitude: Sex ($B$=.29) |
| **Cognitions/traits NOT related to CAM use or belief** | Perceived control & self-CAM 6 months (OR=0.92). | Neurot. ($r$=-.08), Compliance ($r$=.03), Humility ($r$=.03), Extra'n ($r$=.16), Int. LoC ($r$=.05). | Intuition ($\beta$=.04), Creativity ($\beta$=-.05), Conscientiousness ($\beta$=.12), Agreeableness ($\beta$=.30). | Rational thinking $r$=.00. | / | Group comparisons not significant on neuro'm., extra'n, agreeableness and conscientiousness, int. LoC and ext. LoC. | Neurot'm, Extra., Agreeableness, Conscientiousness, Mood Clarity, Mood Repair, optimism, religiousness. | Need for cognition ($r$=.12); Actively open-minded thinking ($r$=-.19). | / | State/trait anxiety (STAI), CAM users M=43.7 (SD=8.0), non-CAM users M=44.3 (SD=8.2). | Not rel. to CAM attitude: OtE ($B$=.08); Intuitive thinking ($B$=.16). |

Figure P1. PRISMA flow diagram of search process.



# Chapter 1. Introduction to the thesis

## The nature of CAM

Complementary and alternative medicine (CAM) encompasses many treatments outside conventional healthcare, including acupuncture, aromatherapy, chiropractic, healing, herbal medicine, homoeopathy, hypnosis, massage, meditation, nutritional therapy, reflexology, reiki, and yoga (Zollman & Vickers, 1999). In England, a large household survey showed that 44.0% of respondents have used CAM in their lifetime, 26.3% in the last 12 months and that 12.1% had consulted with a CAM practitioner within the preceding 12 months (Hunt, Coelho, Wider, Perry, Hung, Terry & Ernst, 2010).

The incidence of CAM use is similar in the US (Eisenberg, Davis, Ettner, Appel, Wilkey, Van Rompay & Kessler, 1998) and may even be higher in East Asia (Harris, Cooper, Relton & Thomas, 2012). However, as the statistics show, CAM use is not universal; many choose not to use such treatments. This raises questions about which kinds of people are most likely to believe in and use CAM.

## Who uses CAM and why

The most commonly reported motivations for CAM use are as remedies for chronic conditions (Eisenberg et al. 1998), but CAM is also used for less serious conditions, for health promotion and disease prevention (Yamashita, Tsukayama & Sugishita, 2002) and for health maintenance (Lim, Sadarangani, Chan & Heng, 2005).

In addition to health status, demographics are important predictors of CAM use. A systematic review shows that female and younger cancer patients - and in Western countries, those with higher incomes and more years of education - use CAM more. In Turkey and in Hawaii however, CAM use was related with lower income (Verhoef, Balneaves, Boon & Vroegindewey, 2005), perhaps as it is less costly than orthodox medicine. A review of the general population and medical professionals (Frass, Strassl, Friehs, Müllner, Kundi & Kaye, 2012) supports these sex and income effects, but (in contrast to Verhoef et al., 2005) found higher CAM use in older people. A Taiwanese survey found that demographics differed depending on whether CAM use was for health maintenance (e.g. male, fewer years of education) or illness treatment (e.g. lower income) (Wu, Chou, Chen, Chen, Yeh & Lin, 2012). In their US review, Barnes, Bloom and Nahin (2008) found that native American and white adults were more likely to use CAM than Asian and black adults.

## Psychological factors in CAM use/belief

Attitudes and beliefs also play a role both in CAM use and also faith in CAM (i.e. faith in whether CAM is effective as a treatment). A review of CAM use in type 2 diabetes suggests beliefs and attitudes are more important predictors than

demographics (Chang, Wallis & Tiralongo, 2012). In their systematic review, Bishop, Yardley and Lewith (2007) found that a collaborative and participative approach to health, active coping, perceptions of illness causality (e.g. diet, stress), unconventional life philosophies (e.g. post-materialism) and spirituality, all predicted CAM use. Elsewhere, negative attitudes to conventional medication (Hsiao, Wong, Kanouse, Collins, Liu, Andersen, ... & Wenger, 2003), holistic philosophy toward health (Astin, 1998), modern health worries and mistrust of conventional science and orthodox medicine (Furnham, 2007; Jeswani & Furnham, 2010; Vincent & Furnham, 1996) have all been demonstrated as predictors of CAM use. CAM use/belief has also been shown to associate with belief in the paranormal (Jeswani & Furnham, 2010; Van den Bulck & Custers, 2009).

So beliefs and attitudes have been reliably shown to predict CAM use and CAM beliefs. However, other psychological factors such as cognition and personality have also been explored as predictors of CAM use/belief. A recent systematic review by the author (see Preliminary Chapter) established firstly that openness to experience (hereafter OtE; being imaginative, unconventional and willing to consider new ideas) predicted use of CAM (e.g. Honda & Jacobson, 2005; Lombart, 2002) and to a lesser degree, belief in the effectiveness of CAM (Won, 2014). Secondly, the review concluded that intuitive thinking (rapid, instinctive, effortless thought) reliably predicted belief in CAM effectiveness (e.g. Svedholm & Lindeman, 2013; Won, 2014). In contrast, a propensity for rational (analytical, effortful) thought did not predict CAM beliefs (nor CAM use). Thirdly, the review identified another correlate of CAM beliefs: ontological mistakes (e.g. Lindeman, 2011). Ontology concerns our understanding of the rules and categories which define our reality. A number of studies have shown that confusion of these categories, such as muddling the distinctions between physical and mental phenomena (e.g. thoughts blocking energy) or between sentient and non-sentient entities (e.g. assigning intentionality to internal organs), is more likely in people who believe in the effectiveness of CAM.

### The current thesis

The systematic review reported in the preliminary chapter highlights empirical studies relevant to CAM use/belief. In particular, it suggested a role for cognitive bias in the development of CAM beliefs and use. Cognitive biases are heuristics or mental short-cuts which people systematically rely on to make decisions and draw conclusions, often when the demands of a task exceed cognitive processing capacity (Evans, 1989; Evans & Stanovich, 2013; Stanovich & West, 2008; Tversky & Kahneman, 1975). If intuitive thinking and ontological confusions are related to CAM beliefs/use, it suggests that these biases are partly responsible for the development or at least the maintenance of belief in CAM. The wider research evidence is in line with this notion: intuitive thinking and ontological confusions are associated not only with CAM beliefs, but also other non-scientific beliefs relating to

the paranormal (Lindeman, Svedholm-Häkkinen & Lipsanen, 2015; Lobato, Mendoza, Sims & Chin, 2014) and pseudoscience (Pennycook, Cheyne, Barr, Koehler & Fugelsang, 2015).

From the systematic review in the Preliminary Chapter, three separate empirical investigations were suggested. The first was the development of a measure of CAM belief and use. Although some questionnaires on CAM belief/use already exist, the rigor of validity and reliability testing to which they have been subjected is variable and indeed some measures have questionable validity (Bishop, Yardley & Lewith, 2005; Finnigan, 1991; Hyland, Lewith & Westoby, 2003; Lindeman, 2011). Furthermore, in general these questionnaires do not distinguish between different forms of CAM, which is a particular focus of the current thesis given that CAM is a heterogeneous phenomenon. It is plausible that psychological variables might correlate with belief in some forms of CAM but not all. Study 1 therefore reports on the development and testing of a questionnaire measuring belief in different forms of CAM and also CAM use.

The second investigation suggested by the systematic review was the relation between intuitive thinking and CAM belief/use. The studies identified in our review, all tested intuitive thinking with self-report thinking questionnaires. The disadvantage of such measures is that they might not offer an accurate insight into the person's actual thinking styles, in effect, they measure what people believe (or want) their thinking style to be, not necessarily what it actually is. Furthermore, self-report measures of thinking style do not necessarily correlate well with performance measures of thinking (Newstead, Handley, Harley, Wright & Farrelly, 2004). Thus studies 2 and 3 will examine whether the previously found relationships between CAM belief/use and intuitive thinking are replicated on performance measures of thinking such as the Cognitive Reflection Test (CRT; Frederick, 2005) and base rate neglect problems (Bar-Hillel, 1980). These test how willing or able people are to override an initial, intuitive response to a problem and engage in more effortful, analytical thought to solve the problem. Unlike self-report measures of thinking, measures such as the CRT test people's actual thinking rather than their assumptions of how they think.

The third empirical investigation suggested by our review relates to ontological mistakes, which are not only associated with belief in CAM (Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2013) but also with intuitive thinking (Lindeman, 2011; Pennycook et al., 2015). These findings raise the question of whether ontological mistakes are a system 1 heuristic process - a cognitive bias that people fallback onto when system 2, analytical processing is too difficult. And correspondingly, whether the ability to detect such mistakes requires system 2 processing (slow, effortful, analytic; Evans & Stanovich, 2013). If this is the case, it

suggests a cognitive mechanism by which ontological mistakes – and in turn belief in CAM - might become more likely. Using reasoning paradigms, studies 4-5 will test the question of whether noticing ontological mistakes is a system 2, analytic process. More specifically, these studies will explore whether people's ability to notice ontological in/correctness diminishes when cognitive processing is made more difficult. The syllogistic belief bias paradigm (e.g. Evans, Barston & Pollard, 1983; Markovitz & Nantel, 1989) provides a method for testing this. It is well established that believability biases people's assessments of logical validity when they attempt to solve syllogisms, because awareness of believable and unbelievable statements requires very little cognitive capacity and thus beliefs can interfere even when one is simultaneously engaged in reasoning. We will use the belief bias paradigm to test the hypothesis that (unlike believability) ontological correctness does not bias responding on difficult syllogisms, because difficult reasoning expends the cognitive capacity required to notice said mistakes.

### The relevance of these studies to health psychology

By placing faith in CAM, people are potentially investing in therapies which have questionable scientific credibility and/or a limited evidence base for their effectiveness (Angell & Kassirer, 1998; Barnes, 2003). If the effectiveness of certain forms of CAM is unsupported by evidence, then such investment is misguided, potentially wasting time, money and in some cases diverting patients away from orthodox, evidence-based treatments (Talalay & Talalay, 2001). By understanding the role that cognitive factors play in CAM beliefs, we are in a better position to design interventions to educate people about CAM and to help them make informed health decisions. Indeed, evidence suggests that the targeting of cognitions can be effective in health behavior change (Albarracın, McNatt, Klein, Ho, Mitchell & Kumkale, 2003; Bandura, 1989; Decruyenaere, Evers-Kiebooms, Welkenhuysen, Denayer & Claes, 2000; Hadjistavropoulos, Craig & Hadjistavropoulos, 1998; Peters McCaul, Stefanek & Nelson, 2006). Thus the following series of studies sets out to uncover new knowledge about the cognitive biases that are associated with belief in and use of CAM.

# Chapter 2. Development and testing of a new measure of CAM beliefs and CAM use.

The author and colleagues recently conducted a systematic review (see Preliminary Chapter) of the cognitions and traits associated with belief in and use of CAM. In reviewing this literature, it was noted that studies had employed a range of measures for CAM belief and use. Mostly these measures had been designed by the authors for their own studies but had apparently not been subjected to tests of validity and reliability.

Due to the absence of a commonly-used and widely tested measure of CAM beliefs, it was decided that a new measure of attitudes to CAM would be designed to suit the requirements of the current research. This would also allow the author to rigorously test the new measure.

## Existing measures of CAM

A number of measures of CAM belief have been developed, but these vary in emphasis and in the degree to which they have been tested for reliability and validity. The complementary and alternative medicine beliefs inventory (CAMBI; Bishop, Yardley & Lewith, 2005) is a valid and internally consistent 17-item measure, encompassing three dimensions of belief: beliefs in natural treatments, beliefs around participation in treatment and beliefs about a holistic approach to health. However, the CAMBI does not measure beliefs about the effectiveness of different forms of CAM, rather it measures more general attitudes about CAM. Mike Hyland and colleagues developed the the 11-item holistic complementary and alternative medicine questionnaire (HCAMQ; Hyland, Lewith & Westoby, 2003). This too contains a 'beliefs about holistic health' subscale as well as a subscale pertaining to the scientific validity of CAM. It has good internal reliability and validity but questionable external validity. The question-mark over external validity arises because the holistic health subscale failed to distinguish between patients from a CAM clinic and patients attending a conventional hospital. Furthermore, as with the CAMBI, the HCAMQ does not measure beliefs about the effectiveness of different forms of CAM. Finnigan (1991) has developed a unitary measure of CAM beliefs. Finnigan's measure (the attitude towards alternative medicine scale; AAMS) reflects general attitudes towards CAM, but has questionable convergent validity. The CAMBI, the HCAMQ and the AAMS, all encompass general philosophies common to CAM, such as a holistic approach to health or participation in healthcare. However, the emphasis of these scales does not capture beliefs about CAM effectiveness per se. As the aim of the current research was to test attitudes towards the *effectiveness* of CAM as treatment for illness, the foci of the aforementioned questionnaires were inappropriate.

The CAM health belief questionnaire (CHBQ; Lie & Boker, 2004) is a unitary measure of CAM beliefs but is designed for trainee health professionals and is therefore unsuitable for the current research. Lindeman (2011) developed a scale testing for belief in the effectiveness of various complementary and alternative medicines (BCAM). However, it would require further testing for validity and reliability, as currently there is no published data on the validity or reliability of this scale. Furthermore, although Lindeman's BCAM does gather attitudes on a diverse range of CAM, it derives a unitary score and does not distinguish between the different forms of CAM.

For the current study, it *is* desirable to distinguish between different forms of CAM. Indeed, evidence suggests that people's faith in CAM effectiveness varies as a function of familiarity with the particular CAM approach in question (Furnham, 2000). After all, CAM is heterogeneous and use of one form of CAM does not entail use of all (Honda & Jacobson, 2005; LaCaille & Kuvaas, 2011; Smith, Dalen, Wiggins, Christopher, Bernard & Shelley, 2008). Furthermore, different forms of CAM vary with regard to the veracity of the research evidence which underpins them. For example, meditation is a recognized form of CAM, yet it also forms a central feature of mindfulness-based psychological interventions which have been shown to bring clinical benefit (for reviews see: Goyal, Singh, Sibinga, Gould, Rowland-Seymour, Sharma, ... & Ranasinghe, 2014; Keng, Smoski & Robins, 2011). In contrast, the research evidence on homeopathy for example, suggests that it yields no clinical benefit above that of placebo (e.g. Ernst, 2002). CAM is a heterogeneous set of approaches and there is evidence that beliefs predict CAM use. As none of the existing measures of CAM beliefs are designed to 1) test beliefs about CAM effectiveness *and* 2) distinguish between attitudes to different forms of CAM, it was decided that a new measure would be designed for these purposes.

## Study 1. Measure development and testing

### Aims

Study 1 will test the validity and reliability of a newly developed questionnaire which measures use of and belief in CAM (the working title of this new measure will be the Attitudes to Complementary and Alternative Medicine scale (ACAM)). More specifically, the questionnaire will be subjected to tests of internal consistency, face validity, content validity, and construct validity in a sample containing students and members of the general public.

*Testing the internal structure of the ACAM*
An exploratory principal components analysis (PCA) will be conducted to test for the internal integrity of the ACAM. Internal consistency will be assessed using Cronbach's alpha.

*Face validity and content validity.*
The content of items for the ACAM will be informed by relevant literature on different categories of CAM (Honda & Jacobson, 2005; Smith, Wiggins, Christopher, Bernard & Shelley, 2008; the USA's National Centre for Complementary and Integrative Health (NIH), 2015, 15 September).

*Construct validity (divergent and convergent validity)*
Two forms of construct validity will be tested: divergent and convergent validity. Divergent validity will be evaluated by comparing ACAM scores across five different groups of respondent: pharmacy students, psychology students, nursing students, humanities students and people from the general population. Studies suggest that psychology students are generally critical of CAM (Ditte, Schulz, Ernst & Schmid-Ott, 2011). Others have reported that pharmacy students are most likely to believe that orthodox medicines are beneficial and not harmful and humanities students more likely to believe that orthodox medicines are over-prescribed (Horne, Frost, Hankins & Wright, 2001). One would therefore expect pharmacy students to be less supportive of non-pharmacological treatments. However, there is also evidence that pharmacy and nursing students can have positive views toward CAM (Kreitzer, Mitten, Harris & Shandeling, 2002; Yildirim, Parlar, Eyigor, Sertoz, Eyigor, Fadiloglu, & Uyar, 2010). It is expected then that psychology students will have lower scores on the ACAM than the other student groups and the general population.

Convergent validity*:* if the ACAM is measuring beliefs about the effectiveness of CAM, then it should correlate with other similar measures. To test this, it is expected that the ACAM will be positively correlated with:

1) Lindeman's (2011) BCAM
2) Scores on the importance of psychological factors in physical illness and the harmful effects of orthodox medicine from Vincent, Furnham and Willsmore's, (1995) Attitudes to Science and Medicine scale (ASM)

And negatively correlated with:

3) Scores on the scientific basis for medicine from Vincent et al.'s (1995) ASM
4) Finnigan's (1991) AAMS (NB high AAMS scores reflect negative attitudes to CAM).

# Method

## Participants

All participants were 17 or over, and able to read and speak in English. There were 277 participants in total (51 males) collected through opportunity sampling. The sample included University of Wolverhampton undergraduate students (from a range of academic disciplines) and members of the general population. The general population participants comprised non-academic staff from the university of Wolverhampton, and people from communities in the West Midlands. Table 2.1 displays characteristics of the sample, which is mostly university educated and mostly young: the mean age is 26 but the median age is 20 (range from 17-81). The sample was gathered with a view to representing people from science and medical backgrounds (pharmacy and psychology) and non-science (humanities, general population) backgrounds.

| Group | Mean Age | Sec. Sch. | Vocat. | Some Uni. | Bachelor | Master's | Doctoral | Total | Missing |
|---|---|---|---|---|---|---|---|---|---|
| Gen. | 39y 4m (16y 8m) | 14 | 4 | 8 | 8 | 1 | 0 | 35 | 0 |
| Psychol. | 22y 8m (5y 11m) | 0 | 0 | 133 | 1 | 0 | 1 | 135 | 0 |
| Pharm. | 22y 1m (5y 4m) | 0 | 0 | 30 | 1 | 0 | 0 | 31 | 2 |
| Human. | 20y 9m (3y 11m) | 0 | 0 | 13 | 2 | 0 | 0 | 15 | 1 |
| Nursing | 32y 5m (20y 6m) | 3 | 4 | 33 | 11 | 0 | 0 | 51 | 7 |
| Total | 26y 8m (13y 5m) | 17 | 8 | 217 | 23 | 1 | 1 | 267 | 10 |

Table 2.1. Study 1: Mean age (standard deviations in parentheses) and level of education as a function of group.

## Design

Tests of divergent validity compared five groups (pharmacy students, psychology students, nursing students, humanities students and the general public) on the ACAM. Tests of convergent validity correlated the ACAM with other scales from the research literature. A principal components analysis, with varimax rotation was conducted on the ACAM items to establish the structure of the questionnaire.

## Materials

*The Attitudes to Complementary and Alternative Medicine scale (ACAM).* The measure presents questions about beliefs in the effectiveness of various types of CAM for a range of conditions. Five types of CAM were chosen and categorised in

line with Honda and Jacobson (2005), Smith, Wiggins, Christopher, Bernard and Shelley (2008) and also the USA's National Centre for Complementary and Integrative Health (NIH, 2015, 15 September). They are: energy medicines (such as acupuncture and Reiki, medicines which unblock or channel types of energy that are said to exist on the body); herbalism or natural products (therapies which make use of plants, seeds, roots, flowers, vitamins and minerals); alternative whole medical systems (holistic systems of theory and practice which are outside orthodox biopsychosocial medicine such as homeopathy and naturopathy); body manipulation (such as osteopathic or chiropractic manipulation and also massage); mind-body techniques (therapies which attempt to restore balance between the mind and the body including meditation, relaxation, yoga, tai chi and the Alexander technique). Descriptions and examples of each were provided. For each of the five CAM categories, six questions ask about its effectiveness for particular uses: serious conditions; non-serious conditions; long-term conditions; general wellbeing; psychological problems; preventing illness. These six questions are measured on a five-point Likert scale (not at all effective to very effective). For example:

*How effective are energy medicines in treating serious conditions such as cancer, heart attacks or pneumonia?*

*Not at all effective* *Very effective*
*1* *2* *3* *4* *5*

For each of the five CAM categories, there was also a question on how much respondents know about the respective form of CAM. Finally, the questionnaire asks participants to indicate how often they have used each of the five categories of CAM in the last 12 months (never, once, monthly, weekly, daily).

The following three questionnaires were included to enable tests of convergent validity with the ACAM.

*Attitudes to alternative medicine scale (AAMS).* Finnigan's (1991) attitudes to alternative medicine scale presents 14 items which provide either positive (e.g. Alternative medicine produces longer lasting and more complete results) or negative statements (e.g. Alternative medicines are merely a financial con trick.) about CAM. Responses are measured on a six-point Likert scale ranging from strongly disagree to strongly agree. Higher scores represent negative attitudes to CAM (after reverse scoring positive items).

*Belief in CAM (BCAM).* Lindeman's (2011) belief in CAM measure asks respondents to rate the effectiveness of 12 types of CAM e.g. Energy healing (treatments of blockages within the energy channels or meridians in the body, such as Shiatsu) on a five-point scale, ranging from not at all effective to very effective. There is also a

'can't say' option. This is a unitary measure where higher scores represent stronger beliefs in CAM effectiveness.

*Attitudes to science and medicine (ASM).* Vincent et al.'s (1995) attitudes to science and medicine scale presents 12 statements about science and orthodox medicine (e.g. Medicine is a science and should be based on rigorous scientific principles). The questionnaire has three subscales: the scientific basis for medicine, the importance of psychological factors in physical illness and the harmful effects of orthodox medicine. The response format is a five-point scale from strongly agree to strongly disagree.

Demographic questions (sex, age, education) were also incorporated.

### Procedure

The materials were administered face-to-face in paper form. Participants were all instructed to complete the materials without discussing their answers with others. Data was gathered from students at the end of classes. Respondents from the general public were tested in various settings either one-to-one or in groups of up to 12. All participants were verbally debriefed when they finished their participation.

## Results

### Item analysis

Item analysis was conducted on the five CAM categories (AWMS, energy medicines, body manipulation, herbalism, mind and body). For each category of CAM, the six items included were those relating to serious conditions, non-serious conditions, long-term conditions, wellbeing, psychological problems, preventing future illness. Two further item analyses were conducted for CAM for serious conditions and CAM knowledge items. In total then, seven subscales were selected for item analysis. For each of these seven subscales, a high (top quartile) and a low (bottom quartile) scoring group was formed. The groups were then compared on each item from the subscale at hand. The mean difference between the groups on each item was divided by the range of the response scale minus 1 (i.e. 5 - 1 = 4). The resulting discrimination index could range from 0 to 1, with any index equal to or above .2 indicative of good discrimination. All items produced a good discrimination index (≥ .29).

### Principal components analysis

A principal components analysis (PCA) was conducted on 30 of the items from the Attitudes to Complementary and Alternative Medicine scale (ACAM). More specifically, for each of the five CAM categories (AWMS, energy medicines, body manipulation, herbalism, mind and body), the six items on the effectiveness of the

therapy for different purposes were included (serious conditions, non-serious conditions, long-term conditions, wellbeing, psychological problems, preventing future illness). Items on CAM knowledge and on CAM use were not included in the PCA.

The Kaiser-Meyer-Olkin (KMO) value was .89 and confirmed the sampling adequacy for the analysis (de Vaus, 1991). Bartlett's test for sphericity was highly significant, ($p < .001$) indicating that the inter-item correlations were sufficiently large for PCA. Factor extraction was based on the Kaiser-Guttman criterion of eigenvalues > 1. Factor loadings less than .3 were suppressed. Following orthogonal (varimax) rotation, all items loaded onto at least one factor. The resultant seven factors accounted for 68.00% of the variance. Items which loaded onto more than one factor were considered for removal, unless one of the factor loadings clearly surpassed the others. The criterion was that multiple factor loadings would be tolerated if the highest factor loading was at least 100% greater than the next largest. For example, the item on mind-body techniques for general wellbeing loaded onto factors 3 and 4, but as the factor 4 loading was .71 and the factor 3 loading was only .31, this item was retained for factor 4.

As shown in Table 2.2, after inspection of the factor loadings, only four factors were retained. Factor 1 comprised items exclusively on AWMS relating to its effectiveness for a) non-serious conditions, b) long-term conditions, c) wellbeing and d) preventing future illness. Factors 2 and 4 retained the same items but for energy medicines and mind-body approaches respectively. Factor 3 comprised three items exclusively on herbalism relating to its effectiveness for a) non-serious conditions, b) wellbeing and c) preventing future illness.

| Item | Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **AWMS wellbeing** | **.829** | | | | | | |
| **AWMS preventative** | **.809** | | | | | | |
| **AWMS non-serious** | **.775** | | | | | | |
| **AWMS long-term** | **.745** | | | | | | |
| AWMS psychological | .697 | | | | | | .448 |
| AWMS serious | .591 | | | | | .385 | |
| **Energy wellbeing** | | **.761** | | | | | |
| **Energy non-serious** | | **.736** | | | | | |
| **Energy preventative** | | **.690** | | | | | |
| **Energy long-term** | | **.686** | | | | | |
| Energy serious | .318 | .492 | | | | .469 | |
| **Herbalism preventative** | | | **.795** | | | | |
| **Herbalism wellbeing** | | | **.775** | | | | |
| **Herbalism non-serious** | | | **.753** | | | | |
| **Mind-Body preventative** | | | | **.744** | | | |
| **Mind-Body wellbeing** | | | *.305* | **.707** | | | |
| **Mind-Body non-serious** | | | | **.680** | *.309* | | |
| **Mind-Body long-term** | | | | **.635** | | | |
| Mind-Body psychological | | | .426 | .500 | | | .420 |
| ***Body Manip. wellbeing*** | | | ***.300*** | | ***.718*** | | |
| ***Body Manip. preventative*** | | | | ***.331*** | ***.696*** | | |
| Body Manip. non-serious | | | | | .654 | .400 | |
| Body Manip. psychological | | | | | .534 | | .525 |
| Body Manip. long-term | | .306 | | | .487 | | |
| Body Manip. serious | | | | | .368 | .705 | |
| Herbalism serious | .315 | | .417 | | | .605 | |
| Herbalism long-term | | | .518 | | | .573 | |
| Mind-Body serious | | | | .532 | | .540 | |
| Energy psychological | | .565 | | | | | .645 |
| Herbalism psychological | | | .492 | | | | .572 |

Table 2.2. Study 1: ACAM factor loadings after rotation. Note: items in bold are deemed to load predominantly onto one factor. The two body manipulation items in bold and italics load predominantly onto one factor but a factor with fewer than three items is unstable.

Factor 5 (containing items on body manipulation) was not retained as only two of its items clearly loaded onto one factor and factors with two or fewer items are considered unstable (Costello & Osborne, 2005). Factors 6-7 were not retained as they contained items with multiple factor loadings of similar magnitude, or the items had much higher factor loadings on another factor.

In summary, four factors emerged relating to specific types of CAM and their effectiveness for wellbeing, illness prevention, non-serious and long-term conditions respectively. Thus items on CAM for serious and psychological problems were not retained following factor analysis. However, 'CAM for serious conditions' is an important construct theoretically, as it arguably reflects a more extreme faith in the

effectiveness of CAM. Given its theoretical importance, it was decided that the 'CAM for serious conditions' construct should be further tested as a discrete category.

## Internal consistency

*Before removal of weak items*

Cronbach's alpha was computed for the five CAM categories with all items included: AWMS ($\alpha$ = .88), energy ($\alpha$ = .83), body manipulation ($\alpha$ = .79), herbalism ($\alpha$ = .84), mind and body ($\alpha$ = .81). All alphas were acceptable to good, but in three cases (AWMS, mind and body and energy medicines) alpha was improved slightly by removal of either the serious conditions item or the psychological problems item. Two further alphas were conducted: for CAM for serious conditions ($\alpha$ = .76); and CAM knowledge items ($\alpha$ = .57), where removal of the AWMS item improved alpha to .72.

*After removal of weak items*

Further Cronbach's alphas were conducted on the reduced subscales suggested by the factor analysis. Here, AWMS ($\alpha$ = .87), energy medicines ($\alpha$ = .84), herbalism ($\alpha$ = .81) and mind and body ($\alpha$ = .79) all recorded acceptable to good alphas (corrected item-total correlations $\geq$ .54) but in no cases would removal of further items improve alpha.

In summary, the PCA suggests that the structure of the ACAM is best represented by subscales for four different types of CAM: AWMS, energy medicines, herbalism and mind and body (but not containing the body manipulation items). The Cronbach's alpha analyses confirm the internal integrity of these four subscales, whilst also supporting the internal consistency of a CAM for serious conditions subscale and a CAM knowledge subscale (with the knowledge about AWMS removed). The items comprising the reduced ACAM are shown in Table 2.3.

| | |
|---|---|
| Energy medicines | How effective are *energy medicines* in treating non-serious conditions such as common cold, hay fever or menstrual problems?<br>How effective are *energy medicines* for treating long-term conditions such as back-pain, asthma and arthritis<br>How effective are *energy medicines* for maintaining general wellbeing?<br>How effective are *energy medicines* for preventing future illness (i.e. keeping you healthy)? |
| Herbalism & natural products | How effective are *herbalism or natural products* in treating non-serious conditions such as common cold, hay fever or menstrual problems?<br>How effective are *herbalism or natural products* for maintaining general wellbeing?<br>How effective are *herbalism or natural products* for preventing future illness (i.e. keeping you healthy)? |
| Alternative whole medical systems | How effective are *alternative whole medical systems* in treating non-serious conditions such as common cold, hay fever or menstrual problems?<br>How effective are *alternative whole medical systems* for treating long-term conditions such as back-pain, asthma and arthritis<br>How effective are *alternative whole medical systems* for maintaining general wellbeing?<br>How effective are *alternative whole medical systems* for preventing future illness (i.e. keeping you healthy)? |
| Mind & body | How effective are *mind-body techniques* in treating non-serious conditions such as common cold, hay fever or menstrual problems?<br>How effective are *mind-body techniques* for treating long-term conditions such as back-pain, asthma and arthritis<br>How effective are *mind-body techniques* for maintaining general wellbeing?<br>How effective are *mind-body techniques* for preventing future illness (i.e. keeping you healthy)? |
| CAM for serious conditions | How effective are *energy medicines* in treating serious conditions such as cancer, heart attacks or pneumonia?<br>How effective are *herbalism or natural products* in treating serious conditions such as cancer, heart attacks or pneumonia?<br>How effective are *alternative whole medical systems* in treating serious conditions such as cancer, heart attacks or pneumonia?<br>How effective is *body manipulation* in treating serious conditions such as cancer, heart attacks or pneumonia?<br>How effective are *mind-body techniques* in treating serious conditions such as cancer, heart attacks or pneumonia? |
| CAM knowledge | How much do you know about *mind-body techniques*?<br>How much do you know about *herbalism or natural products?*<br>How much do you know about *body manipulation*?<br>How much do you know about *energy medicines*? |

Table 2.3 Study 1: ACAM items retained following PCA and Cronbach's alpha

## Construct Validity

### *Divergent validity*

Divergent validity of the ACAM was tested by comparing groups of people who were predicted to differ in their beliefs and use of CAM. People from the general

population, humanities students, nursing students, psychology students and pharmacy students were compared on the ACAM (AWMS, energy medicines, herbalism, mind and body, CAM for serious conditions and CAM knowledge).

Using a MANOVA, there was a significant multivariate effect of group on ACAM responses (Pillai's Trace = .18; $F(6, 24) = 1.65$; $p = .026$; $p\eta^2 = .05$). Following-up with univariate ANOVAs, the groups differed only on energy medicines ($F(2, 208) = 3.05$; $p = .018$; $p\eta^2 = .06$). Post-hoc (LSD) tests show nursing students scoring higher on this measure than the general population ($p = .018$), psychology ($p = .002$) and pharmacy ($p = .042$) but not humanities ($p = .109$). The means and standard deviations for the groups on energy medicines are displayed in Table 2.4.

| | *N* | AWMS | Energy | Mind | Herbalism | Serious | Knowledge |
|---|---|---|---|---|---|---|---|
| General | 35 | 11.77 | 10.71 | 12.21 | 9.17 | 10.69 | 11.47 |
| population | | (3.80) | (4.41) | (4.06) | (3.29) | (4.05) | (3.89) |
| Psychology | 107 | 10.57 | 10.75 | 10.87 | 10.07 | 9.03 | 10.86 |
| | | (4.00) | (3.94) | (3.46) | (2.63) | (3.37) | (2.93) |
| Pharmacy | 33 | 9.97 | 10.97 | 11.69 | 10.09 | 9.97 | 10.78 |
| | | (4.46) | (3.71) | (2.93) | (2.02) | (3.61) | (2.87) |
| Humanities | 16 | 12.00 | 10.94 | 11.88 | 9.56 | 10.69 | 11.25 |
| | | (4.38) | (2.98) | (3.93) | (3.16) | (2.89) | (2.46) |
| Nursing | 57 | 11.86 | 12.67 | 11.79 | 10.22 | 10.26 | 11.30 |
| | | (3.57) | (3.36) | (3.64) | (2.53) | (3.87) | (2.86) |

Table 2.4. Study 1: Mean scores (with standard deviations in parentheses) on the ACAM subscales as a function of group.

*Convergent validity*

Convergent validity was tested by correlating the ACAM with existing measures. If the ACAM is indeed measuring attitudes to CAM, it should also correlate with existing tools which measure the same or similar constructs. The first measure was the Attitudes to science and medicine scale (ASM; Vincent et al., 1995), which has three subscales: the scientific basis for medicine, the importance of psychological factors in physical illness and the harmful effects of orthodox medicine. The second and third measures were both unitary scales of CAM beliefs: Lindeman's (2011) Belief in CAM (BCAM) scale, and Finnigan's (1991) Attitudes to Alternative Medicine scale (AAMS).

As shown in Table 2.5, the ACAM subscales all had moderate correlations with the BCAM scale and weak to moderate relationships with the AAMS (high AAMS scores indicate low faith in alternative medicines, therefore correlations with the AAMS are negative). Regarding the ASM, belief in the psychological basis of illness showed weak to moderate relationships with four of the ACAM subscales (AWMS, energy

medicines, mind and body and knowledge). The other two ASM subscales (belief in the harmful effects of orthodox medicine and the scientific basis to medicine) mostly yielded weak relationships with the ACAM.

The ACAM also measures use of CAM. Use of CAM was calculated by summing participants' reports of CAM use for all five of the CAM categories originally included in the questionnaire (AWMS, energy medicines, herbalism, mind & body and body manipulation). As the measure of CAM use was not a linear scale (once, yearly, monthly, weekly, daily), it was correlated with other variables using a Spearman's rho. As shown in Table 2.5, it produced moderate relationships with energy medicines and CAM knowledge and with Lindeman's (2011) BCAM and also Finnigan's (1991) AAMS. There were weaker relationships with Vincent et al.'s (1995) ASM and with the other ACAM subscales. Overall there was evidence that CAM use was at least moderately associated with CAM beliefs/attitudes.

| | M | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.ASM Harm | 13.57 | 2.37 | | | | | | | | | | | |
| 2.ASM Sci. | 14.32 | 2.44 | -.069 | | | | | | | | | | |
| 3.ASM Psy. | 15.83 | 2.25 | .554** | -.154 | | | | | | | | | |
| 4.AAMS | 49.94 | 10.12 | -.381** | .477** | -.440** | | | | | | | | |
| 5.BCAM | 20.59 | 10.44 | .145 | -.114 | .206 | -.377** | | | | | | | |
| 6.AWMS | 10.63 | 4.59 | .047 | -.219 | .281* | -.439** | .444** | | | | | | |
| 7.Energy | 10.95 | 3.45 | .227 | -.189 | .387** | -.398** | .525** | .411** | | | | | |
| 8.Mind/Body | 11.59 | 3.38 | .357** | -.165 | .431** | -.337** | .452** | .363** | .378** | | | | |
| 9.Herbalism | 9.77 | 2.67 | .148 | -.058 | .227 | -.370** | .355** | .451** | .333** | .431** | | | |
| 10.Know. | 10.95 | 2.80 | .179 | -.088 | .246 | -.247 | .279* | .129 | .204 | .457** | .437** | | |
| 11.Serious | 10.05 | 3.59 | .260* | -.240 | .186 | -.431** | .572** | .646** | .514** | .344** | .417** | .242 | |
| 12.Use | 4.63 | 4.10 | .246 | -.220 | .291* | -.494** | .421** | .242 | .377** | .267* | .219 | .372** | .276* |

Table 2.5. Study 1: The Spearman rho correlations between ACAM subscales and other measures of CAM beliefs. ** significant at .01; * significant at .05.

## Discussion

### Scale structure and internal consistency

A series of analyses have tested the internal structure and consistency as well as the construct validity of the ACAM. A principal components analysis of the five categories of CAM included in the original ACAM suggested four factors (components): alternative whole medical systems, energy medicines, herbalism and natural products and mind & body. The items comprising these factors were mostly those on the effectiveness for non-serious conditions, wellbeing, long-term conditions and preventing future illness. Items on CAM for psychological problems and on CAM for serious conditions did not load uniquely onto any factor.

However, the aim of this thesis is to explore psychological factors in beliefs about CAM. In this context, CAM for serious conditions is an important variable. Arguably, believing that CAM can help with serious conditions (such as cancer for example) represents a more radical faith, than believing that CAM can help with wellbeing, future illness and non-serious conditions. This is in line with the argument that some CAM users are committed devotees whereas other CAM users are casual adherents who shop around (see Bishop, Yardley & Lewith, 2007; Furnham & Kirkaldy, 1996). Although use of/belief in CAM might be due to things such as dissatisfaction with orthodox medicine or belief in healthy lifestyles (Furnham & Forey, 1994; Furnham, Vincent & Wood, 1995), CAM use is still strongly related to beliefs in its effectiveness to treat (Furnham & Kirkaldy, 1996).

Believing that CAM is effective for serious conditions, requires greater faith in its potency as a treatment than do beliefs about CAM as a treatment for wellbeing, prevention, non-serious or even long-term conditions. Therefore, the CAM items suggested by the PCA, arguably represent more moderate beliefs about CAM. Given the aims of the thesis, it is believed that inclusion of CAM for serious conditions is theoretically important, as this subscale might have more power to tease out the psychological factors which underpin more extreme CAM beliefs. For this reason, the CAM for serious conditions subscale was considered for inclusion in the questionnaire.

The items withdrawn from the measure were mostly those relating to body manipulation and to CAM for psychological problems. The psychological items appear not to relate exclusively to any one factor. This is somewhat surprising given that previous studies have shown that belief in the psychological basis of physical illness is related to CAM use (Furnham, 2007). However, the psychological items in the ACAM referred not to the psychological causes of illness but rather the effectiveness of CAM for treating psychological problems.

It is argued here that the items retained for the ACAM are those most suited for exploring the psychological predictors of CAM beliefs/use in the current study. However, the items retained for the current sequence of studies, would not necessarily represent the finished measure. Firstly, the current measure is somewhat imbalanced: although the body manipulation items were excluded following the PCA, the body manipulation for serious conditions item was retained as part of the CAM for serious conditions factor. As all forms of CAM mentioned in the questionnaire are preceded by a brief description, this would mean that respondents would read a description of body manipulation treatments just for one item. For the sake of face validity, this item would likely be excluded from the

questionnaire in future if further testing (such as confirmatory factor analysis) supported the conclusions drawn here.

### Construct validity

The tests of divergent validity were largely null. It was predicted that due to their training in science, students of psychology would show the least faith in CAM compared to other groups. These differences did not emerge, only on energy medicines was there a difference between the groups and here it was nursing students who had stronger beliefs than the other groups.

No previous study had compared such a wide range of student groups. However, there is evidence that psychology and medical students have unfavourable views of CAM (Ditte, Schulz, Ernst & Schmid-Ott, 2011) and that medical training can make students more sceptical of CAM (Furnham & McGill, 2003). The lack of differences between the groups is perhaps consistent with other research though, which shows that attitudinal differences between social science students and medical students are small (Yardley, Fahmy, Jamie & Furnham, 1999). Numerous other studies also report that nursing and pharmacy students can have generally *positive* attitudes toward CAM (Kreitzer et al., 2002; Yildirim et al., 2010). One concludes therefore that the distinctions between different student groups and the general population were insufficient to elicit differences in attitude to CAM.

This conclusion seems to be warranted more so than the conclusion that the ACAM is invalid, as the ACAM subscales generally correlated in the expected way with other measures of CAM beliefs. The correlations with the AAMS and the BACM indicate that the ACAM is indeed measuring attitudes to CAM effectiveness.

## Conclusions

To support the conclusions drawn from the PCA in this study, a future study could collect further data on which to perform a confirmatory factor analysis (CFA). This might include comparisons (based on the Akaike information criterion) of the reduced four factor structure reported above with other possible factor structures. It might be that different conclusions are drawn about the questionnaire's structure following these follow-up analyses, whereby items rejected following the analyses reported in the current paper are reinstated. In summary, the ACAM's structure, internal consistency and construct validity have been tested. The retention of four factors (AWMS, energy medicines, herbalism and mind & body) was suggested by a PCA; for theoretical reasons, items relating to CAM for serious conditions and CAM knowledge were also retained. These six subscales showed good internal consistency and also satisfactory convergent validity. This reduced scale will therefore be the dependent measure used in studies 2 and 3, which report findings on the psychological correlates of CAM beliefs (see Chapter 3).

# Chapter 3. Exploring the relationship between CAM beliefs and reasoning

## Study 2. Performance measures of reasoning, CAM beliefs and CAM use

One of the weaknesses of the literature identified in the systematic review (Preliminary Chapter), was that most of the studies which measured intuitive and rational thinking employed the Rational-Experiential Inventory (REI; Pacini & Epstein, 1999). This self-report measure is not a truly objective test of dual process thinking and does not correlate with common reasoning paradigms such as syllogisms or Wason's Selection Task (Newstead et al., 2004). According to dual process theories of thinking (e.g. Evans & Stanovich, 2013), humans operate two systems of thought: system 1 is rapid, cognitively inexpensive and automatic; system 2 is slow, analytical, cognitively expensive and deliberate. Furthermore, humans are known to be cognitive misers: our minds default to system 1 thinking and this automatic response must be overridden by system 2 processing (Evans & Stanovich, 2013; Kahneman, 2011). The cognitive reflection test (CRT) is a powerful test of people's willingness or ability to resist appealing (but incorrect) automatic responses in favour of deliberate analytical reasoning (Toplak, West & Stanovich, 2011). The CRT has been found to be an excellent predictor of performance on rational thinking tasks (Cokely & Kelly, 2009; Frederick, 2005) and explains variation in rational thinking independently of intelligence and executive functioning (Toplak et al., 2011). The purported relationship between intuitive/rational thinking and CAM beliefs would be more compelling if demonstrated with paradigms used in the reasoning literature such as the CRT.

A recent study has shown that thinking style, as tested with cognitive tasks such as this, does indeed predict other types of belief (paranormal and religious) (Pennycook, Cheyne, Seli, Koehler & Fugelsang, 2012). Furthermore, as CAM is often seen as separate from orthodox medicine and modern science (Furnham, 2007), it was reasonable to ask whether faith in CAM would be weaker in those who analyse more and stronger in those who intuit more.

### Aims and predictions

Study 2 will explore, in a sample of students, whether thinking style predicts CAM belief and CAM use. More specifically, this study will test whether the previously reported relationship between intuitive thinking and faith in CAM's effectiveness is replicated when using a more robust cognitive test of thinking: the cognitive reflection test (CRT). Other important relationships with CAM use/belief will be tested. The following relationships are predicted:

A positive relationship between CAM belief/CAM use and: intuitive responding on the CRT; OtE; experiential (intuitive) thinking on the REI;

A negative relationship between CAM belief/CAM use and rational thinking on the REI.

# Methodology

### Participants

All participants (*N* = 125; 109 females) were 18 or over with a mean age of 22 years, 4 months (SD = 5 years, 7 months), and able to read and speak in English. The respondents were all undergraduate psychology students at the University of Wolverhampton.

### Design and statistical analyses

The study was correlational. The principal analyses were Pearson correlations followed by multiple linear regression. There were six regressions in total. The outcome variables in each regression were respectively 1) alternative whole medical systems, 2) Energy medicines, 3) Mind and body approaches, 4) Herbalism and natural products, 5) Serious conditions, 6) CAM use. The predictors were sex, age, Intuitive responses on the CRT (CRTi), self-reported rational thinking, self-reported experiential (intuitive) thinking, OtE, WordSum (a measure of verbal intelligence; Huang & Hauser, 1998). Statistics pertaining to all regressions are shown in Tables 3.3 to 3.7 respectively.

For all regressions, the assumptions were tested as follows: 1) Independence of errors with the Durbin-Watson test, whereby values distant from 2 (< 1, >3) indicate lack of independence (Durbin & Watson, 1951); 2) collinearity with the mean variance inflation factor (VIF; Bowerman & O'Connell, 1990), whereby mean values greater than 1 indicate multicollinearity; 3) scatter plots of residuals were scrutinised for problematic heteroscedasticity, indicated by funnelling of the data; 4) normality of the residuals was assessed with the Kolmogorov-Smirnov test, where significance indicates deviation from normality; 5) influential cases were screened using Cook's distances, values greater than 1 might be unduly influencing the regression model. Violations of these assumptions are reported below. As CAM use was measured on a non-linear scale (never, once, monthly, weekly, daily), this variable underwent a log 10 transformation before it was regressed.

### Materials

*Belief in Complementary and Alternative Medicine (BCAM).* The participants completed the full ACAM questionnaire, but all analyses reported here are based

on the amended ACAM with items removed following PCA and tests of internal consistency, as described in Study 1.

*Cognitive reflection test (CRT)*. The original CRT (Frederick, 2005) is becoming well known, in particular to psychology students. Therefore an alternative, less well-known version of the CRT was used (Thomson & Oppenheimer, 2016). This version contains four questions (see below) which test whether people tend to choose either an intuitively appealing but incorrect solution, or override the intuitive response in favour of more effortful analysis to derive the correct answer. For example, the intuitive answer for question 1 is 'first place'. If one can override the appeal of this response and engage in system 2 analytical thought (see Evans & Stanovich, 2013), the correct answer (second place) can be derived. Other incorrect responses are possible also, i.e. incorrect answers which are neither the cued intuitive response or the correct response. In this study, only the number of intuitive responses was counted, therefore giving a score ranging from 0 to 4.

> *(1) If you're running a race and you pass the person in second place, what place are you in? (intuitive answer: first; correct answer: second)*
>
> *(2) A farmer had 15 sheep and all but 8 died. How many are left? (intuitive answer: 7; correct answer: 8)*
>
> *(3) Emily's father has three daughters. The first two are named April and May. What is the third daughter's name? (intuitive answer: June; correct answer: Emily)*
>
> *(4) How many cubic feet of dirt are there in a hole that is 3 feet deep x 3 feet wide x 3 feet long? (intuitive answer: 27; correct answer: none)*

*Verbal intelligence*. The WordSum is a brief test of vocabulary knowledge which correlates highly with other measures of intelligence (Huang & Hauser, 1998). Participants are given a list of 10 words. Each word has to be matched with another word of the same meaning, from a list of five possibilities (e.g. SEDULOUS: muddled, sluggish, stupid, assiduous, corrupting).

*Rational-Experiential Inventory*. The REI-10 (Epstein, Pacini, Denes-Raj & Heier, 1996) presents 10 items which ask respondents about the type of thinking style they adopt: five items measure faith in intuition (experiential thinking e.g. I believe in trusting my hunches), five measure need for cognition (rational thinking, e.g. I prefer to do something which challenges my thinking abilities rather than something that requires little thought). Responses are measured on a five-point scale from completely false to completely true.

*Openness to experience*. The Big Five Inventory is a valid, reliable and quick to use measure of the big-five personality traits (Soto & John, 2009). The OtE subscale (10 items e.g. I see myself as someone who is original, comes up with new ideas; I see myself as someone who is curious about many different things), was extracted from the questionnaire. Responses are measured on a five-point scale from agree strongly to disagree strongly.

### Procedure

The materials were presented to participants on computer in a laboratory, in groups of up to 60 at a time. Participants were instructed to complete the materials in silence and without discussing their answers with others. The materials were presented in a fixed order.

## Results

The means and standard deviations of the key variables are displayed in Table 3.1. The median response for CAM use generally was 'used once'. However, herbal and natural products, body manipulation and mind/body approaches were used more than energy medicines and AWMS ($\chi^2$ = 125.03; df = 4, $p$ < .001).

| Serious | Know | AWMS | Ener | Mind | Herb | CRTi | OtE | Exp | Rat | Word |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.79 | 2.70 | 2.52 | 2.52 | 2.66 | 3.26 | 1.35 | 3.40 | 3.48 | 3.32 | 4.97 |
| (0.66) | (0.73) | (1.04) | (1.03) | (0.89) | (0.98) | (1.27) | (0.29) | (0.70) | (0.56) | (2.22) |

Table 3.1. Study 2: Means (with standard deviations in parentheses) of the variables. *Note*: Serious = CAM for serious conditions; Know = knowledge; AWMS = alternative whole medical systems; Ener = energy medicines; Mind = mind and body; Herb = herbalism and natural products; CRTi – cognitive reflection test intuitive responses; OtE = openness to experience; Exper = experiential thinking; Rat = rational thinking; Word = WordSum.

The correlations between the key variables are shown in Table 3.2. As can be seen, correlations between the outcome variables (alternative whole medical systems; energy medicines; mind and body approaches; herbalism and natural products; serious conditions) and the predictors yielded at best modest effect sizes and were mostly non-significant. Given the low number of sizeable correlations between predictors and outcomes, multiple linear regressions were computed in a backward method, in order to remove weak predictors from the model.

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Ser | .35 ** | .43** | .38** | .22 * | .22 * | .09 | .05 | -.31** | -.07 | -.10 | .16 |
| 2.AWMS | | .35** | .35** | .45** | .18 | .11 | .11 | -.19 | -.10 | -.34** | .05 |
| 3.Ener | | | .52** | .55** | .13 | .22* | .18 | -.28** | -.03 | -.20 | .04 |
| 4.Mind | | | | .42** | .07 | .02 | .07 | .003 | .03 | -.05 | .05 |
| 5.Herb | | | | | .06 | .20* | .20* | -.20* | -.05 | -.28 | .17 |
| 6.CRTi | | | | | | .06 | -.07 | -.21* | .04 | -.07 | -.07 |
| 7.OtE | | | | | | | .23* | -.03 | -.09 | -.07 | .17 |
| 8.Exp | | | | | | | | .01 | -.09 | -.08 | .22* |
| 9.Rat | | | | | | | | | .17 | .45** | .11 |
| 10.Word | | | | | | | | | | .28** | -.18 |
| 11.Age | | | | | | | | | | | .11 |
| 12.Use | | | | | | | | | | | |

Table 3.2. Study 2. Correlations between the variables. *Note*: * = p < .05, ** = p < .01; Ser = CAM for serious conditions; AWMS = alternative whole medical systems; Ener = energy medicines; Mind = mind and body; Herb. = herbalism and natural products; CRTi – cognitive reflection test intuitive responses; OtE = openness to experience; Exper = experiential thinking; Rat = rational thinking; Word = WordSum; Use = CAM use.

## Regression analyses

*Alternative whole medical systems (AWMS)*

In the first regression ($F$ (1, 92) = 8.14; $p$ = .005; $R^2$ = .081), AWMS was predicted negatively only by age (see Table 3.3). Residuals differed from a normal distribution, $p$ = .047 and there was evidence of heteroscedasticity), therefore the regression was re-run with bootstrapping and this confirmed the negative relation between AWMS and Age ($B$ = -.18; 95% CI -.36 and -.04).

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| **Age** | **-.29** | **2.85** | **-.29*** | |
| Sex | -.08 | -0.81 | -.09 | Alternative whole medical systems |
| CRTi | .18 | 1.80 | .19 | |
| OtE | .10 | 1.00 | .10 | |
| Exper. | .07 | 0.69 | .07 | |
| Rat. | -.06 | -0.58 | -.06 | |
| Word. | -.10 | -0.92 | -.10 | |

Table 3.3. Study 2: Statistics pertaining to the regression with alternative whole medical systems as the outcome. Note: * = p < .05, ** = p < .01.

*Energy medicines*

In the second regression ($F$ (2, 91) = 6.95; $p$ = .002; $R^2$ = .13), energy medicines had a small negative relationship with REI rational and a small positive relation with OtE (see Table 3.4).

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| Age | -.11 | -0.97 | -.10 | |
| Sex | -.06 | -0.56 | -.06 | Energy |
| CRTi | .04 | 0.36 | .04 | medicines |
| **OtE** | **.21** | **2.11** | **.22*** | |
| Exper. | .11 | 1.14 | .12 | |
| **Rat.** | **-.29** | **-2.93** | **-.29**** | |
| Word. | -.01 | -0.12 | -.01 | |

Table 3.4. Study 2: Statistics pertaining to the regression with energy medicines as the outcome. Note: * = p < .05, ** = p < .01.

*Mind & body*

Mind and body was not predicted significantly by any variables and thus no regression was computed.

*Herbalism and natural products*

Herbalism and natural products ($F$ (1, 92) = 5.12; $p$ = .026; $R^2$ = .053) was predicted weakly and negatively by age (see Table 3.5).

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| **Age** | **-.22** | **-2.26** | **-.22*** | |
| Sex | -.17 | -1.66 | -.17 | Herbalism |
| CRTi | .04 | 0.35 | .04 | and natural |
| OtE | .20 | 1.95 | .20 | products |
| Exper. | .17 | 1.69 | .17 | |
| Rat. | -.11 | -0.98 | -.10 | |
| Word. | -.04 | -0.35 | -.04 | |

Table 3.5. Study 2: Statistics pertaining to the regression with herbalism and natural products as the outcome. Note: * = p < .05, ** = p < .01.

*CAM for serious conditions*

CAM for serious conditions (F (1, 86) = 12.18; p = .001; $R^2$ = .124) had a moderate negative association with REI rational thinking (see Table 3.6).

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| Age | -.002 | -0.02 | -.002 | |
| Sex | -.07 | -0.69 | -.08 | CAM for |
| CRTi | .12 | 1.19 | .13 | serious |
| OtE | .10 | 1.00 | .10 | conditions |
| Exper. | .07 | 0.67 | .07 | |
| **Rat.** | **-.35** | **-3.49** | **-.35**** | |
| Word. | -.09 | -0.92 | -.10 | |

Table 3.6. Study 2: Statistics pertaining to the regression with CAM for serious conditions as the outcome. Note: * = p < .05, ** = p < .01.

*CAM use*

CAM use ($F$ (2, 78) = 6.59; $p$ = .002; $R^2$ = .145) was associated positively with age and negatively with verbal intelligence (see Table 3.7). Assumptions were largely met although the residuals were close to a non-normal distribution, $p$ = .053.

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| **Age** | **.32** | **2.80** | **.30**** | |
| Sex | .08 | 0.77 | .09 | |
| CRTi | .01 | 0.09 | -01 | |
| OtE | .11 | 1.08 | .12 | CAM use |
| Exper. | .17 | 1.60 | .18 | |
| Rat. | .02 | 0.21 | .02 | |
| **Word.** | **-.37** | **-3.22** | **-.34**** | |

Table 3.7. Study 2: Statistics pertaining to the regression with CAM use as the outcome. Note: * = p < .05, ** = p < .01.

## Conclusions

In summary, OtE had weak but positive relationships with energy medicines and herbalism. Although this is consistent with one previous study (Ho, 2012), others have mostly failed to find such a relationship (Hogan, 2006; Won, 2014). Instead, previous literature suggests OtE is more reliably related to CAM use (Lombart, 2002; Smith et al., 2008; Sirois & Gick, 2002). However, in the current study, this relationship was not evident at all.

Rational thinking style had weak to modest negative relationships with energy medicines and CAM for serious conditions. This conflicts somewhat with previous findings, in which stronger CAM beliefs are found in intuitive thinkers (Lindeman, 2011; Saher & Lindeman, 2005; Svedholm & Lindeman, 2013). In the current study, weaker CAM beliefs were found in rational thinkers. Contrary to expectations, the performance measure of intuitive thinking – the CRT – was not significantly related to CAM beliefs either: the CRT did have a weak positive relationship with CAM for serious conditions, but rationality explained more of the variance in this particular belief. This suggests that CAM belief is related not to actual thinking performance but more to one's perceived thinking style, and as shown in Table 3.2 the CRT is, at best, only weakly correlated with self-reported thinking style.

Sex, verbal intelligence, experiential thinking and intuitive responding on the CRT failed to register significant relationships with any types of CAM belief. CAM use was more frequent in older participants, less frequent in those with higher verbal intelligence (WordSum scores).

Study 3 will set out to test these relationships further, but with a different sample and with modifications to some of the materials: in particular, alternative and additional measures of OtE and of intuitive thinking.

## Study 3. Performance measures of reasoning, CAM beliefs and CAM use: a replication

Openness to experience was one of the variables that had been identified most strongly with CAM use and CAM beliefs in the systematic review by the author and colleagues, reported in the Preliminary Chapter. In study 2 however, OtE had, at best, weak relationships with CAM beliefs and was not related to CAM use. In order to further test the relation between OtE and CAM beliefs/use, study 3 would employ an alternative measure of OtE to explore whether the weak relationships were due simply to the choice of OtE questionnaire. The new measure would be the mini-IPIP deriving two separate dimensions of OtE: imagination and intellect (Donnellan, Oswald, Baird & Lucas, 2006).

Another predictor which failed to yield relationships with CAM beliefs in study 2 was the CRT. A different version of the CRT was employed in study 3, to eliminate the possibility that the failure to observe relationships in study 2 was due to using a particular version of the CRT. Here, in study 3, the original CRT (Frederick, 2005; Toplak et al., 2011) would be employed.

Furthermore, an additional performance measure of intuitive/rational thinking was introduced. Base rate problems offer an alternative means of testing people's ability to override automatic, intuitive responses in favour of analytical, system 2 thinking (Bar-Hillel, 1980). They present the respondent with a conflict between an intuitively appealing stereotype and probabilistic information. As with the CRT, choosing the probabilistic information represents an override of intuitive thought in favour of analytical thought (De Neys & Glumicic, 2008). Thus five base rate problems would be added as a further means - additional to the CRT - for testing the relation between CAM beliefs and thinking performance. Although the CRT has demonstrated very strong validity in the reasoning literature, it was felt that adding a different performance measure of thinking would give more robustness to the methodology. This would allow the researcher to measure whether relationships between CAM beliefs and thinking performance were task specific.

### Aims and predictions

The aims were to further test the relationships explored in study 2. The following relationships are predicted:

A positive relationship between CAM belief/CAM use and: intuitive responding on the CRT; intuitive responding on Base rate problems; OtE imagination; OtE intellect; experiential (intuitive) thinking on the REI;

A negative relationship between CAM belief/CAM use and rational thinking on the REI.

## Method

### Participants

All participants (*N* = 87; 65 females) were 18 or over with a mean age of 36 years (SD = 19 years, 6 months), and able to read and speak in English. The respondents were either members of the general public or undergraduate students in a range of subjects.

### Design and statistical analyses

Given the low number of sizeable correlations between predictors and outcomes (See Table 3.8), multiple linear regressions were computed in a backward method, in order to remove weak predictors from the model.

As with study 2, the outcome variables in each of the six regressions were respectively: 1) alternative whole medical systems, 2) Energy medicines, 3) Mind and body approaches, 4) Herbalism and natural products, 5) CAM for serious conditions, 6) CAM use. The predictors were CRTi, base rate, OtE imagination, OtE intellect, experiential thinking, rational thinking, WordSum score (verbal intelligence). Age and sex. Statistics pertaining to all regressions are shown in Tables 3.10 to 3.13 respectively.

Violations of the assumptions for linear regression were checked, but none were found.

### Materials

The materials were the same as in study 2 but for the following.

*Base rate neglect*. A set of base rate measures was included as an additional performance measure of reasoning. These problems tested whether people either make use of base rate information or rely on stereotypes to make a judgement (De Neys & Glumicic, 2008). For example:

> *In a study 1000 people were tested. Among the participants there were 995 nurses and 5 doctors. Jake is a randomly chosen participant of this study. Jake is 34 years old. He lives in a beautiful home in a*

*posh suburb. He is well spoken and very interested in politics. He invests a lot of time in his career.*
*What is most likely?*
*a. Jake is a nurse.*
*b. Jake is a doctor.*

These problems present a conflict between the base rate data, which suggests a high statistical likelihood that Jake is a nurse and an intuitive response which is triggered by the similarity between the stereotyped description and the possibility that Jake is a doctor. As with the CRT, base rate problems test whether individuals are willing or able to resist the intuitive answer and to engage with system 2, analytical thought (Stanovich & West, 2000). Unlike the CRT, there is no objectively correct answer, but in this study, scores were derived by summing the number of intuitive responses – i.e. responses which neglect base-rate.

*Cognitive reflection test.* The original version of the CRT was administered here (Frederick, 2005; Toplak et al., 2011). Three arithmetic problems test whether people tend to choose either an intuitively sensible but incorrect solution, or override the intuitive response in favour of more effortful analysis. For example:

*A bat and a ball cost £1.10 in total. The bat costs a pound more than the ball. How much does the ball cost? ____ pence (intuitive answer: 10p; correct answer: 5p.)*

*Openness to experience*. The mini IPIP is a valid, reliable and quick to use measure of the big-five personality traits (Donnellan et al., 2006). The OtE subscale is labelled Imagination/Intellect and has only 4 items (e.g. I have a vivid imagination). Responses are measured on a five-point scale from very inaccurate to very accurate. The OtE subscale was tested for internal consistency and produced an unsatisfactory Cronbach's alpha (.56). Inter-item correlations revealed that the two Imagination items correlated moderately with each other ($r$ = .41) and the two intellect items correlated moderately too ($r$ = .48). Imagination items did not correlate with intellect items ($r \leq$ .19). For this reason, it was decided that two separate OtE scores would be calculated: imagination and intellect.

Aside from these changes, the materials were identical to those used in study 2.

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Ser | .47** | .40** | .58** | .28* | .22* | .28* | -.29* | -.11 | .32** | -.15 | -.15 | .15 | .26* |
| 2.AWMS | | .49** | .41** | .40** | .13 | .11 | .02 | -.14 | .23* | .00 | -.14 | -.08 | .24* |
| 3.Ener | | | .36** | .54** | -.07 | .05 | -.07 | .04 | .18 | -.18 | -.02 | -.15 | .34** |
| 4.Mind | | | | .39** | .04 | .09 | -.24* | -.04 | .17 | .04 | -.05 | .09 | .32** |
| 5.Herb | | | | | -.07 | .09 | .01 | .01 | .13 | -.06 | -.02 | -.04 | .33** |
| 6.CRTi | | | | | | .10 | -.12 | -.08 | .08 | -.04 | -.15 | .18 | -.13 |
| 7. Basei | | | | | | | -.04 | -.09 | .13 | -.10 | .18 | .18 | -.24* |
| 8.OtE Im | | | | | | | | .19 | -.09 | .32** | -.03 | -.03 | .11 |
| 9.OtE Int | | | | | | | | | -.13 | .24* | .08 | -.13 | .02 |
| 10.Exp | | | | | | | | | | -.16 | -.06 | .29* | .19 |
| 11.Rat | | | | | | | | | | | -.06 | -.05 | .07 |
| 12.Word | | | | | | | | | | | | .26* | .19 |
| 13.Age | | | | | | | | | | | | | .12 |
| 14.Use | | | | | | | | | | | | | |

Table 3.8. Study 3: Correlations between the variables. Note: * = $p < .05$, ** = $p < .01$; Ser = CAM for serious conditions; AWMS = alternative whole medical systems; Ener = energy medicines; Mind = mind and body; Herb. = herbalism and natural products; CRTi – cognitive reflection test intuitive responses; Basei = base rate neglect; OtE Im = openness to experience, imagination; OtE Int = openness to experience, intellect; Exper = experiential thinking; Rat = rational thinking; Word = WordSum score; Use = CAM use.

## Results

The means and standard deviations for key variables are shown in Table 3.9. The median response for general CAM use was 'never'. However, herbal and natural products, and mind/body approaches (both with a median = 'used once') were used more often than the others ($\chi^2$ = 55.47; df = 4, $p$ < .001).

| | Ser | Kno | AW | Ener | Min | Her | CRTi | Basei | OtE Im. | OtE Int. | Exp | Rat | Wor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| x̄ | 2.08 | 2.82 | 2.9 | 3.01 | 2.98 | 3.24 | 1.37 | 3.02 | 3.98 | 3.42 | 3.61 | 3.55 | 5.79 |
| SD | 0.79 | -0.79 | -0.92 | -0.97 | -0.95 | -0.97 | -1.06 | 1.43 | -0.90 | -0.87 | -0.79 | -0.76 | -1.8 |

Table 3.9. Study 3: Means and standard deviations for the variables. Note: Ser = CAM for serious conditions; Kno = knowledge; AW = alternative whole medical systems; Ener = energy medicines; Min = mind and body; Her = herbalism and natural products; CRTi – cognitive reflection test intuitive responses; Basei = base rate intuitive responses; OtE Im = openness to experience, imagination; OtE Int = openness to experience, intellect; Exp = experiential thinking; Rat = rational thinking; Wor = WordSum score.

### Regression analyses

*Alternative whole medical systems*

In the first regression, no significant relationships emerged; the strongest relationship with AWMS was that of experiential thinking (partial $r$ =-.21; $p$ = .073).

*Energy medicines*

In the second regression ($F$ (2, 73) = 2.98; $p$ = .057; $R^2$ = .075), experiential thinking had a weak, positive relationship (see Table 3.10) and age had a weak, negative relationship with energy medicines.

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| CRTi | -.04 | -0.32 | -.04 | |
| Basei | .03 | 0.29 | .04 | |
| OtE Im. | -.09 | -0.79 | -.10 | |
| OtE Int. | .03 | .022 | .03 | Energy |
| **Exper.** | **.24** | **2.05** | **.23*** | medicines |
| Rat. | -.17 | -1.51 | -.18 | |
| Word. | .03 | 0.23 | .03 | |
| Age | -.23 | -1.91 | .22 | |
| Sex | -.06 | -0.53 | -.06 | |

Table 3.10. Study 3: Statistics pertaining to the regression with energy medicines as the outcome. Note: * = $p$ < .05, ** = $p$ < .01.

*Mind & body*

With mind and body as the outcome, there was a significant regression ($F$ (1, 71) = 6.88; $p$ = .011; $R^2$ = .088). OtE imagination was the only significant predictor, with a moderate negative relationship (see Table 3.11).

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| CRTi | -.003 | -0.03 | -.003 | |
| Basei | .02 | 0.13 | .02 | |
| **OtE Im.** | **-.30** | **-2.62** | **-.30*** | |
| OtE Int. | .00 | -0.002 | .00 | Mind and body |
| Exper. | .14 | 1.19 | .14 | |
| Rat. | .13 | 1.13 | .13 | |
| Word. | -.10 | -0.87 | -.10 | |
| Age | .06 | 0.51 | .06 | |
| Sex | .03 | 0.25 | .03 | |

Table 3.11. Study 3: Statistics pertaining to the regression with mind and body as the outcome. Note: * = $p < .05$, ** = $p < .01$.

*Herbalism and natural products*

Herbalism and natural products yielded no sizeable (≤ .13) or significant simple correlations with any predictor variable (see Table 3.8). Therefore a regression was not conducted for this outcome.

*CAM for serious conditions*

With CAM for serious conditions as the outcome, a significant regression emerged ($F$ (4, 71) = 6.32; $p < .001$; $R^2$ = .263) with four significant predictors. Two positively related: experiential thinking (see Table 3.12) and base rate intuitive; and two negatively related: OtE imagination and WordSum.

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| CRTi | .10 | 0.99 | .12 | |
| **Basei** | **.22** | **2.09** | **.24*** | |
| **OtE Im.** | **-.30** | **-2.90** | **-.33*** | |
| OtE Int. | -.04 | -0.35 | -.04 | CAM for serious conditions |
| **Exper.** | **.23** | **2.23** | **.26*** | |
| Rat. | -.02 | -0.14 | -.02 | |
| **Word.** | **-.24** | **-2.25** | **-.26*** | |
| Age | .07 | 0.57 | .07 | |
| Sex | .12 | 1.09 | .13 | |

Table 3.12. Study 3: Statistics pertaining to the regression with CAM for serious conditions as the outcome.

*CAM use*

With CAM use as the criterion, the regression was significant ($F$ (1, 60) = 4.39; $p$ = .040; $R^2$ = .068). Intuitive responding on the base rate problems was the only significant predictor with a weak positive relationship (see Table 3.13).

| Predictor | B | t | Partial correlation | Outcome |
|---|---|---|---|---|
| CRTi | -.08[i] | .54 | -.08 | |
| **Basei** | **.26** | **2.09** | **.26*** | |
| OtE Im. | .07[i] | .58 | .07 | |
| OtE Int. | -.003[i] | .98 | -.003 | CAM use |
| Exper. | .19[i] | .13 | .20 | |
| Rat. | .02[i] | .88 | .02 | |
| Word. | .09[i] | .48 | .09 | |
| Age | .07[i] | .59 | .07 | |
| Sex | -.16[i] | .21 | -.16 | |

Table 3.13. Study 3: Statistics pertaining to the regression with CAM use as the outcome.

In summary, there were weak to moderate relationships between CAM beliefs/knowledge and various predictors, however only experiential thinking and OtE imagination emerged as significant more than once. Of all the measures of CAM, it was CAM for serious conditions which was explained most comprehensively by the predictors. Base rate neglect emerged twice: as a weak predictor of CAM for serious conditions and CAM use.

## Conclusions

These findings are somewhat consistent with those of study 2. Firstly, self-reported experiential thinking style predicted CAM beliefs in relation to energy medicines and also CAM for serious conditions. This supports previous studies which had reported relationships between CAM beliefs and intuitive thinking as measured on the REI self-report questionnaire (Lindeman, 2011; Saher & Lindeman, 2005; Svedholm & Lindeman, 2013). Only one of the performance measures of intuitive thinking - base rate problems - predicted CAM beliefs: beliefs about serious conditions, although base rate problems did also predict CAM use.

OtE did predict belief in two types of CAM. Unlike previous studies which report associations between CAM use/CAM beliefs and OtE (Smith et al., 2008; Ho, 2012) the direction of the relationship was negative. This can perhaps be explained by the use of the mini IPIP: its OtE imagination score was related to CAM beliefs, the OtE intellect variable was not. The OtE imagination score correlates with rational not intuitive thinking on the REI (see Table 3.8), which is consistent with wider literature (Pacini & Epstein, 1999). Therefore, it is possible that this component of OtE reflects the tendency to analyse and think of alternatives - a trait negatively associated with

CAM beliefs. This also illustrates that OtE itself is multidimensional and the relationship between OtE and CAM beliefs might vary depending on the measure used.

## Discussion

Although the findings from studies 2 and 3 do not replicate perfectly, there is congruence between them. Firstly, in both studies, the most common relationships with CAM beliefs were those from the REI. Secondly, although CAM beliefs were sometimes associated with people's perceptions of their own thinking (i.e. the REI), they were generally not associated with actual thinking performance.

### CAM beliefs and self-reported thinking style

Turning to the first of these key findings; in study 3, CAM believers were more likely to be intuitive thinkers, consistent with previous research (Lindeman, 2011; Saher & Lindeman, 2005; Svedholm & Lindeman, 2013. In study 2, a new finding was observed: CAM believers were less likely to be rational thinkers.

The reason for this new finding could be due to sampling. Like study 3, Lindeman and colleagues' found that CAM believers were also intuitive thinkers. In all these studies, samples comprised members of the general public and undergraduates from a range of disciplines. In study 2 the sample was made-up purely of psychology undergraduates and here it was rational not intuitive thinking which related to CAM beliefs. It could be that the emphasis on critical and scientific thinking in undergraduate psychology training contributed to this relationship. In essence, due to their training, psychology students who see themselves as rational thinkers, might associate this with not believing in CAM, more so than undergraduates generally or the general public.

### Performance measures of thinking style

The second main finding from studies 2 and 3 is related to the first. Self-reported thinking style was related to CAM beliefs, but actual reasoning performance generally, was not. Our findings suggest that it is not thinking style per se which predicts CAM beliefs, but rather a person's view of what their thinking style is. This suggests that the conclusions drawn by Lindeman and colleagues (Lindeman, 2011; Saher & Lindeman, 2005; Svedholm & Lindeman, 2013) about the relation between CAM beliefs and thinking might need to be reviewed. An alternative interpretation is that people who see themselves as intuitive thinkers, who value trusting their hunches, are more likely to believe in CAM. Conversely people who like to see themselves as rational might be more likely to reject CAM. However, these self-views of one's thinking style do not necessarily reflect their actual thinking style, which itself is a poor predictor of CAM belief.

Thus, despite evidence that cognitive/reasoning biases play a role in various kinds of beliefs (e.g. delusions, Galbraith & Manktelow, 2014; phobias, de Jong, 2014; paranormal belief, Rogers, 2014) studies 2 and 3, together suggest that cognitive bias is less of a factor in CAM beliefs than one's perception of one's thinking (even though that perception itself might not be accurate). This view is in line with previous literature showing that CAM beliefs are reliably predicted by other beliefs – if one believes in CAM, then one is likely to believe in certain other concepts too, such as holistic health (Astin, 1998), suspicion of modern medicine and science (Furnham, 2007; Hsiao et al., 2003), new age philosophies (Bishop, Yardley and Lewith, 2007) and belief in the paranormal (Jeswani & Furnham, 2010; Van den Bulck & Custers, 2009). In this sense, beliefs about one's own thinking style could be added to the list of beliefs associated with CAM. A direction for future research could be to explore whether CAM believers' beliefs about their own thinking style correspond with their ideas about what constitutes 'good thinking' (see Baron, 1995).

### Other variables

In study 2, age was negatively related with belief in two different forms of CAM. This finding was generally not replicated in study 3. This finding supports previous research that CAM use is more common in those who are younger (see Verhoef et al.'s (2005) review of CAM use in cancer patients). Sex was not a significant predictor of CAM belief, in contrast to previous research (e.g. Frass et al., 2012; Verhoef et al., 2005). Verbal intelligence, as measured by the WordSum was generally not related to CAM beliefs but was related negatively to CAM use in study 2.

Openness to experience was related to some CAM beliefs, but the relationships were weak and the direction of the relationships changed as a function of the measure used. Overall, the evidence for a relationship between CAM beliefs and OtE is unconvincing. These studies also failed to support previous findings that CAM *use* is related to OtE (Lombart, 2002; Smith et al., 2008; Sirois & Gick, 2002). Future studies might consider testing a broader range of OtE sub-factors, such as openness to fantasy (Stephan, 2009) as there is evidence that this facet of OtE is related to belief in the paranormal (Smith, Johnson & Hathaway, 2009) – which itself has been shown to be a correlate of CAM belief (e.g. Jeswani & Furnham, 2010).

There was no obvious indication that some categories of CAM belief were better predicted than others, although REI scores correlated with energy medicines and CAM for serious conditions in both study 2 and 3. All types of CAM belief were associated with some predictors. What studies 2 and 3 do indicate is that relationships between psychological variables and CAM beliefs are nuanced and might be obscured if CAM belief is homogenised. Where relationships emerged they were consistently of a .2 to .3 magnitude, showing that the predictors only explain a small degree of variance in CAM belief. This opens up the question of what variables might explain the remaining variance. This could be accounted for by previous

experience of exposure to CAM, by other belief systems (see Bishop et al. (2007), but this poses intriguing questions for future research.

One of the difficulties posed by testing multiple forms of CAM is the increase in family-wise error and therefore the increased chances of type 1 error. This was necessitated by the exploratory nature of studies 2 and 3, however future research might reduce potential error by choosing dependent variables according to a priori hypotheses and by testing multiple forms of CAM only when theoretically justified.

### Future research

Relationships between CAM beliefs and performance measures of reasoning were mostly non-significant and weak, despite employing three tests (two versions of the CRT and a set of base rate problems). These tasks were chosen because they tested intuitive versus analytical responding. However, this is by no means an exhaustive set of the possible tests of reasoning that could be employed. Stanovich, West and Toplak (2016) have published a taxonomy of tasks for testing various types of rationality, partly based on the heuristics and biases literature (Kahneman, 2011; Tversky & Kahneman, 1975). These encompass tests of various cognitive biases, linked to processing limitations (like the CRT) but also tests of knowledge and belief. A comprehensive exploration of the different forms of rationality potentially associated with CAM belief is an option for future studies.

Future studies might also consider the issue of demand characteristics. It is possible that the aims of the study are transparent to the participants – 'are CAM believers less analytical?' This might bias their responding on the measures. There are a number of possible solutions. Firstly, the instructions might be tailored so as to be less explicit about the aims of the study. For example, the instructions might speak about approaches to healthcare rather than CAM specifically. Secondly, the administration of the measures might be split across time, for example, with the ACAM being completed a week or two prior to/after the thinking measures, so that the aims of the research are less obvious.

## *Conclusions*

Studies 2 and 3 demonstrate that self-reported thinking style can have a subtle relationship with CAM belief. The observation of such relationships depends on the type of CAM in question and possibly the characteristics of the sample. Additionally, people's self-reported thinking style and their actual thinking style correlate poorly, and the former (self-reported thinking style), predicts belief in CAM somewhat more consistently. In exploring both thinking style and OtE, studies 2 and 3 have empirically tested two of the three psychological factors in CAM use/belief identified in the author's systematic review (Preliminary Chapter), and in doing so have added new knowledge to the psychological literature. The third psychological factor

identified by the systematic review has not yet been explored within the thesis: namely that of ontological confusions.

Ontological confusions are where one blurs the distinctions between the basic categories which define our reality, in particular the distinctions between physical, biological and mental phenomena (see Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2013). Lindeman (2011) argues that such confusions can underpin CAM beliefs. Given that ontological confusions represent an important cognitive factor in CAM belief, this cognitive bias is of potential interest to health psychology. Therefore, the final empirical chapter will explore how ontological mistakes interact with another important theme in this thesis: thinking.

# Chapter 4. Ontological mistakes and reasoning

## Introduction

Ontology is a branch of philosophy concerned with the categories and rules which define our reality. Thus ontology provides a classification of things (Smith, 2003). Core ontological categories provide the foundation for our understanding of the world and here Lindeman (2011) draws the distinction between physical, biological and mental categories. Physical objects are contrasted with mental phenomena in that the former have an independent existence and they can move if touched by another moving object. Mental phenomena are the product of sentient beings with intentionality. Core biological knowledge includes notions of contamination and healing and the distinctions between artificial and living (Lindeman, 2011).

Lindeman (2011) argues that, in many types of CAM, the underlying principles or philosophies incorporate clear ontological mistakes. For example, that processes such as energy can be good or bad, that non-sentient physical phenomena can have mental properties (e.g. water with memory), confusing processes with objects (Saher & Lindeman, 2007; Svedholm & Lindeman, 2013). Lindeman (2011) argues that an awareness of these mistakes provides a cue to the individual that some of the underlying premises of the therapy lack credibility. If such ontological mistakes go unnoticed, an important weakness in the theoretical basis of the therapy is overlooked. Thus the ability to spot ontological mistakes might be associated with believing in CAM. Lindeman and colleagues provide support for this idea: believers in CAM are more likely to make ontological mistakes (Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2013). Indeed, Lindeman (2011) shows that the tendency to make ontological mistakes is related to both beliefs in CAM and self-reported intuitive thinking. Furthermore, the tendency to make ontological mistakes is also related to performance measures of intuitive thinking, as measured on the CRT and base rate tasks (Pennycook et al., 2015). There is evidence then that a tendency to make ontological mistakes is a potentially important bias in health beliefs. Therefore, this represents a psychological factor of potential interest to health psychology.

Although humans begin to understand core ontological distinctions in infancy (Backscheider, Shatz, & Gelman, 1993), children are more prone to ontological mistakes than adults (Keleman, 1999a, 1999b). For example, adults are less likely than children to offer teleological accounts – that things exist for a purpose (e.g. the function of a mountain: 'to climb'; the function of a lion: 'to look at'; Keleman, 1999a), suggesting that people acquire more sophisticated ontological understanding as they age. However, adults make more ontological mistakes when put under time-pressure. Keleman and Rosset (2009) found that when under no time restrictions, adults successfully identified teleological statements, but when under time-limited

conditions they were more likely to endorse such statements. Keleman and Rosset (2009) therefore argue that adults retain teleological explanations which, with age, are *suppressed* rather than *replaced* by more scientific explanations.

Furthermore, Keleman and Rosset (2009) found that adults with poorer inhibitory control were more prone to endorsing teleological statements. Thus teleological mistakes are more likely when one succumbs to intuition, but can be suppressed if processing time is available. This is consistent with dual-processing accounts of cognition, whereby thinkers rely on fast and effortless system 1 processing unless cued to engage in slow and cognitively expensive system 2 processing (e.g. Evans & Stanovich, 2013). Experiments by Valerie Thompson and colleagues show that rapid responding on reasoning tasks is associated with an intuitive 'feeling of rightness' (FOR), whereas low FOR is associated with longer thinking time and an increased likelihood of changing one's initial answer (Thompson, Prowse Turner & Pennycook, 2011). As analytical, system 2 cognition is comparatively slow, when processing time is inhibited participants are more likely to fall-back on intuitive, system 1 thinking (See Evans & Curtis-Holmes, 2005).

If people need unfettered access to cognitive resources to efficiently spot ontological mistakes, then other ways of limiting cognitive processing, besides limiting time, might have the same effect. One possibility here is reasoning itself: if people are busy using their cognitive resources to reason logically, would this effort expend the cognitive resources needed to simultaneously notice ontological mistakes? The belief bias paradigm offers a means of exploring this. Belief bias is where believability interferes with logical analysis: reasoners instructed to conclude on the basis of logic only, nevertheless tend to favour believable over unbelievable conclusions (Evans, Barston & Pollard, 1983; Morley, Evans & Handley, 2004). Belief is said to be a system 1 process, therefore comparatively fast and effortless, hence the ease with which believability can bias logical reasoning. If spotting ontological mistakes requires cognitive effort, then ontological incorrectness should not bias logical reasoning in the way that mere believability does – because the cognitive effort it requires is already allocated to the task of logical analysis.

The failure to notice ontological mistakes is potentially one reason why people put faith in scientifically questionable forms of complementary medicine. Two experiments will test the ease of detecting ontological mistakes when simultaneous cognitive processing demands are either high or low. There is ecological validity in exploring ontological mistakes in this way. In everyday contexts, when people are presented with arguments about a form of CAM, such information will likely be assessed according to belief and argument strength, and inferences will be drawn from the information presented (Green, 2008; Hoeken, Timmers & Schellens, 2012; Lin, Horng & Anderson, 2014; Shaw, 1996; Thompson, Evans & Handley, 2005; von der Mühlen, Richter, Schmid, Schmidt & Berthold, 2016). So, although the theory

behind many forms of CAM might contain ontological mistakes, in the real world, such mistakes will rarely be laid bare, the ability to detect will likely be hindered by competing processing demands such as reasoning.

## Study 4. Syllogisms with instructions on validity only

Some argue that belief (system 1) and analytical (system 2) processes are engaged simultaneously in reasoning tasks (De Neys & Glumicic, 2008; Sloman, 2002; Stupple & Ball, 2008). In some cases though, these two processes will conflict: a conclusion to a reasoning problem will be unbelievable but valid, or believable yet invalid. When this conflict between belief and logic is detected, cognitive resources will be engaged to resolve the conflict. When belief and logic are in agreement, processing will be less intensive because no resolution is required. Stupple and Ball (2008) supported this view by showing that people inspect premises and conclusions for longer on problems where belief and logic conflict than when they do not conflict.

So, system 1 processes such as belief can operate simultaneously with system 2 processes. However, as resolution of belief-logic conflict is computationally expensive, in this situation people often fall-back onto heuristics such as belief: indeed belief bias is more pronounced on conflict than on non-conflict problems (Stupple & Ball, 2008). If detecting ontological mistakes is a system 2 process, then ontological correctness should not bias conflict syllogisms, because the spare cognitive capacity required for detecting ontological mistakes should be unavailable, instead being devoted to resolving the conflict between logic and belief. In contrast, one would expect ontological correctness to have more of an effect where belief and logic are in harmony and where more cognitive capacity is available for the ontological mistake to be noticed.

Study 4 will test this theory. Participants will be presented with syllogisms in which ontology and belief/validity conflict will be manipulated. Participants here will not be instructed on the presence of, nor how to detect, ontological mistakes. Participants will be told that their task is to evaluate the conclusions on the basis of logical validity only.

It is expected that ontology and conflict will interact, such that ontologically correct conclusions will be endorsed more than ontologically incorrect on non-conflict syllogisms but not on conflict syllogisms.

There was a second aim to study 4. If belief in CAM is related to ontological confusions (Lindeman 2011; Svedholm & Lindeman, 2013) then the ability to be biased by ontological correctness even when cognitive resources are depleted should reduce belief in CAM. This is because if one can still notice mistakes when cognitive resources are in high demand, then perhaps ontological flaws in CAM

claims will be more evident. Thus the second aim here was to test whether the ability to be biased by ontological mistakes was related to beliefs in the effectiveness of CAM.

A single score, reflecting the interaction between ontological correctness and conflict was to be created. This score represents the ratio of choosing ontologically correct over incorrect conclusions when it is cognitively hard (i.e. on conflict problems) compared to when it is easy (i.e. on non-conflict problems). Thus this single score represents individual differences in the predicted two-way interaction from study 4. It was predicted that higher scores on this measure would mean lower beliefs in CAM.

## Method

### Participants

Seventy-nine undergraduates in psychology participated in the study (35 females, 36 males, 8 missing). The mean age was 28 years and 7 months (SD = 10 years).

### Design

A 2x2 fully within groups design incorporated ontology (correct, incorrect) and conflict (conflict, non-conflict) as the two factors. Judgements of conclusions as either valid or invalid was the dependent variable.

### Materials

Sixteen categorical syllogisms were presented to participants. Syllogisms consist of two statements or premises followed by a conclusion. An evaluation paradigm was chosen (i.e. where the conclusion is presented for the participant to evaluate) rather than a construction paradigm (in which participant construct conclusions themselves). A syllogism contains three terms, A, B and C. The first premise links A and B, the second premise links B and C and the conclusion links A and C. The premises and conclusion can have any one of four quantifiers, these are also known as a 'mood' and each is labelled with a letter:

A All _ are _
E No _ are _
I Some _ are _
O Some _ are not _

There are four ways in which the premises can be arranged, these are referred to as the 'figure' of the syllogism:

| Figure 1 | Figure 2 | Figure 3 | Figure 4 |
|---|---|---|---|
| AB | BA | AB | BA |
| BC | CB | CB | BC |

The conclusion can take an A-C or a C-A form. By these rules there are 512 possible syllogisms, most of which are logically invalid (Johnson-Laird & Bara, 1984). In order to incorporate ontologically correct and incorrect statements, two syllogistic forms were adopted, the first representing figure 2 (BA-CB), with a C-A conclusion which is valid:

All B are A
C are B
Therefore C are A

And the second representing figure 3 (AB-CB), with a C-A conclusion which is invalid

All A are B
C are B
Therefore C are A

The AAA mood of the syllogisms allowed for easy manipulation of ontology, believability and validity and controlled for the 'atmosphere' effect, whereby certain premise moods bias preferences for conclusion type (Begg & Denny, 1969). The two syllogistic forms do differ in terms of the figural effect: the BA-CB syllogism is known to bias people toward a C-A (rather than an A-C) conclusion, whereas the AB-CB problem does not favour either conclusion type. However, the figural effect is not noticeable on evaluation syllogisms in belief bias experiments (Morley et al., 2004) and although the effect might influence processing time, it has little effect on conclusion acceptance rates in the evaluation paradigm (Stupple and Ball, 2007).

The 16 conclusions contained a physical or biological phenomenon with a particular quality (e.g. rivers are dangerous). Ontologically incorrect conclusions indicated intentionality (e.g. apple orchards are generous). As all the biological/physical phenomena in the conclusions were non-sentient, none could possess intentionality, so attributing intentionality to these categories represented an ontological mistake. Ontologically correct conclusions paired a phenomenon with a permissible quality (e.g. clouds are light). Half of the ontologically incorrect conclusions were also believable, such that the qualities attributed, although incorrect, were plausible as metaphors (e.g. trees are wise). Ontologically incorrect and unbelievable conclusions

attributed qualities which were both incorrect and implausible, even as a metaphor (e.g. sunshine is selfish).

| | Ontologically Incorrect | Ontologically Correct |
|---|---|---|
| Believable | Apple orchards are generous | Rivers are dangerous |
| | Viruses are vindictive | Televisions are human-made |
| | The moon is composed | Clouds are light |
| | Trees are wise | Deserts are dry |
| | $\bar{x}$ = 11.00 (SD = 2.45) | $\bar{x}$ = 17.00 (SD = 2.97) |
| Unbelievable | Mountains are miserly | Diseases are pleasurable |
| | Sunshine is selfish | Atoms are visible |
| | Soil erosion is conscientious | Farms are underwater |
| | Asteroids are thoughtful | Bones are stretchy |
| | $\bar{x}$ = 9.00 (4.20) | $\bar{x}$ = 8.14 (SD = 3.24) |

Table 4.1. Study 4: Conclusions as a function of believability and ontology, with mean believability ratings (standard deviations in parentheses).

The full set of conclusions are shown in Table 4.1 (see also Appendix A). The believability manipulation was tested by asking a group of psychology students to rate how believable the conclusions were on a five-point scale ranging from very believable to very unbelievable. Table 4.1 shows that believable conclusions were rated as more believable than unbelievable conclusions.

Thus ontological correctness, validity and believability of the conclusions were manipulated. Believability and validity were collapsed into one factor to create conclusions where belief and logic conflicted (i.e. believable-invalid, unbelievable-valid) or did not conflict (i.e. believable-valid, unbelievable-invalid. Table 4.2 illustrates this.

| Factor 1 | Ontologically correct | | Ontologically incorrect | |
|---|---|---|---|---|
| Factor 2 | Conflict | Non-conflict | Conflict | Non-conflict |
| Conclusion type | Believable-invalid Unbelievable-valid | Believable-valid Unbelievable-invalid | Believable-invalid Unbelievable-valid | Believable-valid Unbelievable-invalid |

Table 4.2. Study 4: the experimental design.

Participants were given no instructions about the believability of the conclusions or about ontological correctness. They were told that:

> *…you are going to receive a series of thinking problems. Each one contains two statements followed by a conclusion. You must decide whether the conclusion follows logically or not from the statements before it.*

> *So, you must decide if the given conclusion follows logically from the statements. Choose **VALID** if, and only if, you judge that the conclusion can he derived unequivocally from the two statements before it, otherwise choose **INVALID**.*

Four filler syllogisms were included with the form:

All A are B
C are not B
Conclusion: Therefore C are not A

And participants were given three practice problems before beginning (see also Appendix A).

Participants in study 4 were also asked to complete Lindeman's (2011) belief in CAM treatments scale. The questionnaire lists 12 forms of CAM and respondents rate how effective they believe each one is on a scale from 0-5 (0 = cannot say, 1 = do not believe at all, 5 = believe fully). This measure was chosen, rather than the ACAM because firstly it is briefer and secondly, this is the measure which has been previously used to test relationships between CAM beliefs and ontological confusions (Lindeman, 2011; Svedholm & Lindeman, 2013).

## Results

A 2x2, fully repeated measures ANOVA was computed. The means and standard deviations are shown in Table 4.3. Ontology (correct, incorrect), and conflict (conflict, non-conflict) were the factors. The number of conclusions endorsed as valid was the dependent variable.

| | Ontology | | Conflict | |
|---|---|---|---|---|
| | Correct | Incorrect | Conflict | Non-conflict |
| Mean | 3.19 | 2.66 | 2.65 | 3.18 |
| SD | 1.47 | 2.05 | 1.85 | 1.63 |

Table 4.3. Study 4: Descriptives pertaining to the ontology and conflict main effects.

There was a significant main effect of ontology ($F(1, 77) = 9.10$; $p = .003$; $p\eta^2 = 0.11$), with ontologically correct endorsed as valid more than incorrect (see Table 4.3). There was a significant main effect of conflict ($F(1, 77) = 10.57$; $p = .002$; $p\eta^2 = 0.12$), with non-conflict conclusions endorsed more than conflict. There was also a significant two-way interaction ($F(1, 77) = 7.26$; $p = .009$; $p\eta^2 = 0.09$): as shown in Figure 4.1, on conflict problems, ontology had no effect on endorsement rates, but on non-conflict problems ontologically correct conclusions were endorsed more than incorrect. Simple effects analyses showed that although there was no effect of

ontology for conflict problems ($F(1, 78) > 1$), on non-conflict problems, ontologically correct conclusions were endorsed more than incorrect ($F(1, 77) = 20.87$; $p < .001$).

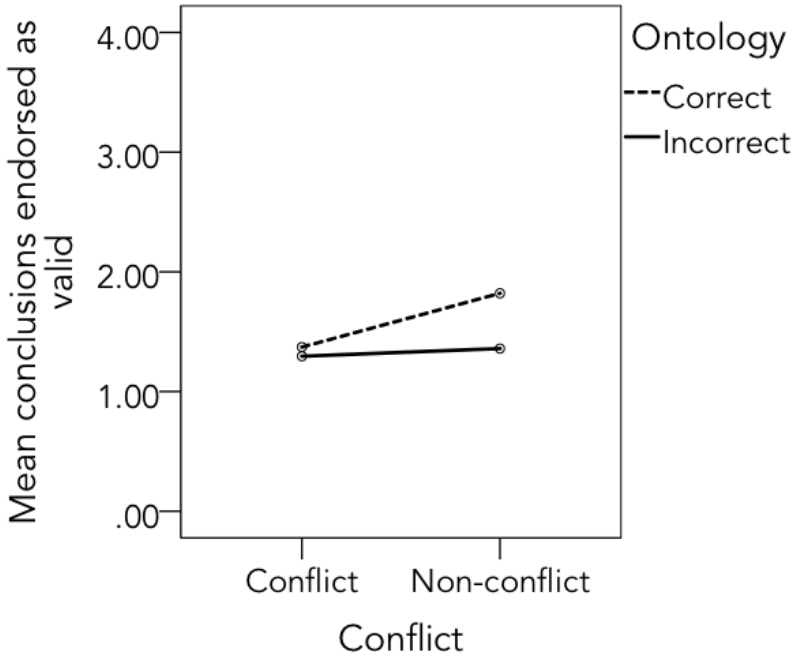



Figure 4.1. Study 4: The interaction between ontology and conflict.

### Ontological bias and beliefs about CAM

The interaction score was indeed negatively correlated with beliefs in CAM ($r$ ($N$ = 77) = -.25; $p$ = .026) albeit weakly. This indicates that the ability to be biased by ontology in conflict compared to non-conflict problems co-occurs with less faith in CAM. Those who cope best with the cognitive challenges of noticing ontological mistakes are also the ones who believe less in CAM. This extends research – on the relationship between ontological confusion and CAM beliefs (Lindeman, 2011; Svedholm & Lindeman, 2013) – by illustrating aspects of the cognitive processes underlying that relationship. More specifically, when people are engaged in difficult reasoning, believing in CAM might be more likely in those who do not have sufficient cognitive capacity to both notice (and be biased by) the ontological mistakes underlying the CAM and simultaneously assess the cogency of the argument. This is because both of these mental tasks require cognitive resources to be performed.

## Conclusions

Ontologically correct conclusions were endorsed more than ontologically incorrect, but this was only on the cognitively less challenging non-conflict problems. This supports the prediction that ontological correctness only biases syllogistic reasoning when sufficient cognitive capacity is available, as is the case with computationally easy non-conflict problems. Keleman and Rossett (2009) showed that detection of

ontological mistakes was more difficult when processing time was time-limited, indicating that decoding ontological mistakes is a system 2 process. The study 4 findings are consistent with this, in that ontological correctness does not bias responding on conflict syllogisms, because the capacity required for this is being used to resolve the belief-logic conflict.

## Study 5. Syllogisms with instructions on ontology, believability and validity

In study 4, ontology biased people's responding, but only when solving cognitively undemanding non-conflict problems. This suggests that the decoding of ontological mistakes is not a heuristic process like belief evaluation, but rather is an analytic process which demands cognitive capacity. In study 4, participants were given no prior warning as to the presence of ontological mistakes or how to detect them. However, the cognitive load of decoding ontological mistakes might be lessened if participants were given detailed instructions on how to spot them and prior warning that the materials would contain them. If such instructions can lighten the cognitive load, then the interaction between ontology and conflict seen in study 4 might dissolve. This is because with recent and detailed instructions, decoding ontological mistakes might be less effortful and more like a heuristic process. If so, then detection of mistakes could be done even as the mind is directing its resources to other tasks, i.e. for resolving the conflict between belief and logic.

Study 5 will test this theory. Participants will be given the same materials as in study 4, but this time, will be briefed on the presence of ontological mistakes within the problems and what such mistakes look like. They will similarly be briefed about the presence of believable and unbelievable conclusions. It is expected that ontologically correct conclusions will be endorsed more than ontologically incorrect but that there will be no interaction between ontology and conflict: the effect of ontology will be evident with both conflict and non-conflict syllogisms.

## Method

### Materials

The materials were identical to that of study 4 save for the inclusion of additional instructions:

> *Some of the conclusions will be unbelievable (e.g. 'Therefore pigs can fly') and some will be believable (e.g. 'Therefore planes can fly').*
>
> *Furthermore, some of the conclusions will be technically incorrect. Technically incorrect explanations will say that non-intelligent things have mental characteristics which only intelligent animals could have e.g.:*

*'rocks are careful', or 'wind is fickle'*

*Technically correct explanations will say that non-intelligent things have non-mental features e.g.:*

*'rocks are hard', or 'wind is invisible'*

*Although the technically incorrect statements can be meant as metaphors, taken at face value they cannot be correct, because non-intelligent objects cannot possess these features.*

Participants were finally told that, in spite of these features, they should suppose that all the premises are true and to choose valid only if the conclusion can be derived unequivocally from the premises (see also Appendix B).

### Participants

Participants were 163 undergraduate students in psychology (140 females) with a mean age of 22 years and seven months (SD = six years and six months).

### Procedure

Participants completed the materials on computer in a psychology lab, in groups of up to 60. They were asked to work in silence and were given as much time as they wished.

## Results

A 2x2 fully repeated measures ANOVA was conducted. Ontology (correct, incorrect) and conflict (conflict, non-conflict) were the factors. The number of conclusions endorsed as valid was the dependent variable.

| | Ontology | | Conflict | |
|---|---|---|---|---|
| | Correct | Incorrect | Conflict | Non-conflict |
| Mean | 4.44 | 3.53 | 3.95 | 4.02 |
| SD | 1.81 | 2.58 | 2.28 | 2.06 |

Table 4.4. Study 5. Descriptives pertaining to the ontology and conflict main effects.

There was a main effect of ontology ($F(1, 162) = 46.85$; $p < .001$; $p\eta^2 = 0.22$), as shown in Table 4.4, ontologically correct conclusions were endorsed more than ontologically incorrect. There was no main effect of conflict ($F(1, 162) < 1$). There was no significant interaction ($F(1, 162) = 1.46$; $p = .229$; $p\eta^2 = 0.01$), as shown in Figure 4.2, the effect of ontology is evident with both conflict and non-conflict syllogisms. Simple effect analyses showed that the higher endorsement of ontologically correct

conclusions was statistically significant both for conflict problems ($F(1, 162) = 46.74$; $p < .001$) and also non-conflict problems ($F(1, 162) = 26.31$; $p < .001$).

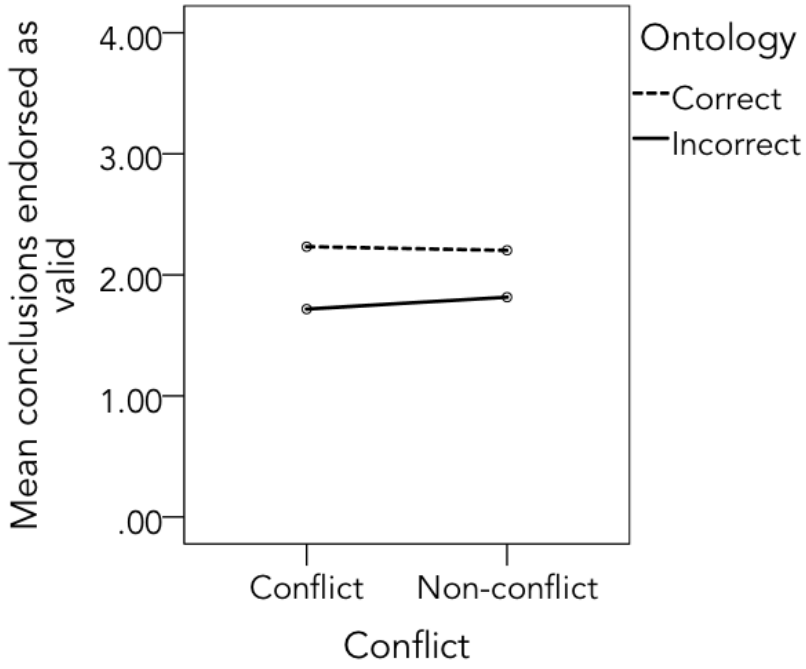



Figure 4.2. Study 5: The interaction between ontology and conflict.

## Conclusions

Ontologically correct conclusions were endorsed more than incorrect, as in study 4. But unlike in study 4, here the effect of ontology was found even on the computationally difficult conflict problems, as well as the less challenging non-conflict problems. This suggests that the cognitive load normally incurred when decoding ontological mistakes, was relieved by the prior instructions and examples of such mistakes. The recency and clarity of these examples might have helped to make detection of such mistakes more like a heuristic process and thus easier to perform even when cognitive resources are in high demand from attempts to resolve belief-logic conflict (see Stupple & Ball, 2008).

## Discussion

Authors have argued that ontological mistakes lie at the heart of scientifically questionable forms of complementary and alternative medicine (Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2013), that they are linked to belief in pseudoscience (Pennycook et al., 2015) and could undermine scientific literacy (Keleman & Rosset, 2009). Studies 4 and 5 provide data on how detection of ontological mistakes might interact with the process of reasoning.

The evidence suggests that identifying ontological mistakes is a system 2 process, that analytic processing must be engaged to do it (Keleman & Rossett, 2009) and that people who rely less on system 2 processing, make more ontological mistakes (Pennycook et al., 2015). Identifying such mistakes is not a system 1 or heuristic process which can be done with cognitive ease. If identifying ontological mistakes is a system 2 process, then it should require some cognitive capacity to do it. It is known that belief – usually a system 1 heuristic process – can bias reasoning (Evans, 2007), presumably because belief can be processed even when cognitive capacity is fully occupied elsewhere, with simultaneous reasoning (Pennycook et al., 2015; Stupple & Ball, 2008). If identifying ontological mistakes is not a heuristic process like belief, but is an analytic (system 2) process, then such mistakes should *not* bias reasoning. This is because the cognitive resources normally used to decode ontological mistakes are being directed elsewhere - for the purpose of logical analysis.

Study 4 supported this prediction: on computationally easy syllogisms (where belief and logic were in accordance), ontological correctness biased logical responding, presumably because these easier syllogisms did not deplete the cognitive resources required for noticing ontological mistakes. However, on the more computationally difficult problems – where belief and logic conflicted, ontological correctness did not bias responding at all, suggesting that the cognitive capacity required for noticing such mistakes was unavailable and the bias was therefore not observed. In study 5, the cognitive demands for noticing ontological mistakes were relieved by providing detailed instructions on what these mistakes look like. Following this intervention, ontological correctness biased logical responding once again, even on the cognitively demanding conflict syllogisms.

Together, these findings have implications for people's understanding of CAM. If CAM is often underpinned by ontologically incorrect claims (Lindeman, 2011; Lindeman & Saher, 2007; Svedholm & Lindeman, 2012), e.g. energy as good or bad, misrepresenting processes (e.g. energy, heat, etc.) as objects, or attributing mental abilities to physical objects (e.g. water has memory), then the ability to notice the incorrectness of such claims can protect one against investing in scientifically invalid therapies. Outside the laboratory however, when people are exposed to arguments about the effectiveness of CAM, those people are not merely processing the meaning of isolated statements. When assessing such claims, they will also be thinking – i.e. drawing inferences and constructing arguments (Hoeken et al., 2012; Schellens et al., 2017) and this is likely to be an analytical process which requires cognitive resources (Shaw, 1996). If evaluating claims about a form of CAM uses valuable cognitive resources, then there might not be enough remaining cognitive capacity to decode the ontological mistakes.

However, study 5 shows that a simple intervention to educate people about the nature of ontological mistakes, can increase the degree to which ontological

correctness biases reasoning, even when cognitive demands are high. The question here is whether education can equip people with a more intuitive grasp of what ontological mistakes are. If education can make ontological understanding less effortful and more heuristic-like, then people might be better able to spot ontological mistakes even when simultaneously evaluating the arguments and inferences behind a claim. Following such interventions, even cogent arguments about a form of CAM might become less persuasive to people if those arguments rely on ontological mistakes.

The question as to whether education can give people a more heuristic-like and effortless grasp of ontological correctness is one for future studies. In study 5, people were tested immediately after instructions on ontology were given. The longevity of this effect was not tested. Future studies might explore whether it is possible to sustain the effect over time and if so, how much and what kind of education is needed to produce it.

In study 4, although people were, on average, not biased by ontology on conflict problems, individual differences in this were negatively related to CAM beliefs. The correlation was small but if this can be replicated in future studies, it would support other research in which fall-back on system 1 and failure to engage system 2 processing have been proposed as important components in CAM beliefs (Lindeman, 2011; Svedholm & Lindeman, 2012), beliefs in pseudoscience (Pennycook et al., 2015) and also in paranormal beliefs (Riekki, Lindeman & Lipsanen, 2013; Svedholm & Lindeman, 2013). However, as the correlation was small this requires robust replication before confident conclusions can be drawn.

Future studies might consider some of the limitations of the current methodology. In order to generalise these findings, these effects should be tested on a wider range of materials, encompassing a wider range of ontological mistakes. Furthermore, although believability and ontology were manipulated, they also overlap and future research should aim to dissociate one from the other as much as is possible. The current findings are consistent with the claim that ontological awareness is a system 2 process, but there are other ways in which such a claim could be tested. For example, dual-task methods to assess the role of working memory in detection of ontological mistakes (Gilhooly, Logie, Wetherick & Wynn, 1993). Finally, testing these effects with materials containing real-life CAM-related arguments would allow for more confident generalisations to be made.

In conclusion, studies 4 and 5 offer evidence that ontological mistakes fail to bias responding when people are engaged in cognitively-demanding logical reasoning. Detailed instruction on how to decode ontological mistakes appears to restore people's ability to notice them when reasoning. This suggests that detection of ontological mistakes is a system 2 process, which might be made less cognitively

challenging through instruction. Studies 4 and 5 provide new knowledge about a potentially important bias in health beliefs (particularly beliefs about CAM) and furthermore on how health psycho-educational interventions might utilise this knowledge to reduce the effect of this bias. Thus studies 4 and 5 are of relevance to health psychologists interested in the cognitive factors underpinning health beliefs.

# Chapter 5. General discussion

## Summary of the findings

### Study 1

In study 1, a measure of CAM beliefs and CAM use was created and tested: the attitudes to complementary and alternative medicine scale (ACAM). The ACAM was designed to measure beliefs about the effectiveness of five types of CAM (AWMS, energy medicine, herbalism, body manipulation and mind and body techniques), for various purposes (serious conditions, non-serious conditions, long-term conditions, wellbeing, psychological, preventative). Following principal components analysis, 15 items settled into four factors (AWMS, energy medicine, herbalism and mind and body techniques). Five items relating to CAM for serious conditions were retained as a fifth factor, as for theoretical reasons, this was an important variable to test in studies 2 and 3. Items on CAM use were not included in the PCA, but were also retained for testing in studies 2 and 3, leaving 25 items in total. The ACAM had good internal consistency and satisfactory construct validity.

### Studies 2 and 3.

Self-reported thinking style was found to predict beliefs in CAM effectiveness. These relationships depended on the type of CAM in question: thinking style was related to faith in some types of CAM but not all. Furthermore, the nature of these relationships depended on the sample: in psychology students, those who thought themselves to be rational thinkers were *less* likely to believe in CAM; in a more heterogeneous sample consisting of the general public and undergraduates from numerous disciplines, those who thought of themselves as intuitive thinkers were *more* likely to believe in CAM. Although self-reported thinking style predicted some CAM beliefs, actual thinking performance was less predictive of CAM beliefs. The cognitive reflection test failed to predict CAM beliefs in any of the analyses from studies 2 and 3. However, in study 3, the base rate problems were related to belief in CAM for serious conditions and also CAM use.

### Studies 4 and 5

The tendency to make ontological mistakes is an important cognitive bias underpinning beliefs in CAM (Lindeman, 2011). Studies 4 and 5 addressed the question of whether detection of ontological mistakes was a system 2, analytic process, as opposed to a system 1, heuristic process. It was found that ontological

correctness biases reasoning on easier reasoning problems. But when cognitive demands are high (such as when grappling with a conflict between logic and belief), ontological correctness biases reasoning much less. However, when detailed instructions on ontology are given, ontological correctness biases reasoning once again, even on the computationally difficult problems, presumably because the instructions lighten the cognitive load. These findings suggest that the detection of ontology is not a heuristic bias (like believability for example) that people can fall back onto when processing capacity is exhausted. Instead, detection of ontological mistakes resembles a system 2, analytic process (relatively effortful, non-automatic). There was also evidence that individual differences in the ability to be biased by ontological correctness, even when processing demands were high, is linked with less faith in CAM.

## Contribution to knowledge

It is argued here that this thesis makes three original contributions to knowledge.

### The heterogeneity of CAM beliefs.

Studies 1-3 illustrate that belief in the effectiveness of CAM varies considerably according to the type of CAM under consideration. Furthermore, the psychological correlates of CAM beliefs also vary depending on the type and purpose of CAM. Beliefs in energy medicines and the effectiveness of CAM for serious conditions were both associated with self-reported thinking style in both studies 2 and 3. The correlates of other CAM beliefs were less stable across studies 2 and 3 and future studies might help to establish the replicability of these relationships.

### The distinction between self-reported and performance thinking style

Previous studies on the relation between CAM beliefs and thinking have relied on self-report measures of thinking (Lindeman, 2011; Saher & Lindeman, 2005; Svedholm & Lindeman, 2013). It was argued here that self-report questionnaires are insufficient as tests of reasoning, as they rely on accurate metacognition and do not correlate with performance measures of thinking (Newstead et al., 2004). This is the first study of which the author is aware, in which performance measures of thinking style (such as the CRT and base rate tasks) have been used to test the previously reported relationship between intuitive thinking and CAM beliefs. In the current studies, consistent with previous research, relationships between self-reported thinking style and CAM beliefs were found. But in contrast to expectations, relationships between actual thinking style and CAM beliefs were less frequently observed. This suggests that it is how people see their own cognition more than the cognition itself which might be most important here. Rather than a cognitive bias, one might describe this as a metacognitive bias. It could be that those who see themselves as intuitive thinkers identify more so with the concept of CAM. Conversely, those who see themselves as analytical thinkers identify less with the

unscientific nature of CAM, regardless of whether they themselves actually reason analytically in practice – it is how they perceive their thinking to be which is most important. What remains to be explored is whether people's self-reported thinking style also correlates with their view of what good thinking looks like (see Baron, 1995). This offers a new direction for follow-up studies.

Another question for follow-up research is whether the type of performance measure used to measure intuitive/rational thinking is a factor. Although the CRT did not predict CAM beliefs, base rate problems did predict one type of CAM belief in study 3. There are numerous other performance measures of intuitive/rational thinking (see Toplak et al., 2011) and future studies might explore further whether the presence or absence of relationships between CAM beliefs and thinking are due to task effects – i.e. whether other tests of miserly thinking (e.g. ratio bias, belief bias, disjunctive reasoning, etc.; see Stanovich, West & Toplak, 2017) predict CAM beliefs more strongly than others.

### Detection of ontological mistakes is a system 2 process

Previous work had indicated that detection of ontological mistakes by adults, was relatively easy when cognitive processing was unimpeded. Ontological mistakes could be easily detected by engaging ontologically mature knowledge (Keleman & Rosset, 2003). However, detection of ontological mistakes was more difficult when processing time was limited and especially in adults with poorer inhibitory control. In light of these findings, in studies 4 and 5, it was predicted and demonstrated that the detection of ontological mistakes is an analytical process which is more difficult to do when a person is simultaneously engaged in cognitively-demanding reasoning. This suggests that although people can be influenced by ontological mistakes when cognitive demands are low, when they are simultaneously drawing inferences or formulating arguments, such mistakes are less likely to be noticed. In everyday life, when evaluating information related to CAM, individuals are likely be simultaneously drawing inferences and arguments (which require cognitive processing) and the current findings suggest therefore, that at such times, ontological mistakes will not always be detected. More optimistically, the current work indicates that educating people about the nature of ontological mistakes can make it easier for people to be biased by them (or notice them), even when processing demands are high. This opens-up a new direction for future studies, that is, to explore the most effective ways of educating people about ontological mistakes in relation to CAM.

## Relevance to health psychology

The studies reported here have been concerned with cognitive bias associated with beliefs in and use of CAM. CAM represents a popular health choice for many people across the world, and therefore understanding CAM beliefs and CAM-related behaviour helps to shed light on an important aspect of health behaviour.

CAM is usually separate from mainstream science, there are doubts about its effectiveness and it has a questionable evidence-base (Angell & Kassirer, 1998; Barnes, 2003). In studying the cognitive (or metacognitive) biases that relate to CAM beliefs, the implication is that people make irrational or unscientific health choices, in part because they sometimes fall-back on short-cuts in cognitive processing. One of the recommendations from chapter 4 (studies 4 and 5) is that simple educational interventions might ease the cognitive challenges in detecting the unscientific principles which underpin CAM. Furthermore, the findings from chapter 3 (studies 2-3) also offer potential for intervention: psychologists do not necessarily have to change people's actual thinking style, but rather change the thinking style they value. By valuing a rational thinking style, people might begin to value more evidence-based health schemes, even if they are unable to do rational thinking in practice.

So it is argued here that the findings add new knowledge about beliefs and cognition in relation to CAM, but also that this knowledge has the potential to inform effective interventions to change behaviour or attitudes.

Finally, this raises another question: is it ethical to change people's beliefs about CAM? Although the evidence on CAM effectiveness is questioned by many (e.g. Talalay & Talalay, 2001), there is a branch of neuroscience which illustrates the potential importance of CAM. Psychoneuroimmunology is the study of the interaction between psychological states and the immune system (Dinan & Cryan, 2017; Kiecolt-Glaser, McGuire, Robles & Glaser, 2002). There is a vast amount of research evidence showing that negative psychological states are linked to disease (Everson, Kaplan, Goldberg & Salonen, 2000; Glaser, 2005; Reiche, Nunes & Morimoto, 2004) and that positive psychological states such as hopefulness can improve symptoms and survival rates (Ho, Ho, Bonanno, Chu & Chan, 2010; Lewis, Dennis, O'rourke & Sharpe, 2001). It has been shown that complementary therapies can facilitate improvements in hopefulness and affect in patients with physical disease (Bishop, Yardley & Lewith, 2010; Hsu, Blue Spruce, Sherman & Cherkin, 2010). This raises the question of whether it is ethical to discredit forms of CAM which might do good, albeit only as elaborate placebos (Dorn, Kaptchuk, Park, Nguyen, Canenguez, Nam, ... & Lembo, 2007)?

Perhaps the answer lies in re-defining CAM, so that claims about CAM effectiveness are not based upon mysticism and myth, but instead on evidence-based knowledge as to the psychoneuroimmunological benefits that improvements in hope, and affect can bring. If CAM could be reconfigured so that its practitioners attribute its benefits not to myth but neuroscience, they could focus their practice on aspects of CAM such as empathy, practitioner-patient relationship, relaxation, etc. which are scientifically evidenced (Kaplan, Greenfield & Ware Jr, 1989).

From this argument, psychological interventions which help people to discern against pseudoscientific therapies will not necessarily remove the potential for CAM to do good, if CAM practitioners can embrace scientific explanations for why their therapies work in place of the mystical.

# Chapter 6. Reflective Essay on my Development as a Health Psychologist

## Introduction

This essay will document my development as a professional health psychologist from December 2014 up to the end of November 2016. My background is that of an academic psychologist who has for some years been researching and teaching in the areas of mental health and health psychology (HP). Since the beginning of 2016, I have also been working in an NHS setting as a trainee health psychologist on placement. The essay will be divided into two sections: in Part 1, my development will be described mainly in relation to my academic work: how my development in HP has been reflected in research, teaching and supervision from 2014 to 2015. In Part 2 of this essay, I describe my continued development more so as reflected by my applied HP work. This second part covers the period of January to November 2016.

### Part 1, November 2014 – December 2015

*My background and role as an academic psychologist.*

I completed a PhD in cognition and mental health in 2006. Although my PhD was on mental health, I had moved into health psychology research at round the time I was finishing the PhD. At that time I was working as a research fellow and was involved in various funded projects in the area of health psychology. This led me to begin BPS stage 1 training in HP in 2007. In 2008 I took a lectureship at Wolverhampton and began teaching in psychobiology and research methods at undergraduate level. My duties also involved supervision of doctoral trainees in counselling psychology and PhD students. My research was broadly on beliefs and cognition in relation to health and mental health.

As I began the professional doctorate in HP at UWE in 2014, there were a number of areas I was looking to develop. I was developing doctoral supervision, research output and also teaching – the latter primarily through an undergraduate module in HP.

*Doctoral Supervision*

By 2014 I was director of studies for four PhD students whose projects were broadly on beliefs and cognition in mental health and health. I was also supervising the research projects of six counselling psychology doctoral trainees. As a doctoral supervisor I was developing two important skills: *Communication*: effective supervision is built upon effective professional relationships embodying respect. This requires technical communication: guiding the student in decision-making, explaining concepts, theory, methods, analysis, writing, etc. It also requires emotional support and encouragement. Besides this, I feel that as a supervisor, I must model

professional standards too: including legal ethical codes for research, professional standards of communicating, standards relating to the dissemination of research and the importance of the scientific approach as a psychologist. The second key skill here is *research leadership*. Providing guidance, encouragement, support and instruction when necessary, so that the student has an appropriate role model for how research is conducted and for how research alliances are formed, with respect and inclusiveness as central values. The role of a research leader is also one of enabler, providing others with the confidence to act independently and to feel able to express their creative drive.

*Research*

As a researcher I had been leading on my own projects for a number of years and had built up a strong portfolio of publications. I was also leading a research group within my department. The group was named Cognition in Context (http://www.wlv.ac.uk/research/institutes-and-centres/psychology-research/research-groups/cognition-in-context-research-group/). We had between 8 and 12 members (academics and PhD students) and collectively we were producing a high volume of research outputs (journal papers, book chapters and conference talks). The remit of the group was to support collaborative research projects between members. My principal role was to help bring members together to initiate new projects and also to support younger members as they launched their own research careers.

By 2015 I had a number of partnerships with researchers in other parts of the UK and overseas (France and Japan) and was leading on numerous projects. At this time (2014/2015) I began to focus my efforts intensively on gaining research funding. A number of bids were submitted with various partners. The most successful were in collaboration with an external research company Tiller Research, based in Worcestershire. They conduct commissioned research, mostly for charitable and publically funded organisations. In 2015, Tiller research and myself were successful with two research bids. The first was a project Funded by ASDAN (approximately £13000); an evaluation of a holistic, psychosocial intervention for children transitioning to secondary school. The second was funded by Herefordshire Council (approximately £42000): an evaluation of an intervention to promote exercise in the people of Herefordshire. My role in these partnerships was to provide advice on ethics, methodology and analysis.

In terms of publications, I had been successful there too producing articles in attitudes and beliefs in health and mental health. These publications were with various research partners and with my PhD students. In 2014, myself and two colleagues had secured a book contract: a festschrift for my former PhD supervisor and mentor Ken Manktelow. I was lead editor and this required that I attract high quality authors to write the chapters. The editorial team had to decide on the remit for the book (cognitive psychology of thinking, particularly in relation to real-life

contexts). We gathered together a fantastic collection of authors from across the UK, Europe, the Far East and North America. I had a great relationship with the other editors and together we were able to see the book through to publication in 2016. The publication of this text will add momentum to my recent research on the role of reasoning in health choices.

*Teaching*
My teaching responsibilities were mainly at undergraduate level in psychology: psychobiology and research methods. In 2014, I was also asked to re-launch a final year, undergraduate module in HP (Applications of Health Psychology). The module focuses on theoretical foundations as well as applied HP.

These areas (supervision, research and teaching) represented my principal foci as of late 2014. Thus I was engaged in health psychology-related work, capable of meeting some of the BPS/ HCPC competencies for HP: communicating/disseminating psychological concepts and research; practising within legal codes; using my own judgment and working autonomously; giving advice and guidance; forging collaborations and leading teams.

At the time I began the prof. doc. at UWE, I was no longer content to research and teach concepts without experience in applied psychology to complement them. I had spent much time reading, writing and talking about clinical–related phenomena but had spent little time since 2008 engaging with people in clinical or health-related contexts. This was an area of my practice that needed development, and from late 2015 my focus changed so as to pursue this development need.

## Part 2, December 2015 – November 2016

The beginning of my applied work came in December 2015, when I ran a stress management workshop with West Midlands Police. This was the project completed as part of the prof. doc consultancy competency. It was the first applied work I had done in some years and forced me to learn a new therapeutic framework (solution-focused therapy; O'Connell, 2005). I then adapted this to develop a new academic stress management service for final year undergraduate students at my university. This formed the basis for the behaviour change competency.

At this point I had met the requirements for the above competencies. However, as mentioned in the previous section, my motivation was to develop into a different kind of psychologist with different skills, and the process of studying on the prof. doc. at UWE had accelerated this interest. My wish was to use this training in order to work in applied psychology, not merely to continue as before. To this end, I made use of personal contacts to negotiate a health psychology placement at a physical health psychology service in the Black Country Partnership NHS Foundation Trust. The service provides psychological support to NHS patients with chronic conditions (e.g.

stroke, heart disease, cancer, kidney disease, chronic pain, etc.) who have psychological needs. The service is substantial, with over ten psychologists and numerous counsellors and therapists. The team operates across numerous sites including Cross Street Clinic, Russells Hall Hospital and The Guest Hospital all in Dudley in the West Midlands.

My supervisor was Prof. Anthony Schwartz an experienced clinical and health psychologist. My initial work on placement involved shadowing a psychologist at a pain screening clinic. The clinic was multi-disciplinary, whereby patients with pain could visit a consultant, a physiotherapist and a psychologist in sequence to gain a holistic assessment of their needs. The psychologist's role was to assess whether the patients would be suitable for various forms of psychological input: pain management programme/fibromyalgia support group, psychological therapy, counselling/CBT, or a referral to mental health. After a few weeks of shadowing the psychologist, I began to lead the screening sessions. The screening was structured and principally a time-limited (20 mins) information-gathering process. Here I learned some important clinical skills: working with couples (patients were usually accompanied by partners and the screening protocol included questions about intimate relationships) and using subtle non-verbal communication (e.g. changing seating posture) to prompt a change in conversation (important in a time-limited session).

The main psychological challenge with the patients in these clinics was to match their psychological needs (if they indeed had any) to the appropriate psychological support. For example, patients who were very much precontemplative about changing their lifestyle, or who had enduring and historical mental health needs, would be unsuited to the PMP. After attending a number of these clinics, I felt that it would be helpful to see the PMP in action, so that I might have a better idea of which patients would be best suited to this option. Therefore my next venture was to attend a full eight-week cycle of the PMP.

The version of the PMP that I joined was based on CBT and was aimed at identifying maladaptive thinking and behaviour patterns, as well as providing psychoeducation, physio-education, exercise, relaxation and goal setting. I attended for the full cycle and contributed to the psychoeducation.

By this point, I had been shadowing a psychologist colleague (Dr John Donohue) in his work with oncology patients and had been shadowing my supervisor (AS) in his therapeutic work with renal patients. These sessions helped me to experience different therapeutic approaches but I also learned the process of taking clinical notes. The Trust has a policy on note-taking and I was tutored in this system by a colleague. Thus I learned the importance of efficient note-taking and record-keeping: notes should be legible, understandable by non-psychologists and accessible to the patient should they wish to see them.

In May 2016, I began leading assessments in oncology with JD shadowing me. I was given detailed guidance in conducting assessments with oncology patients. JD provided thorough feedback on my therapeutic skills and we had discussions on the approach I'd taken. This work gradually developed with me leading on post-assessment sessions and delivering interventions. In the summer months I began to see patients unaccompanied, although still working with JD's guidance and under supervision from AS. A similar process developed with patients under renal care. I began to see patients on my own without an accompanying psychologist, but still engaged in regular and frequent supervision.

Part of my supervision involved introduction to new approaches but my therapeutic work was founded on a Rogerian client-centred model (Rogers, 1957). Building on this, acceptance and commitment therapy (ACT: Hayes, 2004) also began to feature in my work. ACT was practised by a number of the psychologists I worked with on placement and it was recommended that I trained in it due to its usefulness when working with patients with chronic conditions. I did indeed follow this advice and enrolled on an ACT workshop at Birmingham University in October 2016. To complement this, I immersed myself in an ACT text recommended to me by my supervisor AS (Harris, 2009). Continuing with close supervision, I continued to integrate ACT in to my therapeutic work. At the current time, I am still working under close supervision, providing psychological therapy to patients being treated for cancer and patients with renal disease. I continue to see some patients on my own. With some patients, particularly those with complex issues, I lead the session but am accompanied by my colleague JD.

## Conclusions

The NHS placement has given me the opportunity to develop therapeutic and behaviour change skills in HP. This work has enabled me to adapt to new skills in relation to patient work. These include: ethical codes of working with patients, such as being non-discriminatory, and aware of the power imbalance (for example, one of the first things I emphasise for patients in initial assessments is that the session is for them to decide whether they want to work with me, as much as it is for me to assess how I can help them); to apply principles of informed consent and confidentiality to patient work; the importance of note-taking and careful record-keeping; communication and tailoring psychological advice so as to be sensitive to the context; protecting patients from harm; being aware of the limits of my own competence and the importance of reviewing competence continually, and how supervision is an essential part of this process; working in a multidisciplinary team. The NHS placement has driven me to develop into an applied psychologist and a significant element of this change is not only learning to apply psychological

techniques in health-related settings such as the NHS, but also learning the professional skills that such a psychologist must embody.

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# Appendices.

## Appendix A. Task from study 4.

Firstly, you are going to receive a series of thinking problems. Each one contains two statements followed by a conclusion. You must decide whether the conclusion follows logically or not from the statements before it.

So, you must decide if the given conclusion follows logically from the statements. Choose **VALID** if, and only if, you judge that the conclusion can he derived unequivocally from the two statements before it, otherwise choose **INVALID**.

**Here are three simple practice problems before you start:**

| | |
|---|---|
| All A are B<br>C are A<br>Conclusion: Therefore C are B<br>☐ **Valid**<br>☐ **Invalid** | All A are B<br>C are B<br>Conclusion: Therefore C are A<br>☐ **Valid**<br>☐ **Invalid** |
| All A are B<br>C are not B<br>Conclusion: Therefore C are not A<br>☐ **Valid**<br>☐ **Invalid** | |

**Now you've done the practice problems, you can begin the real problems. First though, please indicate your age and sex.**

| Age | Sex |
|---|---|

| | |
|---|---|
| All fast things are dangerous<br>Rivers are fast<br>Conclusion: Therefore rivers are dangerous<br>☐ **Valid**<br>☐ **Invalid** | All wise things are useful<br>Trees are useful<br>Conclusion: Therefore trees are wise<br>☐ **Valid**<br>☐ **Invalid** |
| All fragile things are intricate<br>Hammers are not intricate<br>Conclusion: Therefore hammers are not fragile<br>☐ **Valid**<br>☐ **Invalid** | All light things are fluffy<br>Clouds are fluffy<br>Conclusion: Therefore clouds are light<br>☐ **Valid**<br>☐ **Invalid** |
| All dry things are plain<br>Deserts are plain<br>Conclusion: Therefore deserts are dry<br>☐ **Valid**<br>☐ **Invalid** | All simple things are visible<br>Atoms are simple<br>Conclusion: Therefore atoms are visible<br>☐ **Valid**<br>☐ **Invalid** |

| | |
|---|---|
| All bright things are selfish<br>Sunshine is bright<br>Conclusion: Therefore sunshine is selfish<br>☐ **Valid**<br>☐ **Invalid** | Valuable things are popular<br>The pyramids are not popular<br>Conclusion: Therefore the pyramids are not valuable<br>☐ **Valid**<br>☐ **Invalid** |
| Complex things are tiring<br>Languages are not tiring<br>Conclusion: Therefore languages are not complex<br>☐ **Valid**<br>☐ **Invalid** | All machines are human-made<br>Televisions are machines<br>Conclusion: Therefore televisions are human-made<br>☐ **Valid**<br>☐ **Invalid** |
| All underwater things are tasty<br>Farms are tasty<br>Conclusion: Therefore farms are underwater<br>☐ **Valid**<br>☐ **Invalid** | All silent things are generous<br>Apple orchards are silent<br>Conclusion: Therefore apple orchards are generous<br>☐ **Valid**<br>☐ **Invalid** |
| All composed things are peaceful<br>The moon is peaceful<br>Conclusion: Therefore the moon is composed<br>☐ **Valid**<br>☐ **Invalid** | Electrical things are unpredictable<br>Beaches are not unpredictable<br>Conclusion: Therefore beaches are not electrical<br>☐ **Valid**<br>☐ **Invalid** |
| All complex things are pleasurable<br>Diseases are complex things<br>Conclusion: Therefore diseases are pleasurable<br>☐ **Valid**<br>☐ **Invalid** | All dangerous things are vindictive<br>Viruses are dangerous<br>Conclusion: Therefore viruses are vindictive<br>☐ **Valid**<br>☐ **Invalid** |
| All stretchy things are funny<br>Bones are funny<br>Conclusion: Therefore bones are stretchy<br>☐ **Valid**<br>☐ **Invalid** | All miserly things are strange<br>Mountains are strange<br>Conclusion: Therefore, mountains are miserly<br>☐ **Valid**<br>☐ **Invalid** |
| All natural things are conscientious<br>Soil erosion is a natural thing<br>Conclusion: Therefore soil erosion is conscientious<br>☐ **Valid**<br>☐ **Invalid** | All thoughtful things are loud<br>Asteroids are loud<br>Conclusion: Therefore asteroids are thoughtful<br>☐ **Valid**<br>☐ **Invalid** |

# Appendix B. Task from study 5.

You are going to receive a series of thinking problems. Each one contains two statements followed by a conclusion. You must decide whether the conclusion follows logically or not from the statements before it.

Some of the conclusions will be unbelievable (e.g. 'Therefore pigs can fly') and some will be believable (e.g. 'Therefore planes can fly').

Furthermore, some of the conclusions will be technically incorrect. Technically incorrect explanations will say that non-intelligent things have mental characteristics which only intelligent animals could have e.g.:

'rocks are careful', or 'wind is fickle'

Technically correct explanations will say that non-intelligent things have non-mental features e.g.:

'rocks are hard', or 'wind is invisible'

Although the technically incorrect statements can be meant as metaphors, taken at face value they cannot be correct, because non-intelligent objects cannot possess these features.

Despite the fact that some statements are unbelievable or believable, technically correct or incorrect, you must suppose that the statements are all true and decide if the given conclusion follows logically from the statements. Choose VALID if, and only if, you judge that the conclusion can he derived unequivocally from the two statements before it, otherwise choose NOT VALID.

**Here are three simple practice problems before you start:**

| | |
|---|---|
| All A are B<br>C are A<br>Conclusion: Therefore C are B<br>☐ **Valid**<br>☐ **Invalid** | All A are B<br>C are B<br>Conclusion: Therefore C are A<br>☐ **Valid**<br>☐ **Invalid** |
| All A are B<br>C are not B<br>Conclusion: Therefore C are not A<br>☐ **Valid**<br>☐ **Invalid** | |

**Now you've done the practice problems, you can begin the real problems. First though, please indicate your age and sex.**

| Age | Sex |
|---|---|

| | |
|---|---|
| All silent things are generous<br>Apple orchards are silent<br>Conclusion: Therefore apple orchards are generous<br>☐ **Valid**<br>☐ **Invalid** | All light things are fluffy<br>Clouds are fluffy<br>Conclusion: Therefore clouds are light<br>☐ **Valid**<br>☐ **Invalid** |
| Electrical things are unpredictable<br>Beaches are not unpredictable<br>Conclusion: Therefore beaches are not electrical<br>☐ **Valid**<br>☐ **Invalid** | All complex things are pleasurable<br>Diseases are complex things<br>Conclusion: Therefore diseases are pleasurable<br>☐ **Valid**<br>☐ **Invalid** |
| All dry things are plain<br>Deserts are plain<br>Conclusion: Therefore deserts are dry<br>☐ **Valid**<br>☐ **Invalid** | All simple things are visible<br>Atoms are simple<br>Conclusion: Therefore atoms are visible<br>☐ **Valid**<br>☐ **Invalid** |
| All bright things are selfish<br>Sunshine is bright<br>Conclusion: Therefore sunshine is selfish<br>☐ **Valid**<br>☐ **Invalid** | All natural things are conscientious<br>Soil erosion is a natural thing<br>Conclusion: Therefore soil erosion is conscientious<br>☐ **Valid**<br>☐ **Invalid** |
| Complex things are tiring<br>Languages are not tiring<br>Conclusion: Therefore languages are not complex<br>☐ **Valid**<br>☐ **Invalid** | All machines are human-made<br>Televisions are machines<br>Conclusion: Therefore televisions are human-made<br>☐ **Valid**<br>☐ **Invalid** |
| All fast things are dangerous<br>Rivers are fast<br>Conclusion: Therefore rivers are dangerous<br>☐ **Valid**<br>☐ **Invalid** | All wise things are useful<br>Trees are useful<br>Conclusion: Therefore trees are wise<br>☐ **Valid**<br>☐ **Invalid** |
| All composed things are peaceful<br>The moon is peaceful<br>Conclusion: Therefore the moon is composed<br>☐ **Valid**<br>☐ **Invalid** | All fragile things are intricate<br>Hammers are not intricate<br>Conclusion: Therefore hammers are not fragile<br>☐ **Valid**<br>☐ **Invalid** |

| | |
|---|---|
| All underwater things are tasty<br>Farms are tasty<br>Conclusion: Therefore farms are underwater<br>☐ **Valid**<br>☐ **Invalid** | All dangerous things are vindictive<br>Viruses are dangerous<br>Conclusion: Therefore viruses are vindictive<br>☐ **Valid**<br>☐ **Invalid** |
| All stretchy things are funny<br>Bones are funny<br>Conclusion: Therefore bones are stretchy<br>☐ **Valid**<br>☐ **Invalid** | All miserly things are strange<br>Mountains are strange<br>Conclusion: Therefore, mountains are miserly<br>☐ **Valid**<br>☐ **Invalid** |
| All thoughtful things are loud<br>Asteroids are loud<br>Conclusion: Therefore asteroids are thoughtful<br>☐ **Valid**<br>☐ **Invalid** | Valuable things are popular<br>The pyramids are not popular<br>Conclusion: Therefore the pyramids are not valuable<br>☐ **Valid**<br>☐ **Invalid** |

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