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Asymmetry in Belief Formation and Change: The Role of Intuitive Cognition and Inhibition

**Duncan Bruce Samara-Colvin
PhD Psychology
Goldsmiths, University of London**

Declaration of Authorship

I, Duncan Bruce Samara-Colvin, hereby declare that this thesis and the work presented in it are entirely my own. Where I have consulted the work of others, this is always clearly stated.

Signed: _____ Date: 24th September 2019

Abstract

Understanding how beliefs form and change is important because people act upon their beliefs in the world around them, which has implications for everyone. The present research programme therefore aimed to explore mechanisms in the belief process. This was approached from the dual-process perspective that there are two kinds of thinking: intuitive and rational. It was predicted that belief formation and change would be path-dependent, with rational disconfirmation influencing rationally-based beliefs more and intuitive disconfirmation influencing intuitively-based beliefs more. The research programme used a mixture of lab-based studies and naturalistic intervention studies, drawing upon a range of population samples. Belief in Extrasensory Perception (ESP) was the focus for belief change, due to its association with intuitive belief-basis and broad distribution within the general population. The proposed model of path-dependent belief change was not supported, however. Ultimately, it was found that beliefs vary in being held for rational or intuitive reasons, and that this difference emerges at the belief formation stage due to the nature of the material encountered and the person's cognitive processing style. However, neither the nature of the material nor the person's cognitive processing style influences belief change. Therefore, while the findings did not support the specific model being tested, they did successfully demonstrate a connection between belief formation and change. It is argued that the observed asymmetry is only explainable by a difference in encoding at belief formation and that fully understanding belief therefore requires future research to solve this encoding problem.

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Introduction & Aims

Beliefs power the world – people act upon the world based upon how they believe it to be. Beliefs pervade each person’s every waking, and even non-waking, moment – a top-down influence on everything people do and even what they think. Beliefs range from the mundane, such as how much milk is in the fridge at home right now, to the incredibly important and even metaphysical, such as whether the soul survives bodily death or whether people can communicate telepathically. If one believes there is insufficient milk in the fridge then one might go to the supermarket to pick up some more. If one believes that people have special powers, such as communicating directly from mind to mind (telepathy) or being able to see things on the other side of the world using just their mind (remote viewing), then millions of dollars might be spent on trying to weaponise these abilities (Kruglanski & Gigerenzer, 2011; Marks, 2000). This would all be of little consequence if people’s beliefs were normative – that is to say, formed rationally, based on the best available information. However, this is not always the case and people often hold beliefs that are non-normative. Unfortunately, the consequences of such beliefs can be somewhat greater than running out of milk for one’s morning coffee.

For example, acupuncture is an ancient Chinese medical procedure involving the insertion of extremely fine needles into the skin. The theory behind this is that it balances energy channels in the body. However, a meta-analysis of studies on the effectiveness of acupuncture demonstrated that it does not provide better results than a placebo (Madsen, Gotzsche, & Hrobjartsson, 2009), the implication being that the proposed energy channels may not exist as claimed. Nevertheless, the procedure has a long cultural history and consequently it remains a fairly common treatment, even in Western countries. However, it is not without risks. For example, a study conducted in China by Liu et al. (2014) documented a high number of cases (30 patients from a single clinician over a 6-month period) of primary inoculation tuberculosis (PIT), which is a form of tuberculosis caused by bacteria entering into the skin. This can lead

to disfiguring ulcerative lesions and even high temperature and fever. In other, apparently rarer, cases the direct physical nature of acupuncture can even lead to punctured lungs (Stenger, Bauer, & Licht, 2013). Clearly, better medical hygiene and procedure would prevent these sorts of issues, but it is arguably an unnecessary risk for something that is no more effective than a placebo that has no risks attached to it. However, people's beliefs that acupuncture may be effective lead them to use that traditional treatment.

Magical beliefs are a common form of non-normative belief. One commonly heard argument is that such beliefs are of little concern. However, this is not always the case and this is illustrated vividly by the 5-year-old girl in Chicago who was burned during a Voodoo ritual. The ritual was to cleanse her of a demon that was making her misbehave and involved fire being blown over her (Associated Press, 2018). The current state-of-the-art knowledge from developmental psychology, however, is that children are not possessed by devils, no matter what the outward appearances may be. However, the people involved genuinely believed that a spirit was possessing the girl and, in fact, were only acting in her best interests, based upon how they believed the world to be (that devils can possess people and fire can cleanse this).

As social beings, people act collectively in the world as well. This can have a much bigger impact than the individual cases just illustrated. For example, one major challenge for humankind at present is climate change, but while the scientific data are unequivocal, there is a sizeable minority who take issue with the claim that the climate of the planet is warming. This particular case of acting in the world, based upon one's beliefs about it, has the effect of delaying steps to tackle the issue, with enormous consequences for the world as a whole (Snow & Snow, 2015). One of the challenges with respect to climate change is therefore changing people's beliefs about it. In order to do this, however, there needs to be an understanding of how beliefs change.

The present research programme was therefore motivated to investigate mechanisms involved in the belief process. As will be seen, there has been a tendency in the literature to focus on normative beliefs changing in response to rational information, but as illustrated above, people's beliefs are not always normative. Furthermore, they

may not always be based on rational reasons. For example, someone who lives in an area where it snowed a lot more last winter might think that the planet is cooling, not getting warmer. However, they would be basing their claim on personal experience rather than scientific evidence. And, while personal experience is often a useful form of evidence, it is insufficient to negate an entire area of scientific knowledge. Therefore, in order to address this gap in understanding belief, the present programme focused upon paranormal belief, which is less commonly held for rational, normative reasons (personal experience and normative thinking will be discussed in greater depth later).

The key aim of the programme was to make progress in understanding the mechanisms behind the belief process and to this end the programme tested a model of belief change that proposes a connection between how beliefs are formed and how they change. This path-dependent model is described in detail later, but in brief the prediction is that rational beliefs are more influenced by rational information and intuitive beliefs are more influenced by intuitive information. In addition to this, if any knowledge gained about the belief process is to be useful it should generalise to the wider population, so this was another major aim of the programme.

The programme therefore approached the study of belief formation and change using mainly naturalistic studies, as well as samples from multiple populations, rather than being limited to the typical student samples used in much of psychology research (McNemar, 1946; Smart, 1966). The aim was to test the path-dependent model in order to progress understanding of the mechanisms underlying belief change. To this end the study focused upon belief in Extrasensory Perception (ESP), which is a paranormal belief that people can communicate with each other or sense things directly with their minds, such as knowing what card is next in a deck of randomised cards with no normal way to know. Paranormal beliefs are both widespread (Castro, Burrows, & Wooffitt, 2014; Goritz & Schumacher, 2000; Rice, 2003) and of the kind that people often believe for reasons that are not rational in nature, such as personal experience or gut feeling (Clarke, 1995; however see Cardena, 2018, for a review of meta-analyses of research that some people may base their ESP belief on). This is also a kind of non-

normative belief where there are potentially serious ramifications, such as those illustrated in the Voodoo ritual.

In summary, the belief process is an important one to understand due to the potential for negative impacts that can come from people acting upon their beliefs. This is the case both at the level of individuals and at the level of the global population. In order to add to existing understanding of this important process the present research programme aimed to investigate the connection between belief formation and change, based upon the hypothesis that the belief change mechanism is path-dependent. This was to be conducted via a series of studies, focusing largely on naturalistic designs investigating belief in ESP. In order to enhance generalisation to the wider population the aim was also to use largely non-student sample groups where possible.

General Background

What is a Belief?

The importance that beliefs have in the real world has been made abundantly clear, but to study beliefs requires knowing, or at least operationalising, what beliefs actually are. Merriam-Webster (<https://www.merriam-webster.com/dictionary/belief>, 2018) defines belief thus: “something that is accepted, considered to be true, or held as an opinion”. Dictionaries reflect common usage rather than scientific operationalisations, but it certainly seems obvious to most people what a belief is. Definitions of belief in the research literature are, however, much harder to come by; perhaps for the very reason that what belief means does seem so intuitively obvious. For example, in Lindeman’s (2011) paper on belief in complementary and alternative medicine, there is no attempt to define or operationalise ‘belief’, despite it being the key focus of the research study. Instead the meaning of the term is left for the reader to supply. Similarly, Paik, MacDougall, Fabrigar, Peach, and Jellous (2009) did not include any discussion of what is meant by the term ‘belief’, even though belief was the core focus of their research. They were testing whether belief change was dependent upon reasons for belief.

In contrast, Hample (1979) does touch on some of the properties of belief, when explicitly stating that belief and belief change are a matter of degree; belief is not simply a black and white thing. Hample expressed this in terms of mathematical equations and tested the idea empirically. Yet, beyond the nuance that belief is a matter of degree, Hample follows Lindeman, and Paik et al., in omitting to discuss what belief actually is. This is just a very small selection of the literature on belief, intended simply to illustrate the general trend of avoiding or neglecting definition of the key term that the literature is focused on investigating. While intuitively it does seem obvious what belief is, for academic study, it seems to be an oversight not to discuss any issues of definition and to pin down the meaning more rigorously. Indeed, as will be seen, what belief is, is what makes it important to study in the first place.

Even if, after review, the intuitive definition is the one settled upon, it will have been settled upon knowing the issues involved.

Once researchers and other thinkers do try to operationalise the concept of belief, however, it quickly becomes apparent that it is a complex and nuanced concept – yet, as already noted, simultaneously ‘obvious’ to people colloquially. This obviousness is much easier to draw upon than attempting to define belief and it perhaps explains the general tendency of the research literature to avoid or neglect defining the term. For example, in relation to this complexity, Gilbert (1991) begins by raising the question of the distinction between understanding and believing. Specifically, he states that believing means attaching a positive assessment to the thing understood, and thus belief and understanding are two separate things: “Beliefs in the broad and colloquial sense, involve both the mental representation and positive assessment of meaningful information” (p.107). However, he does not stop there and further argues that understanding actually involves at least a fleeting belief that the understood thing is true, thus adding a coupling between the two concepts. In this he takes the Spinozan view that people necessarily initially accept something as true before then unbelieving it (Spinoza, 1677/1996). This is in direct opposition to Descartes (1637/1984) view that a thing can be understood entirely separately from believing in the truth of it or not. However, although Gilbert discusses belief at length, his focus is mainly on the mechanics and less on properties, such as degree or type.

For example, it is quite common for people to be asked simply if they believe in X or not. However, this is a very black and white view of belief and a more granular approach may be needed when actually studying the topic. Politzer and Carles (2001) echo this refrain in their Artificial Intelligence approach to studying belief change. They conclude that belief, and hence belief change, is a matter of degree, rather than an all-or-nothing process. Indeed, this is something that is often implicit in research on belief, usually only made explicit via the use of scale-based belief measures, such as the Revised Paranormal Belief Scale (Tobacyk, 2004) used by Lindeman (2011). At other times the idea of degrees of belief is made more explicitly, such as in the very direct position on this taken by Hample (1979). On the other hand, the black and white idea

of believing or not believing still pertains in colloquial usage. For example, the definition of belief presented in the Collins dictionary (<https://www.collinsdictionary.com/dictionary/english/belief>, 2018) is: “Belief is a feeling of certainty that something exists, is true, or is good.” Here the term ‘certainty’ is used, which is completely contrary to the notion of degrees of belief. Dictionaries, in reflecting usage, do not always completely agree on definitions of terms, and it is also common for a dictionary to provide more than one usage, due to the nature of actual language use. This clearly underlines the need to pin down the concept more rigorously for academic study, rather than relying entirely upon readers’ understandings of the term, as much of the literature does.

Something that is perhaps rather less obvious than degrees of belief, however, is kinds of belief. Indeed, the existence of different kinds of belief has been debated, as will be seen, but overall the argument will be that there are different types. In particular two types are of interest: rational and intuitive. Those terms will be discussed in greater depth later, but for now a brief overview will suffice to raise the point that beliefs might vary in kind. It is relatively obvious, of course, that beliefs can be held regarding many different things (although it is worth reiterating that beliefs can indeed be about any state in the world and not just limited to religious beliefs, or similar topics of belief, such as the paranormal phenomena referred to earlier). Again, this is something typically left as implicit in the literature, such as in the study by Paik et al. (2009), in which participants expressed beliefs about topics as diverse as people’s personalities, animals, and the quality of news articles.

What is perhaps less obvious is that beliefs themselves might vary in kind; not only with respect to what the beliefs are about. Paik et al. (2009) focus on this in relation to category and individual information being the basis for differentially influencing belief change. However, a more fundamental difference in belief is their rational versus intuitive nature. In this vein, Sperber (1997) argued that people hold two main kinds of beliefs: intuitive and reflective, the latter mapping to the ‘rational’ type mentioned above. Sperber took the view that people tend to react to new information initially at an intuitive level; a very rapid and unconsidered response to the information. This

means that all beliefs would initially be based upon intuition on the topic at hand. Only later can reflection (i.e. deliberative rational thinking) on the topic lead to holding a rationally-based belief. Thus Sperber presents the possibility that beliefs may be held for different reasons. In the terminology of the present thesis, this will be referred to as 'belief-basis'.

Meanwhile, Alcock (2018) very explicitly distinguishes between rational beliefs and what he calls irrational beliefs, the latter being akin to the intuitive belief-basis referred to above. Alcock adds some complexity to this distinction, however, when he opines that beliefs are all the same kind of thing regardless of how they are acquired, thus taking the contrasting view that beliefs can be of different types yet underneath it is the same process involved. Finally, unlike much of the main body of psychological literature on the topic, Alcock does actually discuss what belief is, and the difficulties in defining the term. The opposite case tends to be more common, however, with different papers touching upon different aspects of belief, while leaving the core definition for the reader to provide (e.g. Hample, 1979). There is an interesting irony in this approach, where the research or theory is raising a differential factor within belief, yet at the same time the rest of the concept of belief is left undiscussed.

The present thesis will be focusing on mechanisms rather than just kinds of beliefs, however, and will be arguing, in contrast to Alcock, that the two kinds are not the same thing underneath. The beliefs used in the present research are therefore merely a tool to examine the underlying mechanisms. Specifically, the main belief topic used in the present research programme was a paranormal phenomenon (see the section on paranormal beliefs as a research tool), as similarly seen in the research by Lindeman (2011).

With respect to the various issues raised above, the thesis takes a relatively broad view on what a belief is: belief is a person's assertion about the state of the world or some part of it and this assertion may vary in the degree of confidence with which it is held. This includes beliefs about the states of other minds, future states of the world, past states, and so on. One might even hold beliefs about the truth of abstract propositions, such as in formal mathematics; beliefs need not be about concrete things. Broadly

speaking, to say that someone believes something is to say that they think the state of the world is X, to some degree of likelihood – i.e. the strength of the belief in question. Naturally, and logically, it is true that people act in the world based upon how they think the world is, social and other constraints notwithstanding. This may even extend to abstract concepts or ideologies. That is to say, because beliefs are embodied within people, who exist in the world, people act in the world based upon their beliefs. And this is what makes beliefs inherently important to study.

As will be seen, however, all too often studies on belief treat beliefs as abstract forms disconnected from the real world, only having influence inside a person's head. However, this neglects the fact that beliefs exist in people's brains, which are inherently embodied and empowered to act in the world (constraints on the individual notwithstanding). Moreover, people's beliefs are threaded throughout their interactions with the world, be they big or small. As the introduction rather dramatically put it, "beliefs power the world". However, by now it should be clear that this is not actually such an extravagant claim to make. Indeed, as Alcock (2018) notes, beliefs are pervasive in every moment of people's lives and even in their deaths.

Finally, a word on the usage of terminology relating to belief is required. Terms such as, *belief*, *view*, *conceptual change*, and so on, abound in the literature. However, the exact word used matters less than the definition. Indeed, in the present study programme there was a change in terminology from 'belief' to 'view' in the third research study, for better clarity in the materials given to participants. This was due to the cultural connotations that can surround the word 'belief', while 'view' is a more neutral, broader term, that is also closer to how academics operationalise (explicitly or implicitly) the concept of belief. Indeed, turning to the Oxford English Dictionary definition of belief, we can see the additional connotations that belief may have for people outside of academia (<https://en.oxforddictionaries.com/definition/belief>, 2018). Here belief is defined as: "An acceptance that something exists or is true, especially one without proof." This places the emphasis on lack of evidence, which implies that an evidence-based view on something is not a belief about it. Instead, belief is conflated

with faith, which is a conflation that is generally avoided in the psychological literature on belief formation and change.

Now that the argument for operationalising the term has been presented and a suitable operationalisation provided for 'belief', it is time to address the factors relevant to the present research programme. In doing so, the remainder of this chapter and the studies that follow will be reviewing literature on cognition in general as well as belief more specifically, starting with rationality, then moving on to non-rational cognition, and dual-process accounts that bring these two disparate concepts together. Finally, it presents a dual-process model of belief change for testing and then discusses the use of paranormal belief as a research tool.

The Rational Actor

In the literature on belief, phrases such as 'conceptual change' tend to reflect the idea that beliefs and belief change are ultimately the result of a rational thought process. In other words, people are often thought of as 'rational actors' in the world. People are seen as taking the facts into account in an unbiased way and evaluating them in so far as their intellectual abilities allow. This is not to say that people will never make errors due to inaccurate inputs or differences in intellectual ability. Such errors are inevitable, but the key point of the rational actor view is that ultimately it is a rational process that lies underneath all higher order human thinking, such as judgments and decision making.

Ritter (1930) perhaps put it most directly in the 1930's in his paper entitled "Is Man a Rational Animal?", to which the answer given is an emphatic 'yes'. But, the approach continues through to today, with recent studies still taking a rational actor approach. For example, Bucher, Roser, Nejasmic, and Hamburger (2014) investigated belief revision during way-finding, an activity where people navigate across the countryside between way-points. In this activity, there is a common need to update one's direction of travel since, as is so often the case, the map is not exactly the same as the territory. The activity had a fairly good ecological validity (although they did use Virtual Reality

(VR) for the study) and arguably it is relevant to the real world. However, the focus of the research was on rational factors; specifically, the structure of the initial instructions to the participants – i.e. the structure of information presented, which would then be processed by the rational actors in order to find their way through the VR exercise.

At a low level, the Rational Actor approach makes superficial sense. People's brains are in essence highly complex neural networks and neural networks are essentially complex mathematical engines in organic form. In this light, everything in the brain is ultimately mathematical, and thus rational. This might be seen as taking a view that is too low-level, however, since research taking the rational actor approach typically focuses on higher level cognition, well above the neuronal level. Nevertheless, it does serve to demonstrate that there is sense in the mathematical approach that is often found in the rational actor literature, even though the present chapter will be taking a broader view of behaviour and cognition in later sections.

A downside to this computational and highly rational approach to cognition is that it can tend to lead to investigating similarly computational and highly rational judgments and decision-making scenarios. The research by Bucher et al. (2014), referred to above, is in fact marked out as distinct from other rational actor research by its use of a realistic scenario and presentation mode. In contrast, Elio and Pelletier (1997) provide a more classic example of the rational actor approach. In their study they asked people to make judgments about sentences that were either problems of modus ponens or modus tollens inference. Modus ponens is defined as: $P \text{ implies } Q$, and P is true, therefore Q is true. For example, if Jane gets another sale then she will get a bonus this month ($P \text{ implies } Q$). Jane got another sale (P) therefore she will get a bonus this month (Q). Whereas modus tollens is: $P \text{ implies } Q$, but Q is not true, therefore P is not true. Since we can infer that if P always causes Q , then if Q is not true then P is not true either. For example, on Fridays Jane buys donuts ($P \text{ then } Q$). Jane has not bought donuts ($\text{not-}Q$) therefore it is not Friday ($\text{not-}P$). As should be clear, people in such studies are often being asked to make judgments on which clear logical evaluation can be made; the participants are either right or they are wrong when making their judgment.

This also provides a good example of the dangers of leaving belief undefined in literature on belief formation and change. The paper refers to beliefs and the title is “Belief change as a propositional update”. However, many lay people would see it as making judgments not forming beliefs. As mentioned earlier in the chapter, however, lay understanding of the term does not always equate with academic usage and the present thesis would consider such judgments to be acceptable under the umbrella of ‘belief’, although beliefs with greater real-world relevance are to be preferred (see the section on *Paranormal Beliefs as a Research Tool* later in this chapter).

Another classic example is provided by McFarland and Thistlethwaite (1970). In this instance they used syllogistic reasoning tasks, although they were presented in a longer format than is typically the case, in order to make them appear less like pure logic questions. For example: “An increase in American foreign aid to African countries would retard the growth of communism in those countries. American foreign aid to Africa will be increased. The growth of communism in African countries will be retarded.” (p.135). Boiled down to its essence, however, a syllogism is similar to modus ponens, but specialised into having a major premise, a minor premise, and a conclusion. A typical presentation is with a category as the major premise and an individual item as the minor premise. For example: all flowers require water (major premise). A rose is a flower (minor premise) therefore a rose requires water (conclusion). Rewritten as modus ponens gives: If it is a flower it requires water (P implies Q). A rose is a flower (P) therefore it requires water (Q).

The paper also illustrates another feature often found in rational actor literature. Beyond the tendency to focus on rational topics and judgments, there is naturally a tendency to describe belief using rational systems, such as formal logic. This makes sense if human cognition is indeed thought to be rational. McFarland and Thistlethwaite (1970) illustrate this via their use of formal logic notation to model the effect of ‘persuasive statements’ on participants (said statements were actually syllogisms as illustrated above). So the rationality of the rational actor approach is seen right through from how the research is approached to how the results are expressed and theories built.

Finally, as with Elio and Pelletier (1997), the paper refers to the research as being about belief revision. However, a lay person may interpret it as simply evaluation of a logical statement; a judgment upon which belief is not required, since the evaluation itself suffices. For an academic, in contrast, when a person makes a judgement about something they thus hold a belief about it – the person believes or does not believe that X is the case and how they got to that belief state does not invalidate the fact that it is a belief state. Once again, this sort of belief is within the broad remit set by the present thesis.

In contrast, some of the papers taking a classical approach do try to use more realistic material, applying more to the real world. For example, Hample (1979) asked for opinions on questions relating to student cycle paths, the job market, and tenants' rights. To an extent, McFarland and Thistlethwaite (1970) also attempted to do this, but Hample did not use pure logic in the guise of relevant topics. Instead Hample used fake radio and news excerpt transcripts alongside the questions being asked. Nevertheless, the point was merely to introduce the presence of such messages rather than investigating anything to do with the nature of the messages themselves, the latter being something that the present thesis will become very much concerned with. Like McFarland and Thistlethwaite, Hample also concludes with the presentation of a mathematical model of belief and belief change.

The classical approach to humans as rational actors in general is illustrated particularly well by reviews and theoretical papers, such as the one by Schulte (2002). The paper provides a review of logic and mathematical models on the topic of belief change, and from the very start it epitomises the classical approach, with its title "Minimal belief change, Pareto-optimality and logical consequence". Should the reader still be in any doubt then the first line of the abstract clears this up for them: "A rational agent changes her beliefs in response to new information..." Note the terms 'Rational', 'agent', and 'information' – like ants and weather systems, the assumption is that people are mathematically predictable, at least in theory if not in practice, and that this is thanks to the fact that human beings are rational actors. Should the reader continue to read the rest of the paper they will find it much as they would expect it to be. This

in itself is a compliment on the focused writing of the paper, but at the same time it is also indicative of the limited focus of the field as a whole.

Indeed, this is not just the view of one pair of authors, nor is it an anachronism from 1970s research, prior to the 'emotions revolution' (Weber & Johnson, 2009). A good summary of the position is provided by Hansson (2017):

“In the logic of belief revision (belief change), a belief state (or database) is represented by a set of sentences. The major operations of change are those consisting in the introduction or removal of a belief-representing sentence. In both cases, changes affecting other sentences may be needed (for instance in order to retain consistency). Rationality postulates for such operations have been proposed, and representation theorems have been obtained that characterize specific types of operations in terms of these postulates.” (p.1)

While this is only a summary, not a specific theory, the focus on the rational actor is clear: a lack of non-rational factors, and maintenance of internal consistency, for example. With densely packed prose heavily weighted with rational terminology such as “database” and “representation theorems”, it perfectly encapsulates the rational actor approach and literature style. It will be seen later in this chapter that the internal consistency element has not been supported in research on belief outside of the rational actor sphere. However, for now it is worthwhile as an illustration of the view, that people are inherently rational even when it comes to something like ‘belief’, which some, such as Alcock (2018), might label as being irrational at times.

However, not all literature on the rational actor hypothesis is as extreme as that presented so far. Clearly research into human beings as rational actors need not be constrained to problem solving in classic logic or making judgments about sentences, even though much of the literature may conspire to give this impression. As has already been seen, for example, Bucher et al. (2014) used VR to look at belief revision during wayfinding, while retaining a rational actor focus. Another example that has already been touched upon is category congruence. Paik et al. (2009) found that beliefs formed based upon category information rather than individual information were

more likely to change in response to disconfirming information that was also category-based. This paper provides a good example of one that is not directly referring to the rational actor model, but is still taking that approach. By focusing on rational factors, such as category/individual level, the implication is that people's cognition is processing rational information rationally. Similarly, Lange and Fishbein (1983) critique other rationality based judgment and decision making (JDM) literature for not taking categories into account, although their rational actor approach is slightly more direct in that they focus on putting factors into an equation to model belief formation and change. And, of course, these factors exclude non-rational ones. This is assuming that one accepts that the act of categorising is a rational cognitive process, albeit that the categories themselves could be categories of things that are non-rational, such as fantasy creatures.

Other twists on the classical rational actor approach include an interesting one from Mandel (2014). In this paper, Mandel argues for the value of external visualisations to aid reasoning. The theory is that the visualisations externalise some of the demands of a problem, thereby freeing up additional working capacity for manipulating and processing the problem at hand. This, of course, still follows the idea, and in fact emphasizes the idea, that the people are processing the information rationally – hence the reason why freeing up processing resources should improve performance. Indeed, it was already noted at the start of this section that the rational actor approach does not actually assume people will perform flawlessly all of the time, if ever. It is more akin to assuming that once the experimental 'noise' has been removed, people are ultimately rational thinkers beneath it all.

This leniency from the rational actor approach is illustrated by a proposal from Bleile (2014), which has similarities to the 'frame problem' in Artificial Intelligence (AI). The frame problem in AI proposes that a major issue for robots operating in the real world is the sheer amount of information that needs to be processed (Brown, 1987). Using first order logic this would simply be overwhelming. Bleile's proposal can be seen in a similar light, but applied to human beings instead of robots. The premise is that, even though people have a much more powerful way of processing the information than

resorting to first order logic, the amount of information is still overwhelming and it cannot all be taken account of. Bleile proposes that a chief determinant of what information is taken into account is past experiences. This goes some way to explaining why different people faced with the same problems may make different choices even if processing the information completely rationally. Their paths leading up to the decision will have been different and therefore if the amount of information that needs taking into account is large enough, their past experiences will direct their focus, influencing the final outcome. Ultimately then, from this more lenient perspective, people are seen as resource-limited rational actors making the best decisions they can, based upon the information brought into focus via the influence of past experiences. Seen in this light, belief change might be path-dependent – likelihood of belief change may be due to how a belief was arrived at in the first place.

Anderson and Rausch (2009) take this further by actually including non-rational factors, such as desire, in their proposal. However, they include such factors in their model only as inputs to an ultimately rational process of cognition – what they refer to as a ‘rational model of common sense choice’. The proposal therefore demonstrates how non-rational factors can be integrated into an underlying rational model of cognition, without sacrificing the rational actor. By placing such non-rational influences as ‘desire’ outside of the model, the proposal gains the ability to explain apparently non-rational behaviours, while retaining a rational core of human cognition. Once again, people are seen as rational albeit that they are rational actors subject to imperfect inputs for processing.

McFadden (1999) adds another dimension to this view in his paper on rationality for economists. In it he argues that so-called non-normative behaviour by people in various situations is caused by misperceptions, which in turn leads to misframing of the situation – that is to say that people are thinking rationally, but they have accidentally gotten the problem situation represented incorrectly in their head or they are making errors in retrieving details relating to the problem solution. So in this case it is not simply that the inputs are of poor quality or incorrect, but that the person is

liable to the error of framing the problem situation incorrectly which, regardless of the quality of the inputs, leads to an incorrect (i.e. non-normative) outcome.

One thing often missing from the literature reviewed so far, however, are the mechanisms that would underlie these rational thinking processes. How, for example, is it decided that something is true or false, or that a certain input should be weighted in a certain way? A common approach to this problem is the application of probability theories. As in the paper by Morris (1996), people are deemed to have various probabilistic beliefs modelled in their minds. This aligns with the present thesis' assertion that beliefs are a matter of degree, but takes it a step further in trying to include this in the model of belief formation and change very directly. It is also compatible with Bleile's (2014) idea that prior experiences shape future decisions. In Morris' terms, these prior experiences are manifested as a set of beliefs each with a probability attached. These probabilities will be included in any current processing and evaluation of new information, including the selection of what information is most relevant to focus on – it is cognitively easier to build upon existing information (even if it is incorrect) than to start from scratch. Here, of course, Morris is still omitting non-rational factors from the probability modelling.

However, this is not always the case. For example, Stelios (2016) presents a classically dense rational actor paper on JDM, with a heavy emphasis on mathematical modelling, including a comparison of the model with the Bayesian framework. The Bayesian approach uses prior probabilities to influence assignment of new probabilities or revision of existing ones, and in this sense links with the ideas of Morris (1996) and Bleile (2014). However, despite its mathematical focus the author does attempt to explicitly bring in non-rational factors. This is achieved via a factor referred to as 'credibility of the speaker'. While this includes evaluative data, such as the speaker's authority on the topic, it is explicitly included as something that the hearer (the participant) may make an intuitive, instant judgment about.

In summary, the rational actor approach posits people as being rational actors in so far as their intellectual resources and the available information allow. This rationality is echoed in the way that the study of the topic tends to be approached and the ways in

which theories are expressed. Theories are often expressed as mathematical models and the materials used tend towards the abstract or rational, such as judging the truth of syllogisms or the movements of shapes. Exceptions to this are also present in the literature, but they retain the rationality focus. Typically, this consists of eschewing non-rational factors even while they critique other researchers for ignoring various rational ones, such as categories. However, taking the rational actor approach does not mean that people are viewed as flawless reasoners, only that they are ultimately following rational processes albeit not always perfectly, due to reasons such as intellectual ability, inaccurate informational input, or incorrect framing of the problem situation. Indeed, there are even some models of belief in the rational actor literature that allow for path-dependency in belief formation and change. This is interesting because in general if all thinking is rational then the same cognitive processing is in play at belief formation as it is at belief change. However, models that incorporate prior beliefs – i.e. the path to belief formation – allow for path-dependency of belief change, while also retaining the rational actor at the core of the approach.

Finally, despite various criticisms levelled in this section, such as omission of non-rational factors, it must be acknowledged that the rational actor view has endured for a long time. Indeed, it certainly has plausibility, as arguably people *can* act rationally, and as has been seen there is a large amount of literature demonstrating how people conform to rational models of thinking and belief. What is missing, however, is a better understanding of the contribution of non-rational factors to thinking and belief, and whether these factors contribute merely as inputs or as part of the cognitive process itself.

The Non-Rational Actor

In contrast to the literature on rational actors, the literature in the vein of the ‘emotions revolution’ (Weber & Johnson, 2009) is peppered with terminology such as ‘valence’ and ‘affect’. However, emotion is a limited term in this context and more broadly it can be better to speak of non-rational as the simple opposite of rational (later in the

chapter the term 'intuitive' will be favoured, but for now, non-rational is most appropriate). This allows for the discussion of factors in cognition outside of just emotional responses or influences. Nevertheless, much of the material does focus on the feelings involved – typically positive or negative, or simply level of arousal – and this is included in 'non-rational' as well. Briefly, non-rational cognition does not follow rules of pure logic or mathematics, and in doing so may go against the normative (logically correct) responding that rational actor theories presume to be the goal of people's cognitive processes. There is a trade-off here, however, and it is typically one of speed and resources – non-rational thinking tends to take less time and by that token also consumes less energy. However, as will be seen, it is not inherently necessary that non-rational thinking will produce errors or even depart from normative responses (e.g. Kruglanski & Gigerenzer, 2011), although inevitably it does allow more room for this sort of thinking error to occur.

However, before continuing, it is important not to confuse non-rational and irrational thinking, although the terms are sometimes used interchangeably, such as in Alcock's (2018) use of the term 'irrational belief'. For the purposes of maintaining clarity in the present thesis it is important to be clear on the difference between normal cognitive processes and unhealthy ones. In this light, non-rational will refer to a myriad of behaviours by perfectly healthy normal individuals. These are behaviours and thinking that people do all the time, day to day; indeed, it will be shown that it is far from being the exception that people behave in these ways (contrary to how the rational actor model paints people as being). In contrast, people described as behaving irrationally are generally demonstrating a less than healthy mental state, which may be temporary or longer-term. As noted the term is used sometimes to mean non-rational but for the purposes of this thesis irrational will be taken to be a particular subset of non-rational thinking. Specifically, the present thesis will be excluding irrational thinking or behaviour and focusing upon normal cognition.

As noted at the start of this section, research on non-rational cognition and behaviours – the non-rational actor hypothesis, so to speak – often focuses upon affect. Indeed, one of the classic findings is that affect provides information (Schwarz & Clore, 1983,

2003). This appears remarkably close to some of the rational actor theories that treat non-rational factors as merely inputs to the underlying rational processing: affect is literally information to be processed rationally. The difference here, therefore, is largely one of the perspective being taken and the primacy given to the non-rational factors ahead of rational ones. The classic study in this area was conducted by (Schwarz & Clore, 1983). They had people rate how happy they were with their life and found that this correlated with whether people were in a good mood or not. This, in turn, was influenced by the weather being good or not. This simple meteorological difference made a significant difference to the way people evaluated their life in general, not just their life at that point in time. This is a striking conclusion in comparison to that predicted by rational actor theories. It implies that non-rational influences shape the whole thinking process and are not merely information to be crunched. In theory, a rational actor should be discounting the affective information as relevant only to the present and thus irrelevant to the general case that they are being asked to evaluate. Yet the influence of the affect extends beyond the current moment, implying that such factors may be more closely intertwined with thinking processes than previously supposed. This is taking the results of the study slightly further than Schwarz and Clore did at the time. However, in a later paper they argue that affect and cognition are interrelated, not independent (Storbeck & Clore, 2007). By this they do not mean, as Sperber (1997) did, that the one follows the other, but that they are truly interrelated.

Such research as this might suffer the accusation of not including enough rational factors, the reverse of the critique of much rational actor research. However, generally the focus is to control for other factors and demonstrate that non-rational elements are present rather than to present an overarching model of an area of cognition, as is often the case in rational actor theories, which have a strong tendency to present models. Indeed, noting this shift in focus towards research into non-rational thinking, Weber and Johnson (2009) coined the term the 'emotions revolution' as counterpoint to the earlier cognitive revolution.

However, just because people act non-rationally at times does not mean that their behaviours cannot be explained mathematically and perhaps this element of the rational actor approach might survive even in the realm of research into non-rational thinking. Charpentier, De Neve, Li, Roiser, and Sharot (2016) presented a paper taking just this approach. Using models to predict choices, they concluded that models that include feelings about things are better predictors of choice than purely value-based models. However, an alternative is that it is simply not always possible to describe or explain behaviour using mathematics or modelling and this is the view taken by Baker (2008). Baker does not directly argue for non-rationality, yet also does not take a rational actor stance. Instead, Baker argues for what could be termed a 'practical rationality'. That is, things can be argued to be rational in pragmatic terms, such as a person's propensity towards a particular type of action (in which case it is perfectly rational for them to behave thusly). Rather than requiring reasons to be expressible in logical form, Baker argues that attempting to express reasons for actions in such a formal way would actually distort them.

Indeed, the tendency in the literature on non-rational cognition is not to attempt to present mathematical models. However, this may be more due to the nature of the topics and their influence on the approaches used than it actually being impossible to model such behaviour mathematically or not. Indeed, whether this is the case remains an open question. What does not remain an open question, however, is that people do think non-rationally and, as will be seen, it is arguably the norm rather than the exception. Indeed, there are known to be a number of heuristics and biases present in normal cognitive processing, due simply to how the brain works (Kahneman, 2003; Tversky & Kahneman, 1971, 1974), heuristics being mental short cuts that people use unwittingly in their day-to-day cognition.

As will be, seen, this sort of speedy, rule-of-thumb thinking has evolutionary advantages and does not always produce errors. However, it can do so, and one classic example is the conjunction fallacy, which is a thinking bias that occurs due to applying the representativeness heuristic inappropriately (Denes-Raj & Epstein, 1994). For example, in the classic Linda Problem (Tversky & Kahneman, 2002), the Linda of

the title is described in a way that is more representative of a feminist than a bank teller – participants have no problem using the representativeness heuristic to make the not unreasonable judgement that Linda is more likely to be a feminist than a bank teller. However, in this case 85% of participants rated it more likely that Linda was a 'feminist bank teller' than a 'bank teller', whereas in fact there is more chance of Linda being a bank teller in general than specifically a feminist bank teller. As it stands, this might be explained by rational actor models as participants framing the problem incorrectly, as a representativeness problem rather than a conjunction problem – either problem being relatively easy to solve on its own. However, the effect persisted for 57% of participants even when it was made explicit that 'bank teller' includes both non-feminist *and* feminist bank tellers.

This result is hard to explain in terms of inaccurate problem framing, since participants had access to both frames. Yet the representativeness heuristic, a non-rational rule of thumb, won out over the normative rational response. Indeed, Kaiser, Field, Jonides, and Alexander (1986) showed that even when people perform well on solving one problem, it does not predict their performance on another closely related problem. For example, when asked to predict the path of a ball from when it exits a curved tube, it was surprisingly common for people to predict a curved path instead of the straight path that the ball would actually travel. This occurred even after people had *correctly* solved the problem of the path that water would travel when exiting a curved tube. Despite the problems being physically and structurally identical, the ball problem was harder to solve. Indeed, the only difference between the two problems is that the water one is more familiar to most people. It therefore seems that they are solving it by referring to experience, but that this experience is not generalising to a related problem. This is hard for most rational actor theories to explain, since the relevant information is present and ought to be tagged with a high relevance, since the problem is structurally the same - in fact, the only difference is a ball instead of water so there is plenty to cue the use of past experience in a similar situation (cf. Bleile, 2014).

However, as well as making poor predictions about the behaviour of objects in the physical world, it turns out that people are just as bad at making predictions about

their own behaviours. For example, Nisbett and Borgida (1975) found that people disregarded base-rate information when predicting what their own actions would be likely to be. That is to say, even when participants knew the likelihood (base-rate information) of someone doing something in a given situation, it did not influence what they predicted they would do in that situation. There were two such situations in Nisbett and Borgida's study: the first was about a study where people administered dangerously strong electric shocks in a learning study, and the second was about people failing to help someone in serious distress in another room, who they could hear over an intercom calling out for help. In the first case, participants rated themselves less likely than the average to give strong shocks and in the second case more likely than average to help. This in itself is not particularly surprising as people naturally prefer to think of themselves as good people. What was surprising is that compared to not knowing the base-rates, knowing the base-rates made no difference to people's self-predictions; the rational information was completely disregarded in favour of the bias towards maintaining self-image. Contrary to rational actor models, the non-rational 'information' was not simply modifying the weight given to the rational information, it was overriding it completely.

It is worth noting that most psychology research is done with university students (McNemar, 1946; Smart, 1966) and therefore it seems unlikely that such thinking is down to lack of intelligence. However, it might be argued that, even within such an elite population, intellect does vary. In answer to this, Stanovich and West (2007, 2008b) present studies demonstrating that falling foul of cognitive biases does not occur because the participants were less capable. Measures of intellect and cognitive abilities, such as SAT scores, did not correlate with the likelihood of making thinking errors. Research such as this suggests that non-rational cognition is fundamental to the human condition, in direct contradiction to the rational actor view. Of course, if such thinking is inherent to the human condition then it should also influence belief formation and change.

However, when giving examples like the ones given so far there is a risk that the reader comes away with the impression that non-rational thinking, such as the use of

mental heuristics, always leads to thinking errors. This is not at all the case, however, and, in fact, such heuristics exist *because* normally they produce accurate, or good enough, results (Kruglanski & Gigerenzer, 2011). Indeed, it is only by studying when they produce incorrect results that it is possible to know they exist and that not all thinking is rational. Clearly, there is good evidence for non-normative thinking in normal everyday cognition. And this conclusion is also supported by Shafir and LeBoeuf's (2002) review of literature arguing that research demonstrating non-normative behaviours is flawed, for various reasons, including theoretical assumptions and the materials used (e.g. causing participants to frame a problem incorrectly). They conclude that the critique of the rational actor view, similar to the critique given in this chapter so far, is a 'compelling' one.

Unlike this chapter's earlier review of the rational actor literature, where the term 'belief' was widely found, the non-rational actor literature that has been reviewed has focused largely on behaviours. Nevertheless, if people's thinking processes can be non-rational then it follows that beliefs would also be influenced by non-rational factors, such as affect or heuristics. Indeed, this was a motivating premise for the current research programme and a model relating to this will be tested. However, first the review will cover some specific examples of non-rational belief, followed by some examples of the new wave of research into belief that takes non-rational cognition as a primary focus.

Perhaps the most striking example of non-rational belief is when it co-exists with rational belief. For example, Legare, Evans, Rosengren, and Harris (2012) found that people in the Zande tribe could hold both rational and non-rational (magical) beliefs about the exact same phenomenon. In this case, the belief related to the tall grain stores that were used both to store grain and to shelter under. Inevitably sometimes a grain store will collapse, perhaps because of termite damage, and people might be killed. The Zande understood perfectly the physical reasons for the collapses: the structural weakness accruing over time. However, they also held the belief that witchcraft was responsible for specific people being there at that specific time. So, on the one hand they believe the granary collapses due to structural weakness and that

this could happen suddenly at any time, causing loss of life. While on the other hand, they attribute particular deaths to magic. It is more than just 'how' something happens that is important; 'why' it happens is just as important, if not more important. The physical reasons explain 'how' the granary comes to collapse. But, this leaves the question of 'why' at that particular moment? This void is filled with a paranormal explanation.

In rational terms, there is no need to ask the second question, but people do not always believe in things for rational reasons. Indeed, even strong rational counterevidence, such as the world not ending when it is prophesized to, may fail to change belief (Sauvayre, 2017). While the exact mechanisms behind such failures of belief change are still under debate, the fact that beliefs continue to be held for non-rational reasons is not. Such failures of belief change are taken to demonstrate that people are holding non-rational beliefs, because those beliefs are held in contrast to overwhelming rational evidence against the belief.

As noted by Weber and Johnson (2009), there has been something of an 'emotions revolution', a term that they use as akin to the cognitive revolution that followed on from behaviourism. This is reflected in the research on belief, which has seen a greater acceptance of non-rational factors and processes within the research literature. For example, Sharot et al. (2012) looked at the good news/bad news effect, where people tend to update their internal beliefs more when encountering favourable information. In their study, they disrupted the inferior frontal gyrus (IFG) and found that this helped to reduce the good/bad news effect. The importance of this latter detail is not in where the disruption occurred, but rather the implication regarding non-rational thinking being manifest in the brain processes and not merely a type of 'input' into an underlying rational processing core. Additional neuroscientific support for the influence of valence comes from Moutsiana, Charpentier, Garrett, Cohen, and Sharot (2015), whose study revealed differences in the processing of favourable and unfavourable information in relation to belief updating. Again, the specific circuitry that they propose is less important than the implication that comes with it about the

nature of non-rational thinking processes being part of normal thinking rather than just an input to it.

However, valence is perhaps a relatively easy feeling for people to access and a stronger test could use something more subtle so that people are not aware of its influence or even its presence. To this end, Reber and Greifeneder (2016) review the literature on metacognitive effects and affect on belief formation. They argue that fluency, in particular, influences belief formation - if it is easy to process (high fluency), then it must be true. Fluency might be manipulated by making something easier or harder to read by manipulating the font, for example. Or, in the case of a study by Danziger, Moran, and Rafaely (2006), ease of retrieval was manipulated by requiring retrieval of more or fewer items (see also: Simmons & Nelson, 2006). Participants were asked to come up with positive things to say about something and then asked to make an overall evaluation. Retrieving more items is mentally harder than retrieving fewer items, but overall produces a greater number of positive reasons to like the thing in question. One can imagine this applied in the context of being asked to state reasons to like a newly released soft drink or home appliance, for example, and it would be expected that a greater number of positives retrieved would lead to the formation of a more positive view about the product. However, the opposite was actually true. It was the amount of mental effort (the fluency) that actually influenced participants' final evaluations. Those who had come up with a greater number of positives actually gave the least positive final ratings. Whereas those who experienced greater fluency (less cognitive demand) were more positive in their final ratings. These findings strongly suggest that belief formation involves a non-rational component and, in combination with the neuroscientific evidence, that this component is part of the thinking process capable of overriding other parts of the process, rather than being a mere contributory to it.

Another way of manipulating beliefs is by manipulating how something is framed. The key difference from the previous examples is that this does not involve valence or affect; emotions need not play any part. For example, a common belief in basketball and volley ball is the hot-hand belief (Gilovich, Vallone, & Tversky, 1985). This is the

belief that if someone has been shooting well then they have the 'hot-hand' and will continue to shoot well on their next shots. In actual fact, this is down to clusters in random series rather than any actual hot-hand effect, but it remains a prevailing belief due to the compelling nature of the brain to detect patterns even where none exist (Dagnall, Parker, & Munley, 2007; van Elk, 2015). However, Raab and MacMahon (2015) demonstrated that this belief can be manipulated by framing effects. The study used videos of basketball play that differed in terms of the perspective the video was taken from (an observer in the stands or a non-active player at the end of the court). They found lower rates of hot-hand belief (and related allocation behaviour) in the observer perspective condition.

These sorts of findings, where only a video angle is manipulated or fluency is manipulated, are not easily explained as due to individual differences in cognitive ability – i.e. being less capable of using the rational information appropriately. Indeed, Schwitzgebel and Cushman (2015) demonstrated that even experts make the same mistakes as lay people. Their research looked at ethical problems, such as the classic trolley problem and Asian disease problem. This is effectively like asking people about their moral beliefs. In the trolley problem, the decision must be made whether to divert a train trolley down one track or leave it on its current path. If it is diverted, it will kill a person who is stuck on that branch of the track. If it is not diverted, however, it will kill 5 people on the other branch of the track. This pits people's sense of the prerogative to protect life against the blame associated with action or inaction. It is a classic ethical dilemma, the normative answer to which is to kill as few people as possible – not an ethical dilemma that specialist ethics philosophers should have a problem with. This can be framed in different ways, however, indicating greater physical closeness or distance and greater differences in terms of actively putting someone in harm's way rather than diverting something towards them. They therefore presented three trolley scenarios: switch, push, and drop. Switch is the traditional option described above. Push is to push a heavily laden hiker into the path of the trolley to stop it (the person themselves is not heavy enough to stop the trolley; they must sacrifice the hiker not themselves to save the five people). And finally, the drop option is similar to switch, but drops someone onto the track to stop the trolley from

killing five people. Structurally, these are all the same problem and rationally the actions should all be rated as equally morally bad. Nor should it matter what order the scenarios are presented in. What Raab and MacMahon (2015), in fact, found was that the experts were no more immune to framing or order effects than non-experts. It was not the case that experts gave equal ratings to all of the scenarios, nor was it the case that the experts were consistent in their ratings irrespective of the order of presentation. In reality, the experts did not differ in their responses from the lay people in the study. This was the case even though participants were not rushed to make a response so that there was no limitation of cognitive resources (as there is in some other examples that will be given later).

In summary, this section has presented strong evidence that people are not rational actors all of the time. Rather, people's thinking, behaviours, and even their beliefs can be influenced by non-rational factors, such as affect, valence, and framing. These results pertain despite level of expertise or general intellectual capability, and there is also evidence to suggest physical locations of related processing in the brain (further examples in this vein will be given later in the chapter as well). These results cannot be explained by rational actor models of belief and in combination they present a case for non-rational thinking being an inherent part of people's normal thinking processes, rather than an adjunct to an underlying rational thinking process as proposed by many rational actor theories. Such factors therefore need taking into account when developing theories of belief formation and change, such as the one tested in the current research programme.

Dual-Process Accounts of Cognition

The evidence for people's non-rational thinking and behaviours is strong, but so is the evidence for their rational thinking and behaviours. More recently researchers and theorists have, therefore, been taking a dual-process approach to explaining cognition. Dual-process theories essentially agree on a split between intuitive cognitive processing and rational cognitive processing (Epstein, 1994; Lieberman, 2007; Sloman,

2002; Sperber, 1997; Stanovich & West, 2008b; Tversky & Kahneman, 2002; Wegener & Chien, 2013; Zajonc, 1980). While the terminology varies (e.g. associative vs rule-based and reflexive vs reflective), the basic distinction between the types of thinking are the same. Intuitive thinking is rooted in feelings and experience, while rational thinking is deliberative thinking that is largely affect-free. The present thesis will be using the intuitive/rational terminology and a little clarification is required regarding this.

The term 'rational' has already been sufficiently covered in this chapter and no more time will be spent on discussing it here. However, some clarification of what is meant by 'intuitive' cognition is perhaps required. So far in the review the reader has encountered terms such as 'affect' and 'non-rational', but very rarely the term 'intuitive'. As well as not being present very often in the literature reviewed so far, this term was, in fact, deliberately avoided so that its operationalisation could be dealt with properly. In short, the thesis uses the term intuitive because the other two terms (non-rational and affect) are not quite sufficient to address the needs at hand. The term 'non-rational' is too broad and 'affect' is too narrow. Non-rational is a very broad term, which at times makes it very suitable. However, being the negation of rational, means that it encompasses randomness and irrational thinking, which are not things that dual-process theories or the present thesis are trying to explain. The thinking of healthy people when making any meaningful judgment is rarely random and nor do they tend to think in irrational ways (a term which this thesis uses to refer to mentally disturbed thinking). Meanwhile *affect* is a term limited to feelings, which does not include heuristics or cognitive biases, such as those reviewed in the previous section. A different term is needed and the most appropriate one used in dual-process literature is 'intuitive' cognition. This encompasses affect, valence, heuristics and biases, and so on, occurring in normal healthy individuals, but excludes irrationality or sheer randomness.

It also includes personal experience. Personal experience is included under intuitive cognition because the reality judgement about personal experience arrives immediately and fully formed without any need to process it further, although such processing can be applied afterwards. As was discussed earlier, heuristics, such as trusting personal

experience, make sense since otherwise people's navigation through the world would be tortuously slow and dangerous (Kruglanski & Gigerenzer, 2011). Necessarily, personal experience is also highly compelling, since continuously stopping to ponder one's perceptions would not only slow one down, but would also prove evolutionarily disadvantageous. Pausing to ponder the existence of the tiger crouching to pounce is a sure way to have one's genes removed from the pool. People therefore tend to think of personal experience as good quality 'evidence'. Indeed, the legal system places a great deal of weight on eyewitness testimony. This is despite its known fallibility, with 80% of cases that were overturned due to DNA analysis, originally being convicted on faulty eyewitness testimony (Wells et al., 2000). Personal experience is therefore included under the umbrella of intuitive thinking, as reliance upon it is akin to the reliance placed upon other heuristic thinking processes. Perception of the world is necessarily indirect and inaccurate, but trusting this personal experience comes easily without rational reflection and for the most part trusting the accuracy of personal experience is a good rule of thumb to follow. However, as with other heuristics, it may also lead people astray, since although people are not enslaved to believing that all personal experiences are accurate reflections of the state of the world, the tendency is to go with this fast and energy efficient heuristic judgement.

Finally, a word on affect is needed before continuing. While affect comes under the umbrella of intuitive cognition, the current thesis will not be requiring affect to be present in order for thinking to be counted as intuitive. However, according to a review on research into intuitive thinking, this is not always the case in the research literature on intuition (Hodgkinson, Langan-Fox, & Sadler-Smith, 2008). In fact, affect is quite commonly cited as a necessary component of intuitive thinking. Hodgkinson et al. cite Dane and Pratt (2007) as defining intuitions as "...'affectively-charged judgments that arise through rapid, non-conscious, and holistic associations'" (p.4 in Hodgkinson et al., 2008). Furthermore, they state that they feel this statement captures the nature of the reviewed research well. However, as has been seen earlier in the chapter, intuitive thinking includes heuristics and biases, which do not require affect to be present (at least, not any more than affect can be said to be present at any time in decision making or belief, since it is hard to imagine its complete and total absence.

Even personal experience need not involve substantial amounts of affect). One can be 'cold and calculating', for example, instead of 'passionate and emotional'. The term 'affectively charged', used by Dane and Pratt, therefore seems to limit the study of intuitive thinking to the study of emotion or other feelings rather than cognitive processing more broadly. In contrast, dual-process theories of cognition include intuitive processing, such as the application of heuristics, in addition to affect-laden thinking, and personal experience.

A number of dual-process theories have been put forward, some more detailed than others. One of the suggestions already encountered on more than one occasion in this chapter comes from Sperber (1997). Sperber's idea of dual-processing was a sequential one, however, with rational processing following only after intuitive processing has had its effect. This perhaps is useful in explaining very low-level processes, such as perceptual illusions. For example, whilst it is extremely hard (if not impossible) to avoid being fooled by a visual illusion such as the Müller-Lyer, one can nevertheless disregard it as an illusion, either by knowledge of the illusion or by measuring the lines and discovering its illusory nature directly. However, the general trend in dual-process theories is to focus on higher level cognitive processes and for the two types of processing to be independent rather than sequential, although, as will be seen, there is also a general tendency to regard intuitive thinking as having primacy and rational thinking to be harder to activate.

Kahneman, for example, proposes a two-system approach to explaining cognition, with System-1 being intuitive and System-2 being rational (Kahneman, 2003; Tversky & Kahneman, 1971, 1974, 2002). The theory is largely based upon the results of research using exclusion problems, such as the Linda problem, where people have to *exclude* one piece of information (in this case representativeness) in order to get the correct answer. Typically, this means people are presented with rational and intuitive information and have to exclude the latter in order to provide the normative response. For example, in framing problems people are required to exclude surface features, such as pulling a lever or pushing a hiker into the path of a railroad trolley, and focus on the underlying problem structure. In other words, the theory is largely built upon

observations gained from pitting people's two processing systems against each other, often by requiring people to exclude information that is appealing to System-1. The conclusion is that System-1 has primacy and is also much faster than the slower System-2, which patiently waits for when System-1 hands over control due to encountering something outside of its heuristic abilities to handle. The main argument for the primacy of System-1 is that it is evolutionarily advantageous to use rapid, generally accurate, heuristics, which use minimal energy resources (see also: Kruglanski & Gigerenzer, 2011). Time and energy are both critical commodities for survival and passing on of genes. Too much energy spent on rational thinking means energy that cannot be used on other vital survival demands, such as running away from the crouching tiger. Similarly, taking one's time is a luxury when food is scarce and predators are quick. Decisions often need to be made in real-time, often in an instant; as epitomised most famously in the fight or flight response. Based upon these advantages, intuitive thinking would be expected to evolve first.

There is some neuroscientific evidence for this type of systems view from research by Satpute and Lieberman (2006). They found that intuitive and rational thinking activated different areas of the brain and thus different 'systems'. Furthermore, rational thinking was largely constrained to the cortex and hippocampus whereas intuitive thinking included evolutionarily older areas, such as the amygdala and basal ganglia. They ultimately proposed a dual-process theory that they call the X/C system, where the X-system is reflexive and the C-system is reflective – i.e. intuitive and rational (Lieberman, 2007; Lieberman, Jarcho, & Satpute, 2004).

In contrast, Stanovich (Stanovich & West, 2008b) argues that taking a systems view is not justified at this point in time. Indeed, while the neuroscientific findings discussed above are impressive, it must be noted that they come from the same set of researchers and that neuroscience of brain region activations is fraught with technical difficulties (Lyon, 2017). Stanovich argues that the brain is highly interconnected and it is better, at this point, to think of types of processing instead of systems, to which end Stanovich proposes type-1 and type-2 processing, mapping to intuitive and rational thinking

respectively. Beyond this difference, however, Stanovich's conception of dual-processing is very similar to that of others.

Finally, Epstein presents a dual-process theory called Cognitive-Experiential Self Theory (Epstein, 1994; Epstein, Pacini, Denes-Raj, & Heier, 1996). The theory is less wedded to the idea of systems vs types of processing and more generally refers to cognitive style. A key difference is, however, in the development of a measure in relation to the theory. The Rational-Experiential Inventory (REI) is used to measure preference for rational and intuitive thinking styles. Encouragingly, as predicted by CEST, the intuitive and rational subscales were found to be independent rather than poles at either end of a continuum. If the dual-process account, in general, is correct then this obviously has implications for belief formation and change, such as beliefs being formed via different types of processing: intuitive vs rational.

Some of the strongest direct support for this comes from studies that demonstrate dissociation of intuitive and rational thinking. For example, Ferreira, Garcia-Marques, Sherman, and Sherman (2006) used the process dissociation procedure to look at intuitive and rational processing and found that the two types of thinking did indeed dissociate. The process dissociation procedure involves presenting inclusion and exclusion versions of problems, such as the Linda problem encountered earlier in this chapter. The classic Linda problem is an exclusion problem: participants have to exclude one piece of information to get the correct answer, in this case taking the base-rate information into account and excluding representativeness. But, if the base-rate information is changed to match representativeness then participants could use either piece of information, and thus either type of thinking, to arrive at the correct answer – this would be an inclusion problem. In exclusion problems rational and intuitive processes therefore arrive at different results, whereas in an inclusion problem they both arrive at the same result. In theory then, if intuitive and rational thinking are completely independent and parallel then people would score perfectly on the inclusion problems while revealing their use of rational or intuitive thinking on the exclusion problem, thus allowing calculation of the independence of the two processes. Overall, Ferreira et al. (2006) found that the two types of thinking process dissociated,

as predicted, suggesting that the dual-process view of cognition is correct. This was also the case when they added conditions where participants were under increased cognitive load, designed to tie up resources and thus lead to greater reliance upon the less resource-intensive intuitive thinking processes.

Stupple, Ball, and Ellis (2013) used a similar approach in terms of inclusion and exclusion principles, but using surface features versus logical conclusions of syllogistic reasoning tasks. In this case the syllogism can be made to intuitively suggest one answer, perhaps based upon experience of how the world is, but actually the logic gives another answer (e.g. contrary to how the world actually is, but logically correct within the context of the syllogism being presented), thus giving an exclusion problem. Alternatively, the surface and logic features can match, giving an inclusion problem. As general support for a dual-processing account of cognition, they found that processing times were longer for the exclusion problems, suggesting that the rational thinking required for a correct solution was taking longer, as predicted by dual-process theories.

So far it has been seen that intuitive processing seems to take precedence, or at least is the default mode of cognition. In exclusion tasks, such as the one conducted by Ferreira et al. (2006), it is the intuitive thinking that is the default; intuitive thinking is required to fail or be skipped in order for rational thinking to occur. This supports the idea of the evolved primacy of intuitive thinking. But it does not address why or how this primacy might be overridden. One suggestion in answer to this question is cueing, where features of the situation cue the brain to apply the more expensive rational thinking processes. This might be due to rather direct factors, such as the instructions used when asking people to do a task in a lab study (Inbar, Cone, & Gilovich, 2010). Or it might be due to incidental factors, such as a harder to read font, resulting in greater engagement of analytical thinking (Alter, Oppenheimer, Epley, & Eyre, 2007). Either way, the implication is that unless external factors of the situation cue the application of rational thinking, intuitive thinking is the default.

However, positive affect (PA) has also been proposed as promoting intuitive thinking, as in the study by King, Burton, Hicks, and Drigotas (2007), which found that positive

affect was associated with greater formation of paranormal beliefs. Since this type of belief is known to be associated with intuitive thinking style, they proposed that PA promotes intuitive thinking. This certainly makes sense from an evolutionary perspective since PA is a signal that 'all is okay' and thus there is no need to spend extra effort thinking more deeply (Fredrickson, 2001). This might explain how incidental factors such as disfluent fonts would cue rational thinking; via reducing positive affect and the feeling that 'all is okay'.

Another piece of evidence supporting the evolved primacy comes from studies of the inhibition of intuitive thinking. This sort of evidence uses various measures of inhibition, such as time delays, to infer that intuitive thinking has to be inhibited in order for rational thinking to come online and have an effect – so in exclusion problems, correct answers that require rational thinking should take longer (Stupple et al., 2013). Travers, Rolison, and Feeney (2016) took this further in their mouse-tracking study, adding spatial information to the timing information. They not only compared how long it took people to get right or wrong answers on exclusion problems, but they also tracked participants' movements of the mouse during the time they were selecting their answer on a computer screen. This showed participants had a tendency to move towards the intuitive answer initially even if they then went on to give the correct answer that required rational thinking. While this is not a direct view into the minds of the participants, it does support the idea that intuitive thinking has primacy and requires inhibiting. The tests used in Travers et al.'s study were from the Cognitive Reflection Test (Frederick, 2005), which will be covered in detail later in the thesis.

The idea of evolved primacy of intuitive thinking also aligns well with studies demonstrating the dissociation of thinking skills and susceptibility to heuristics and biases (e.g. Blackmore, 1997; Stanovich & West, 2007, 2008b). The evolved primacy of intuitive thinking predicts that it is one thing to have the ability to think critically or intelligently, but it is another thing to actually apply it. And this is exactly what this type of research finds: no association between thinking skills and application of those skills. Kelemen, Rottman, and Seston (2013) also demonstrated the same thing, but in a slightly different way. When placed in conditions where cognitive capacity was

reduced, even trained scientists made judgments counter to their scientific training and knowledge. In this case, they made teleological errors under conditions of a speeded response paradigm. Under unspeeded circumstances, the nature of the problem would cue application of their specialist knowledge.

Finally, the compelling nature of intuitive thinking has already been raised, but it has also been demonstrated in experiments. One example already encountered was the Linda problem where, even when all of the information was present, people still went with their intuitive response (57% of people made this error; Tversky & Kahneman, 2002). However, a more striking example was presented by Denes-Raj and Epstein (1994). Investigating the ratio-bias phenomenon, they presented participants with two bowls of jelly beans each containing a specified proportion of red beans, but different absolute amounts of beans (see also: Kirkpatrick & Epstein, 1992). Participants were asked to choose which bowl they would prefer to draw a bean from at random, with the aim of drawing a red bean. Surprisingly, 82% of participants made one or more non-optimal choices (i.e. choosing the larger bowl despite it having lower odds). The reason participants gave for this was that it *felt* like they had more chance with the bigger bowl. This basic demonstration of the ratio-bias phenomenon is instructive, but what was more surprising was that many participants went ahead and picked the incorrect bowl even when they explicitly stated that they knew the odds were against them. It was not a matter of having insufficient mathematical skills or, as Anderson and Rausch (2009) argue in their rational actor proposal, that non-rational factors, such as desire, are merely inputs into an underlying rational process of cognition. The compelling nature of intuitive thinking was enough to completely overrule rational thinking even after it had been activated and applied. This suggests that the primacy of intuitive thinking is powerful enough to extend beyond the initial judgment process.

Overall in this section, clear evidence has been presented of the need to take a dual-process approach to understanding cognition, rather than relying entirely on one or other of the rational actor or non-rational actor accounts. Although details of the theories, their assumptions, and their terminology vary, the core idea of a dual-process account of cognition is well supported. The research discussed in this section has been

focused on cognition generally, however, while the thesis' main focus is ultimately on belief. Now that the case has been made for the dual-process account it is therefore time to turn to the application of this account to belief formation and change. The next section will review dual-process literature relating to belief and present the model of belief formation and change that the research programme set out to test.

Path-Dependent Belief Change: A Dual-Process Model of Belief

It has been argued in this chapter that a dual-process account has strong support. One of the things implied by this account is that beliefs may be formed in varying degrees by intuitive and cognitive processing. This in turn has implications for belief change as well: it will be argued in this section that the implication is that belief change is path-dependant. In particular, that beliefs formed via one mode of thinking will be most susceptible to change when encountering disconfirming 'information' that appeals to the same type of cognitive processing. That is to say, belief change is dependent upon the path taken at belief formation. Therefore, intuitively-based beliefs will be more influenced by disconfirmation that appeals more to intuitive thinking than rational thinking, and vice versa. It will be argued that this idea has surface plausibility and some degree of emerging support, but that a research programme is needed to evaluate it properly.

One of the key implications of a dual-process approach to belief formation and change is that beliefs can be formed via either of the two processes: intuitive or rational. It can be difficult to know exactly how existing beliefs were formed, however, so generally speaking research tends to rely upon belief-basis as a proxy measure for inferring belief formation mechanisms. That is to say, beliefs formed intuitively will have an intuitive belief-basis: generally, people will state they believe for intuitive reasons, such as personal experience. Whereas beliefs formed via rational cognitive processing will have a rational belief-basis: people will claim belief based on rational reasons, such as the weight of the scientific evidence. This sort of variation in belief-basis is illustrated in research by Griffin (2008), where participants rated their reasons for belief in a

number of topics, including parenting, racial IQs, and evolution, against a number of statements, such as: “I trust my heart not my head on this topic” and “My opinion is supported by science.” They found that belief-basis did indeed vary and that different topics tended to have a different belief profile, such as evolutionary theory being associated with a more rational belief-basis, whereas creationism was associated with a more intuitive belief-basis. Arguably a belief in evolutionary theory is more likely to have come about via the route of rational processing applied to rational information sources on the topic, rather than, for example, personal experience and thus it would be expected that belief-basis would have a greater rational component. This particular research study and others by the same author will be covered in far greater detail in the rest of the thesis.

In contrast to rationally-based belief in evolutionary theory, Irwin and Young (2002) applied Sperber’s (1997) distinction of intuitive and reflective beliefs, and found that paranormal beliefs associated more with intuitive thinking than reflective thinking. This mirrors what Griffin found in relation to Extrasensory Perception (ESP) having a more intuitive belief-basis and is a well demonstrated association within research on paranormal beliefs, as will be seen in the next section of the chapter. In combination with Griffin’s research, such findings suggest that belief-basis does act as a valid proxy for the belief formation path.

However, if beliefs are forming for different reasons then it seems plausible that this may influence how they change. Bleile (2014) made this kind of prediction in their rational actor model of belief formation and change, which saw the influence of past experience as vital to the ability of people to focus their attention on a limited amount of information from the vast sea engulfing them. The implication for beliefs was that the way people arrive at a belief will influence what information they are likely to then process and thus how likely that information is to change the belief. The proposal of the current thesis differs from Bleile, however, in taking intuitive thinking into account, rather than taking a rational actor approach and, furthermore, making an explicit demarcation between two types of processing: intuitive and rational.

There is some support for the idea of path-dependent belief change in the literature, some of it indirect and some of it more direct. Indeed, some support actually comes from the rational actor perspective. For example, a number of studies have found that category congruence is a factor in belief change (Lange & Fishbein, 1983; Paik et al., 2009). When participants formed beliefs based upon category-level information it was category-level disconfirmation that had the most influence on belief change. In a similar vein, but looking at congruency of intuitive factors, Edwards (1990) found that induced emotionally-based beliefs were altered by increasing emotional arousal, but intellectually based beliefs were not. Edwards induced affective associations to a stimulus item (a Chinese ideograph) subliminally. He found that affect-based beliefs were more influenced by affect-based disconfirmation, although he did not find a congruence effect for cognitively (i.e. non-affect) based beliefs, which were manipulated via vignette statements. This study therefore provides only partial support for the path-dependent theory of belief change, although the study is not necessarily comparing like with like, since subliminal association is known to be more likely to create effects (Payne, Cheng, Govorun, & Stewart, 2005) and they were also not specifically looking at rational processing, only non-affect-based processing.

Some interesting, non-academic field-based evidence comes via Oxenham (2016). Citing the Emergent project (<http://www.emergent.info/>), which tracks the truth or falsity of viral social media posts, Oxenham notes that when countermeasures were deployed in the form of competing posts, it was not the factual, rational disconfirmations that had the greatest effect. It was disconfirmations that were presented in the same sort of way as the originals; spoofs of the original viral posts. Thus posting a Snopes (<https://www.snopes.com/>) article debunking a false viral post had only a small effect on the propagation of the viral message. Whereas posting a viral style spoof debunking the false viral message had a much greater effect. This like-cures-like approach is very similar to the path-dependency being tested in the current research programme.

There are, of course, alternative theories on belief change and these will be covered in more depth when discussing results of the studies in the programme. However, one

theme that is worth noting ahead of time is the notion of 'defence' of beliefs, which may be a factor in resistance to belief change regardless of the initial path, or may actually depend upon the initial path. This latter scenario was found in a study by Russell and Jones (1980) in which believers and sceptics both reacted emotionally to material that disconfirmed their views, but only believers were selective in their interpretation of the material. In contrast, others argue that beliefs are defended regardless of the initial path. In fact, presenting disconfirming material to someone with a strong belief may result in a 'backfire effect' (e.g. Betsch & Sachse, 2013). The idea is that people defend against threatening facts just as they do against physical threats and the stronger the threat, the stronger the defence that is mounted, hence the backfire effects. This, of course, has serious implications for any dual-process theory of belief change, since it implies that defences are primary and rational processing does not even have time to come into play regardless of the belief-basis.

Nevertheless, general support for the idea of path-dependent belief change is good, and there is also emerging direct support for the idea. In particular, a study by Griffin and Ohlsson (2001) found that greater rational belief-basis in a topic predicted higher ratings of belief change likelihood in response to rational counter-evidence. They did not test the effect of intuitive information on intuitively-based beliefs and their rationale for their predictions was based upon a slightly different underlying model, but the results do offer support for the model proposed in the present thesis, that belief change is path-dependent. Indeed, this particular study provided a blueprint for some of the studies in the present programme and will therefore be discussed in greater detail as it becomes relevant to do so. For now, it is enough to note that the study provides initial support for the proposed model.

In summary then, the model being proposed is that belief change is path-dependent. It has been argued that information may be processed in different ways (intuitive/rational) and that this will lead to different bases for belief. Given a dual-process account of cognition it also makes sense that beliefs linked to one system, or type of thinking, will respond differentially to material of a different type and some evidence of this occurring has also been presented. Specifically, the path-dependent

model makes the prediction that like-cures-like in terms of belief change. So, an intuitively held belief will be more likely to change in response to disconfirmation that is appealing to intuitive processing by the brain whereas a rationally held belief will be more likely to change in response to disconfirmation that appeals to rational processing in the brain (perhaps with cueing involved – Inbar et al., 2010). In physical system terms (e.g. Lieberman, 2007; Lieberman et al., 2004; Satpute & Lieberman, 2006), it could be framed as beliefs rooted in one system being less likely to be influenced by disconfirmation that is targeted at the other system.

Paranormal Beliefs as a Research Tool

As already noted at the start of this thesis beliefs are wide ranging and pervasive. This means that a full representative sample of beliefs in research on belief is not practical, and this is indeed what has been seen when reviewing the literature. It therefore makes sense to focus upon beliefs that vary in ways relevant to the predictions of the model being proposed. Therefore in this case the beliefs should be believable for intuitive reasons, but have clear rational counterarguments as well. They should also be relatively common, but not ubiquitous, for the purposes of data gathering and for generalising to the wider population in relation to beliefs more generally. For example, most people agree the earth is not flat. Although some people disagree with this, the general proportion is too skewed for a reasonable mix of responses in a general sample. It will be argued that paranormal beliefs fulfil the needs of the present research programme, by being both relatively common and subject to clear rational disconfirmations in contrast to the known tendency for intuitive reasons for belief in these phenomena.

For the purposes of the present thesis, it can be stated that paranormal phenomena are phenomena that go substantially beyond or are contrary to known natural forces. For investigating belief change it is not actually critical whether the beliefs in question are of real phenomena or not; the main thing is that paranormal belief provides the right kind of material to work with. In this case, due to the nature of the paranormal

phenomena, there are a wide range of good counter arguments and counter evidence relating to them.

The first important requirement that paranormal belief needs to satisfy is variation in reasons for belief. There will, of course, always be variation in belief-basis, and paranormal belief tends to be associated more with intuitive reasons for belief, such as personal experience (Clarke, 1995). For the purposes of the present programme, it is acceptable and even desirable that the bias is skewed towards intuitive belief-basis, largely because of the easy access to naturalistic rational disconfirmation (as will be seen later when the intervention study approach is covered). The intuitive belief-basis of paranormal beliefs is generally well replicated in the literature, although Schouten (2010) finds, contrary to Clarke (1995), that paranormal belief did not correlate with personal experience. This remains the exception, however, in a broad literature that finds in agreement with Clarke. This body of research covers both belief-basis and thinking style, the former being treated as a proxy for the latter in the present thesis. This is achieved by either self-report of belief-basis (as in Clarke or Schouten) or via measures of thinking style, such as the REI, which was previously discussed in relation to the CEST dual-process account (Epstein et al., 1996). Measures of paranormal belief commonly include, but are not limited to, the Australian Sheep-Goat Scale (Thalbourne, 1995) and the Paranormal Belief Scale (Tobacyk, 2004; Tobacyk & Milford, 1983). Using these and other measures, paranormal belief has consistently associated more with intuitive than rational thinking style or belief-basis (Aarnio & Lindeman, 2005; Boden, Berenbaum, & Topper, 2012; Clarke, 1995; Irwin & Young, 2002; Wolfradt, Oubaida, Straube, Bischo, & Mischo, 1999). Experimental research by King et al. (2007) can also be added to the correlational findings. In three studies looking at induced or naturally occurring positive affect (PA) in relation to formation of beliefs about phenomena, such as ghosts or UFOs, they found that PA was associated with greater belief formation. In other words, when an intuitive aspect of people's thinking was manipulated, it increased belief in paranormal or similarly anomalous phenomena.

Overall therefore, there is good evidence that paranormal beliefs often have an intuitive component. However, it is not the case that paranormal belief is entirely intuitively-based (Cardena, 2018). For example, in Aarnio and Lindeman's (2005) study involving 3141 participants the correlation between paranormal belief and intuitive thinking style explained less than 12% of the variance – a non-trivial, significant association, but one that leaves plenty of variation for statistical analysis in studies such as the ones in the present programme, and plenty of variance still to be explained, perhaps by a model such as the one proposed here.

It is also very important that when the population is sampled believers in the paranormal will be found. Gallup polls and reviews of polls in the literature demonstrated that this would not be a problem for paranormal belief. While paranormal beliefs do not saturate the population, they are most certainly very common. Haraldsson (1985), for example, reported that 73% of British adults surveyed believed that telepathy exists and 44% believed in hauntings. Moreover, 64% claimed some kind of psychic experience and 14% had experienced being haunted. The exact pattern of beliefs in specific phenomena varies over time, but paranormal belief in general tends to remain relatively stable (Castro et al., 2014; Goritz & Schumacher, 2000; Rice, 2003).

It is common in the literature on paranormal belief to use omnibus measures of belief that ask people about multiple phenomena, aggregating the result into a single overall belief score. However, such scales have proved unreliable in terms of the factors they produce (Hartman, 1999; Lange, Irwin, & Houran, 2000; Lawrence, 1997; Tobacyk, 2004; Tobacyk & Milford, 1983). For example, Reincarnation and Astral Projection both appear under the Spiritualism subscale of the Paranormal Belief Scale (Tobacyk & Milford, 1983), but there is nothing inherent in believing in Reincarnation that suggests belief that the mind or soul can leave the body whilst still alive, as is the case in Astral Projection. Indeed, Reincarnation could be seen as similar to the belief that “the soul continues to exist though the body may die”, which the Paranormal Belief Scale places in a different category: Traditional Religious Belief.

The other problem is a purely practical one. If disconfirmation is to be presented then it will need to be specific to particular phenomena. Given the logistical constraints on the programme, it was simply not practical to do this for more than a few phenomena. The present research program therefore focused mainly on the single phenomenon of Extrasensory Perception (ESP), which is a relatively commonly held belief (e.g. Haraldsson, 1985), and was also the phenomenon included in Griffin and Ohlsson's (2001) study that much of the present programme extends from. The fact that paranormal beliefs are common implies that they are a normal part of the human condition rather than related to clinical issues or extreme circumstances.

Indeed, by example, Lindeman's (2011) definition of paranormal belief includes the notion of core ontological confusions (e.g. Lindeman & Aarnio, 2007; Lindeman & Svedholm, 2012). These are confusions about the nature of how the world works, such as agreeing with the statement "Moss forms around rocks in order to stop soil erosion" (Kelemen et al., 2013), which is untrue because moss does not care about soil erosion; it just grows where it can. As Kelemen et al. demonstrated, this sort of thinking error can beset even highly trained scientific minds. Such basic ontological knowledge is picked up early in development, whereas scientific knowledge about the world is learnt later in life. Lindeman's argument is that paranormal beliefs are largely the result of misapplying such 'intuitive knowledge'. That is to say, to make such errors is not a mental health issue, it is a perfectly normal thinking error that people make. For practical reasons, the present research program focuses mainly on belief change, however, with belief-basis being used as a proxy for the mechanism of belief formation.

There are, however, other ideas relating to belief change, especially in relation to the reduction of paranormal beliefs. These are covered briefly below and then touched upon again where they are pertinent to the study programme findings and developments. Broadly speaking, the majority of theories on belief change, especially in the area of the paranormal, tend to fall under the general heading of 'deficits hypotheses' of varying colours and stripes. In general, deficits models of belief change

take the view that something is missing from believers' understanding or abilities. Addressing this deficit is often seen as the way in which belief change can be achieved.

One of the two main types of deficit model is sometimes known as the *knowledge deficit view* and refers to the existence of a knowledge gap between believers and non-believers. The present thesis will refer to this simply as 'exceptionalism' – i.e. experts have *exceptional* status with respect to knowledge and thus related truth judgements. This view is common in science and government and is demonstrated particularly clearly in a recent statement by Professor Leakey, the famous palaeontologist (Associated Press, 2012):

“If you get to the stage where you can persuade people on the evidence, that it’s solid, that we are all African, that color is superficial, that stages of development of culture are all interactive... then I think we have a chance of a world that will respond better to global challenges.” (p.1)

This statement illustrates the enduring optimism that many academics have: if it were just possible to provide the solid evidence and get it across to people, then they will change their minds. This optimism, of course, ignores Kuhn's (1996) infamous observation that even in science ideas are resistant to change, which usually comes as a result of the old-guard dying off rather than real changes of views. More recently Simis, Madden, Cacciatore, and Yeo (2016) investigated the persistence of the deficit model in science. They conclude that scientists suffer from the belief that people generally process the scientific information rationally like they do. In this light, if only the knowledge gap can be closed then beliefs will change in line with the knowledge. As has been seen, and as argued by Simis et al. (2016), this is not the case, however, since people are not necessarily processing the knowledge in the same way that the scientists are. Indeed, the general view is that the deficits model is suboptimal for changing people's beliefs and that it should be modified or even discarded completely (Ahteensuu, 2011; Ko, 2016; Sturgis & Allum, 2004; Wright & Nerlich, 2016). However, despite this pessimism, it will be seen below that knowledge deficit interventions have actually demonstrated belief change with respect to the paranormal, so it is not an

approach to belief change to be entirely written off, even if it might be considered a suboptimal approach.

The other main type of deficits model is what will be referred to in this thesis as inoculationism. This idea is that the formation of non-normative beliefs, such as paranormal beliefs, can be 'inoculated' against by having knowledge and/or thinking skills to combat the beliefs before they can even be formed. In contrast to the knowledge deficits view, which focuses on belief change, inoculationism focuses on belief formation. One of the key proponents of this view within sceptics of the paranormal is Lilienfeld (Lilienfeld, Ammirati, & David, 2012; Lilienfeld, Ammirati, & Landfield, 2009). Riffing off Miller's (1969) classic call to 'give psychology away' to the public at large, Lilienfeld's argument ultimately concludes by stating that there should be more research on the effectiveness of debiasing people's thinking – what Alcock (2018) refers to as a 'firewall to folly'. This aligns with Stanovich's (e.g. Stanovich & West, 2008b) idea that new 'mindware' can be acquired; that one can learn to avoid thinking errors.

However, inoculationism faces challenges from the existing literature regarding its plausibility as a successful approach. The main problem is that critical thinking skills dissociate from their application. Even if new mindware is acquired there is the issue of triggering it. Indeed, even Stanovich himself demonstrated such dissociation (Stanovich & West, 2007, 2008a, 2008b). But, the dissociation between thinking skills and the application of them is in general a robust finding within the literature (Blackmore, 1997; Dagnall et al., 2007; Hergovich & Arendasy, 2005; Royalty, 1995). At this point therefore, inoculationism would seem less likely to obtain support from the present research programme, if the premise of the programme is indeed correct. Nevertheless, while the present programme did not directly test the inoculationist theory, its prominence amongst sceptics of the paranormal makes it important to keep in mind when evaluating the findings in relation to ESP.

Most relevant to the present research programme, however, is empirical research demonstrating actual belief change in the real world, rather than merely theorizing about it. And as noted previously this research tends to offer some support for

exceptionalism. Such research typically follows an intervention paradigm and teaches knowledge, and possibly also skills in a relevant area, generally finding that skills are less capable of changing beliefs than specific knowledge – contrary to the mindware gap hypothesis. For example, Jones and Zusne (1981) demonstrated that increasing knowledge via a course on specific paranormal topics (including ESP) led to reduction in belief in those topics. Similarly, McLean and Miller (2010) presented a course covering anomalistic psychology topics and compared it to the effects of a standard research methods course. Both samples started at similar belief levels, and both courses led to improvements in critical thinking skills, but only the topic-specific course reduced paranormal beliefs: reducing from 83.57 to 56.50 on a percentage scale (see also: Morier & Keeports, 1994). Banziger and College (1983) also demonstrated the same with an older, non-student sample (mean age 67) and found long-term belief reduction at 6 months follow up. Finally, while all of the above were course-length interventions, Happs (1991) demonstrated belief reduction with a one-time intervention that presented participants with videos of water diviners repeatedly failing to find water under test conditions. Once again, this demonstrated long-term belief reduction in a non-student population (trainee primary school teachers).

These studies lay down a good precedent for the use of interventions, which is the main approach the present study programme took. However, they generally focus only upon whether or not belief change will take place, with little investigation of why belief change is taking place and this is where the present programme diverges from those discussed above – i.e. in testing a model of belief change. The present research programme therefore made extensive use of the type of intervention approach just discussed, both in course-length and single-lecture-length interventions. This was deemed to be a good methodology to use because it has been demonstrated to induce belief change in the expected direction (i.e. belief reduction) and it is more ecologically valid than most lab-based studies.

The studies in the programme would be able to look at changes in real beliefs acquired by people naturally. As Mitchell (2012) notes, lab studies vary in how much they replicate in the real world, with the average correlation between lab and real world

being around $r=.55$, once the highly successful organisational psychology studies are factored out. What is lost in a naturalistic setting, in this present instance, is the ability to control belief formation conditions. As already discussed the programme therefore relied upon belief-basis as a proxy for inferring the mechanism of belief formation. Specifically, it will be assumed, as was argued earlier in the chapter, that intuitive belief-basis correlates positively with intuitive mechanism of belief formation and that the same applies for rational belief-basis and rational mechanism of belief formation.

Furthermore, in the belief research discussed so far it is generally assumed that self-reports of belief are a suitable proxy for people's real beliefs (e.g. Griffin & Ohlsson, 2001; Tobacyk & Milford, 1983). This is based upon the assumption that belief is something that people can accurately access and that their self-reports of belief are unbiased. The present study programme follows suit in simply asking people to rate their belief in each topic of interest. Throughout the present thesis changes in self-reported levels of belief are referred to as 'actual' or 'real-world' belief change, to distinguish this from self-predictions of future belief change, such as that seen in Study 1. However, it must be acknowledged that such 'actual belief change' is change in self-reported belief levels and that such a measure may be subject to inaccuracy caused by demand effects or imperfect self-access to one's true beliefs. One way to mitigate against such issues is to use measures that ask indirect questions, which are then combined to come to a conclusion about the level of belief a person has in a topic. However, where such measures do not already exist they require substantial time to develop. This made the approach impractical for the current research programme, which would have required new measures to be developed for a number of topics.

Finally, as already discussed, it was not practical to cover all paranormal beliefs in the research programme. The focus was therefore on the phenomenon of ESP (extrasensory perception). This is a relatively broad category of paranormal phenomenon, relating to the communication of information without any known physical means – e.g. direct mind to mind communication. Therefore, the research programme used paranormal belief in testing a dual-process model that addresses a gap in the literature on what is known about the connection between belief formation

and change. This was carried out using questionnaires, real-life intervention studies, and laboratory studies.

General Hypotheses

Specific hypotheses are made for the empirical studies discussed in each chapter, but the core set of hypotheses revolve around the idea that belief change is path-dependent: rational information will influence rationally held beliefs more than intuitively held beliefs and intuitive information will influence intuitively held beliefs more than rationally held beliefs. More specifically, moving towards a position of greater scepticism regarding paranormal phenomena will be more likely when a person's existing view is held for rational reasons rather than intuitive reasons. The following general hypotheses can therefore be formed:

H1 – Belief in the paranormal will be reduced after exposure to non-paranormal explanations.

H2 – Greater belief in the paranormal will correlate with a more intuitive belief-basis.

H3 – A more rational belief-basis will correlate with greater belief change (both self-predicted and real-world).

Study 1 – Belief-Basis Correlates with Self-Predicted Belief Change: A Replication Study

Background

As already noted in the general discussion, some direct support for the proposed model comes from a study by Griffin and Ohlsson (2001). The model they test is a little different from the path-dependency one. They arrived at their model by modifying a three-stage model of conceptual change proposed by Chi and Thagard (Chi, 1992; Thagard, 1992; both cited in Griffin & Ohlsson, 2001). This original model proposes that new knowledge firstly has to be recognised as conflicting, then secondly, a conceptual framework has to be constructed within which to understand the new knowledge and, thirdly, that if the new knowledge provides a more coherent conceptual framework, it should replace the old knowledge (i.e. it should be accepted as true and the old knowledge judged as untrue, or less true). This model adheres to Descartes' view that it is possible for people to hold an idea in mind neutrally, without committing to any kind of belief about it (Descartes, 1637/1984). In contrast, Spinoza argued that to understand an idea one must at least momentarily hold it in mind as being true, before then unbelieving it (Spinoza, 1677/1996). This will be something that is reflected upon later in the thesis. However, for now it is enough to note that the three-stage model is generally in line with many existing rational actor models of conceptual change, of the kind discussed in the General Background chapter of this thesis. Such models tend to suggest that if people are aware of non-paranormal explanations and have the ability to process this (rational) knowledge appropriately then they should alter their beliefs accordingly. Failure to change one's beliefs is therefore due to factors such as cognitive dissonance or failing to properly understand the non-paranormal explanations presented.

However, Griffin and Ohlsson (2001) modified this three-stage theory of conceptual change by adding the explicit acknowledgement that beliefs may be held for both

rational and intuitive reasons. They predicted that rationally held beliefs would be more likely to change in the face of strong contradictory evidence (i.e. rational disconfirmation) due to the belief-basis being of like kind and thus directly evaluable against such evidence, whereas an intuitive belief-basis would not be.

Participants in Griffin and Ohlsson's study were 120 undergraduates at the University of Illinois at Chicago. Belief in five topics was investigated: creationism, afterlife, opposites attract, ESP, and evolution. For each topic participants were presented with a description of the topic and then asked to rate their belief in the topic on a scale of 1-9 (complete disbelief to complete belief). They were then asked to provide up to three self-generated reasons for their belief/disbelief in the topic. Finally, they were also asked to rate reasons for belief/disbelief in the topic using five pre-prepared statements provided by Griffin and Ohlsson, which were based upon previous pilot research. Each statement was rated on a scale of 1-9 (not at all their reason for belief to completely their reason for belief). These pre-prepared reasons for belief divided into statements reflecting rational reasons for belief and statements reflecting intuitive reasons for belief (see Table 1 in the methods section of the present chapter for a complete list of statements). The intuitive or rational nature of the statements was not labelled as such for participants, however. The responses to the five statements were combined to give an overall belief-basis score for participants' level of belief in each topic. This score ranged from 1-9, where 1 represents intuitive belief-basis and 9 represents rational belief-basis (see the Scoring section in this chapter for further detail).

Griffin and Ohlsson found that beliefs tended to have greater correlation with one or other type of belief-basis. Notably they found that belief in ESP correlated more with an intuitive belief-basis, which is as would be expected based upon this robust association in the literature on paranormal belief. Furthermore, they found that belief in afterlife, opposites attract, and creationism also correlated with an intuitive belief-basis (i.e. a lower belief-basis score). Whereas belief in evolution correlated with a rational belief-basis (i.e. a higher belief-basis score). Most importantly for the model tested in the present research programme, however, they found that a greater rational

belief-basis correlated with greater self-predicted likelihood of future belief change, if confronted by strong contradictory evidence (which is assumed by Griffin and Ohlsson to be rational in nature). This is exactly what the path-dependency model would also predict.

However, while the path-dependency model therefore makes the same prediction for the outcome of Griffin and Ohlsson's study, the underlying reasoning is different. This is due to the proposed mechanism of belief formation. The intuitive pathways in the brain are being used and intuitive associations being made and thus rational counter-evidence that activates rational pathways and associations will have a difficult time modifying the existing belief. Griffin and Ohlsson take a similar approach, arguing that intuitive reasons for belief are not of the same kind as contradictory new knowledge (the former is intuitive and the latter is rational) and therefore the two pieces of information cannot be easily compared, leading to a low likelihood of belief revision. However, their rationale was based upon the type of knowledge rather than the mechanism underlying the processing of the knowledge. The difference is subtle and ultimately the same prediction is made regarding the present replication study, however. What Griffin and Ohlsson do omit, however, is any prediction about what would happen regarding intuitive disconfirmation. Although their study could not test that prediction it would be interesting to have seen how this factor would fit into their model overall; whether it would be as simple as stating like-influences-like.

Griffin and Ohlsson's (2001) study provided a useful methodological template, but it required replication. It would have been easy to go ahead and run an intervention study with belief recorded before and after the intervention. However, the study by Griffin and Ohlsson had not yet been replicated, so if null results were obtained in a real-world intervention study it would not be clear if it was due to a methodological failure of replication or simply because belief formation and change in the real world differs from self-predictions of belief change in the lab. It may even be the case that their findings do not replicate. As Ioannidis (2005) observes, there is a general tendency to only publish positive findings. The findings of Griffin and Ohlsson might not actually be real effects, just papers that made it out of the file drawer because they

were positive. Before embarking on a research programme it was therefore necessary to replicate the original self-prediction study prior to a real world test.

Brandt et al. (2014) present a recipe for convincing replications. They list the following rules:

1. Carefully defining the effects and methods that the researcher intends to replicate;
2. Following as exactly as possible the methods of the original study (including participant recruitment, instructions, stimuli, measures, procedures, and analyses);
3. Having high statistical power;
4. Making complete details about the replication available, so that interested experts can fully evaluate the replication attempt (or attempt another replication themselves);
5. Evaluating replication results, and comparing them critically to the results of the original study.

The present replication departs from this list on some points. For merely practical reasons the study was not pre-registered, although the ability to do this is now becoming much easier, and preregistration is therefore more common (Nosek, Ebersole, DeHaven, & Mellor, 2018). More notably, however, the present study used a different sample group: a special interest group rather than a student sample. And it was conducted in a different mode: online instead of paper and pencil. Considering that a full research programme might be based upon the replication and considering the issues with the overrepresentation of psychology students in psychology research (McNemar, 1946; Smart, 1966), it was felt that a different type of sample group would be appropriate so long as the material remained the same (Griffin and Ohlsson used a student sample in the USA). Since the ultimate aim was to generalise to the wider population from the programme findings, this divergent replication would provide a more robust replication of the effect, without detrimental impact to the replication itself. The use of online as the mode of presentation was not expected to influence the results and was simply the best way to recruit a non-student sample. Empirical

support for the equivalence of the online mode of research is presented in the method section of this chapter. Finally, for details on statistical power see the Statistical Power, Method subsection.

In summary then, the present study replicated Griffin and Ohlsson's original study, with a different sample group and material was presented online, but otherwise with identical material and identical hypotheses.

Hypotheses

H1 – belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson's study.

H2 – For each topic, a greater rational belief-basis would correlate with greater self-ratings of belief change likelihood.

Method

The study measured three variables. The first two were belief-basis and belief-level in each of five topics: creationism, afterlife, opposites attract, ESP, and evolution. These two factors were measured using a belief-basis measure and a direct self-report of belief level. Both of these used 9-point response scales and are described in detail below. The third variable was the self-predicted likelihood of belief change after encountering strong contradictory evidence in the future, simply referred to as self-predicted belief change in the rest of this chapter. This was also measured for each topic and was measured via a direct question asking for a rating of likelihood on a scale of 1 to 9, described in more detail below. On each of the five topics, participants were also given the option to provide up to three free-text responses, stating their top 3 reasons for belief in each topic.

Participants

A volunteer sample of subscribers to the Anomalistic Psychology Research Unit (APRU) mailing list was recruited for the study. This was a largely non-student sample with a special interest in the paranormal. The group consists of both believers and sceptics. The final sample size was 72 after 12 were removed due to missing data.

This sample consisted of 30 men and 42 women, ranging in age from 20 to 70 (mean 36.16, SD = 14.873).

Statistical Power

As noted by Brandt et al. (2014), it is important that replications have sufficient power to detect the effects they are attempting to replicate. For the present study G*Power (Faul, Erdfelder, Lang, & Buchner, 2014) was used to calculate power related requirements based upon the information provided in Griffin and Ohlsson (2001). There were 120 participants in Griffin and Ohlsson's study, and 72 in the present study.

For the correlations between belief-basis and belief Griffin and Ohlsson report all correlations individually, and these ranged from -.35 to .73, with the ESP correlation being -.42. However, for statistical significance they only report $p < .05$ for all correlations, without going into further detail. Based upon this information it was calculated that the present study would need between 15 and 83 participants to detect effects of the same size as those found in Griffin and Ohlsson. For the ESP topic specifically, it was calculated that 56 participants would be needed. Bearing in mind that $p < .05$ is a maximum p-value for these correlations this means that the above requirements are on the conservative side, since lower p-values for the effects would lead to lower numbers of participants being required to detect the effects.

For correlations between belief and self-predicted belief change Griffin and Ohlsson only give the lowest and highest correlations (from .3 to .4). They report that all correlations were significant $p < .05$, but do not provide detail on individual p-values. Based upon this information it was calculated that the study would need between 63 and 115 participants. Again, for the reasons given previously, these requirements are on the conservative side.

For the present study, which had 72 participants, it was calculated that the power to detect the correlations between belief-basis and belief was between 92% and 100% (the latter was rounded up to 100% by G*Power). For the ESP topic specifically, prospective power was calculated as 98.2%. Power to detect the correlations between belief and self-predicted belief change was calculated as being between 82.83% and

97.12%. Again, it is worth noting that these power calculations are on the conservative side due to Griffin and Ohlsson only stating that $p < .05$ for all correlations.

Equivalence of Online Mode of Presentation

The general consensus on online psychology research is that it is equivalent to pencil and paper presentation. Even as far back as 2008, Andersson, Ritterband, and Carlbring (2008) were recommending that simple questionnaire assessments were equivalent. Furthermore, Aluja, Rossier, and Zuckerman (2007) showed equivalence using multiple samples of direct paper and pencil vs online presentation (see also: Chuah, Drasgow, & Roberts, 2006; Denscombe, 2016). Indeed, even where differences have been found, such as in the prospective memory questionnaire (PMQ), it is unclear that the online mode is actually different in an inferior way to the offline mode, or whether the online mode is different in a superior way (see: Booth-Kewley, Larson, & Miyoshi, 2007, discussed below).

The online mode was deliberately chosen as a way to recruit a largely non-student sample. Use of the online mode is generally supported in the literature (Birnbbaum, 2004; Reips, 2016), including cross-cultural support for equivalence (Ekman, Dickman, Klint, Weiderpass, & Litton, 2006; Yu & Yu, 2007). Whitaker (2007) also observed gender was also not a factor in equivalence of the online and offline modes. Finally, Booth-Kewley et al. (2007) provided evidence that online questionnaires may actually garner a more honest response from participants, due to greater perceived anonymity online, which may make the online mode superior to the offline mode in some cases, such as revealing details about personal beliefs.

Materials

The questionnaire was presented via Lime Survey version 1.92 (<http://www.limesurvey.org/>) hosted on computer servers at Goldsmiths College, University of London. The belief-basis measure of the questionnaire is outlined below (see Appendix 1 for full details of the questionnaire). Briefing and consent were presented on the first page of the questionnaire, followed by demographic questions on age and gender. These included the option of no response. Age was also banded to

make this less of an issue for participants to provide this detail. Each belief topic was described as is given in Table 1 (see next page).

Table 1 - Descriptions of Belief Topics

Topic	Description
Creationism	For the purpose of this study Creationism is defined as the belief that the Bible gives a literally true account of the creation of the Earth and all life upon it.
Evolution	For the purpose of this study Evolution is defined as the development of all the species of animals on earth from earlier forms (for example, land animals evolved from early forms of fish).
ESP	For the purpose of this study Extrasensory Perception (ESP) is defined as the direct perception of information by the mind without using any normal way to find the information out.
Opposites attract	For the purpose of this study the idea that Opposites Attract is defined as people being attracted to partners who are the opposite of themselves in significant ways (such as in their personality or in the hobbies that they like, and so on).
Afterlife	For the purpose of this study Afterlife is defined as a place, or state, in which people continue to exist after their mortal bodies have died.

All of the questions for a single topic were presented before any questions were answered on the next topic. The order of presentation of the topics was as in Table 1. Participants were asked to rate their reason for belief on a 9-point scale ranging from “completely disbelieve” to “completely believe”. They were then asked “What are the top 3 reasons for your belief in [Topic]?” and given the option to enter free-text responses. Following this they were asked to rate each of five provided reasons for belief (see Table 2), rating these on a 9-point scale, ranging from “not at all my reason” to “completely my reason”. Finally, for a given topic, they were asked to predict likelihood of future belief change: “Now imagine that you were presented with strong evidence that contradicted your belief. How likely would you be to change your belief?” They were asked to rate likelihood on a 9-point scale ranging from “not at all” to “completely”.

Table 2 - Predefined reasons for belief and disbelief

Intuitive	Rational
My belief about [topic] makes me feel good or is comforting.	My belief about [topic] is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.
When it comes to issues like [topic], I trust my 'heart', not my 'head' to tell me the truth.	My belief about [topic] is supported by current scientific knowledge.
I don't need proof, I have faith that my belief about [topic] is correct.	

Scoring

Belief in each topic was taken as the raw value reported by participants in response to the single belief rating question asked on each topic. The scale ranged from 1 to 9, where 1 is complete disbelief and 9 is complete belief.

Belief-basis for each of the five topics was scored as per Griffin and Ohlsson (2001). The mean rating for the three intuitive items was subtracted from the mean rating for the two rational items, to give what Griffin and Ohlsson refer to as the knowledge-effect difference score, but is referred to in this thesis as belief-basis score. The belief-basis score ranges from 1 to 9, with 1 indicating highly intuitive reasons for belief in a topic and 9 indicating highly rational reasons for belief.

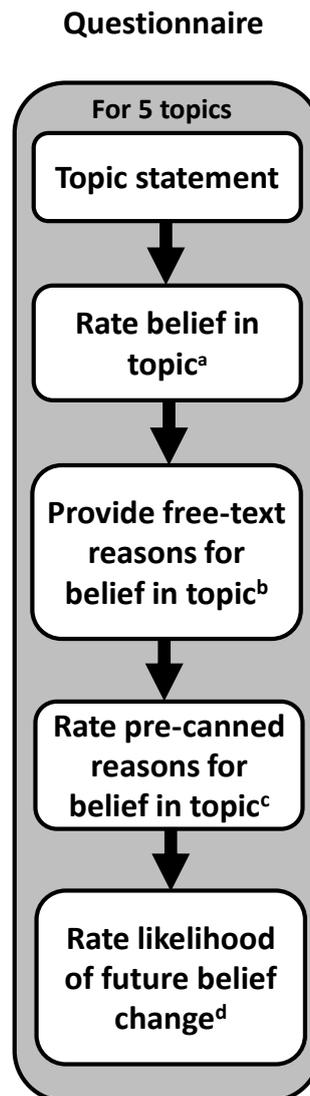
Self-predicted belief change on each topic was taken as the raw value reported by participants in response to the single belief change prediction question on each topic. The score ranged from 1 to 9, where 1 is the least likelihood of belief change and 9 is the highest likelihood.

Procedure

The time sequence of the study is illustrated in Figure 1. Participants were invited to take part via an email directing them to the questionnaire online. Upon visiting the questionnaire webpage, they read a briefing form and gave initial consent to take part in the study (Appendix 1). Participants were assured of their anonymity in the study and that they had a right to leave the study at any point. Participants completed the questionnaire page by page, as detailed in the materials section above and in Appendix 1 (see also Figure 1). Participants did not have to complete the questionnaire at one sitting and could return to it and continue at any time. Consent to use the data was confirmed again at the end of the study, since in an online study people can leave even right at the end without any indication that they wish their data to be withdrawn – final reconfirmation is therefore necessary to ensure consent is adequately obtained. Participants were then offered the option to be notified of the results and debriefed. This preference was handled via an email submission script independent of the survey software, so that anonymity was retained. Notification and an explanation of the study were emailed to those requested it. The delayed debriefing was necessary to prevent

people talking to other people taking part in the study. The study adhered to the ethical guidelines laid out in British Psychological Society guidance (BPS, 2018) and BPS ethics for Internet Mediated Research (BPS, 2017). This study was approved by the ethics committee at Goldsmiths College, University of London.

Figure 1 - Time sequence and measures for Study 1



^a **Belief** in topic rated from 1-9 (none to completely)

^b In their own words, participants provided up to 3 reasons for belief in the topic.

^c **Belief-basis** – calculated from 5 ratings of reasons for belief (1-9, from not at all to completely). Mean rating for the three intuitive items is subtracted from the mean rating for the two rational items, giving an overall rating from 1-9 (from intuitive belief-basis to rational belief-basis)

^d **Self-predicted belief change** on a topic rated from 1-9 (not at all to very likely).

Results

In their original study Griffin and Ohlsson presented graphs that visually illustrate the belief-basis differences for the topics. While these are not statistical tests, it was deemed to be useful to compare the results from the present sample with those of Griffin and Ohlsson, since if belief profiles for topics are robust then they should transcend the samples used. For the purposes of the graphs, believers are classed as those rating belief as 7 or above and disbelievers are classed as those scoring 3 or below (the numbers in brackets below the columns indicate the number of participants contributing to that column – current study on the left and USA sample on the right). As per Griffin and Ohlsson’s original graphs, those participants scoring between 4 and 6 are not on the graphs. The graphs below (Figures 2 and 3) show Griffin and Ohlsson’s original results shaded with diagonal lines and the results from the present study in solid colour. Overall, the results tend to be very similar. This is all the more impressive when the variation in the number of participants contributing to each column is taken into account. For example, in the present sample only 7 participants believed in creationism, while 59 of the USA sample believed in it, yet the belief profile is almost identical. The comparison does show some variations, mainly regarding ESP and Opposites, but generally the graphs are not indicating an alarming difference between the two samples.

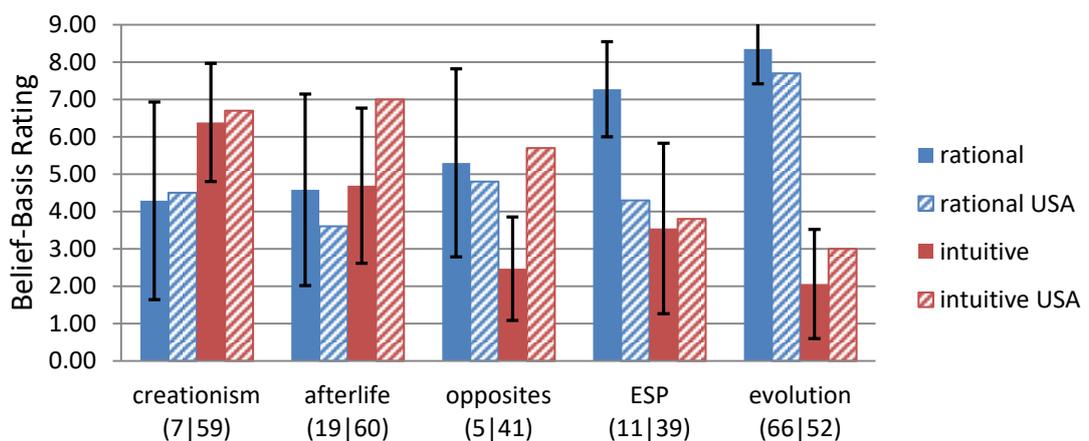


Figure 2 - Comparison between Study 1 and Griffin and Ohlsson’s (2001) USA sample for believers’ belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

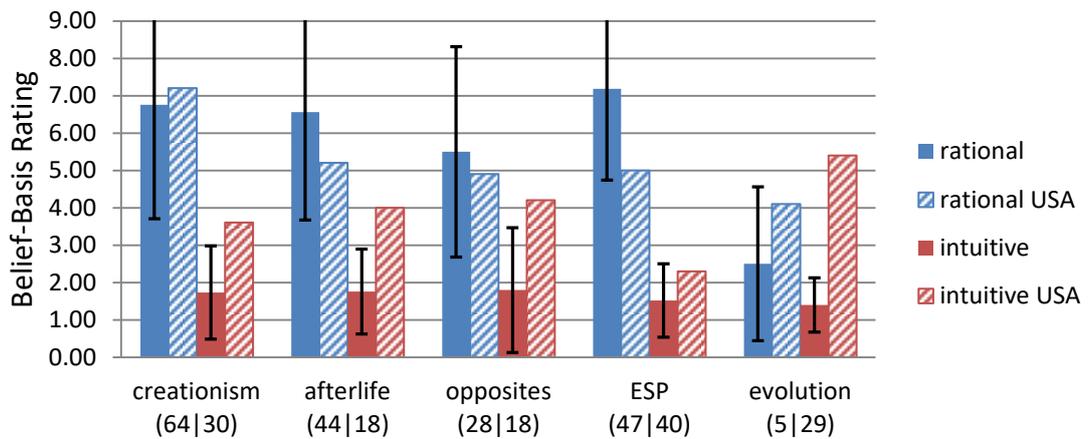


Figure 3 - Comparison between Study 1 and Griffin and Ohlsson's (2001) USA sample for disbelievers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

Griffin and Ohlsson also included self-predictions of belief change in their graphs and this is shown in the two graphs below (Figures 4 and 5). Again, the USA sample is shaded with diagonal lines and the sample from the present study is in solid colour. As can be seen, the self-predicted belief change was very similar in the two samples, even generally following the rise and fall of likelihood of belief change across the five topics.

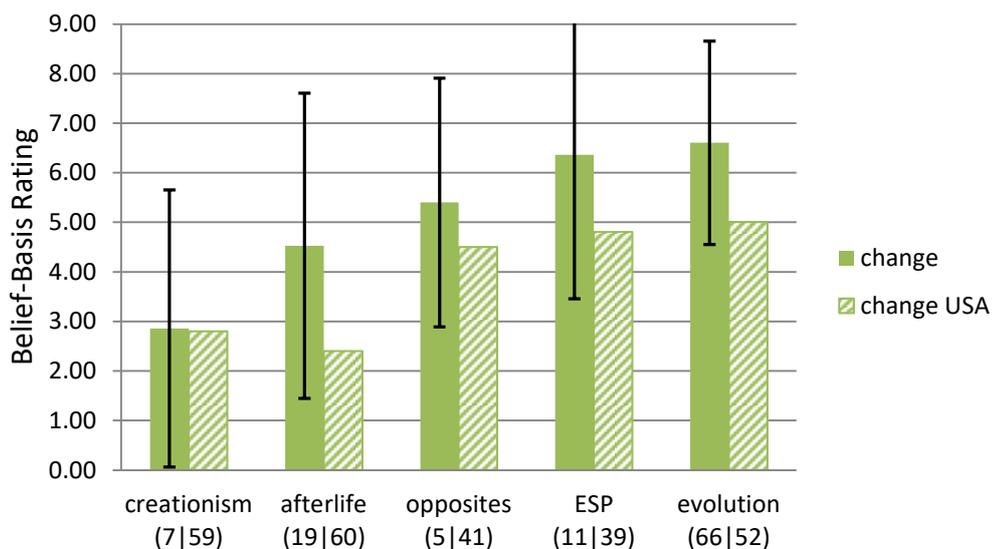


Figure 4 - Comparison between Study 1 and Griffin and Ohlsson's (2001) USA sample for believers' self-predicted belief change (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

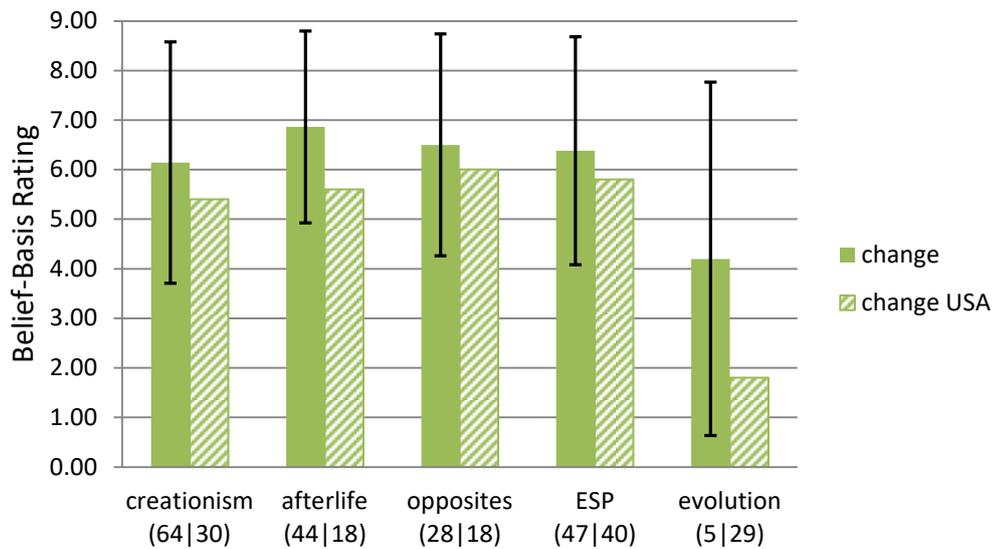


Figure 5 - Comparison between Study 1 and Griffin and Ohlsson's (2001) USA sample for disbelievers' self-predicted belief change (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

Prior to statistical analysis of the results, the integrity of the belief-basis measure was checked. The overall Cronbach's alpha was .574. Factor analysis showed two factors with the expected items loading on them. Cronbach's alpha for intuitive items was .688 and for rational items it was .850. Neither Griffin and Ohlsson (2001) nor Griffin (2008) provide reliability analysis for the belief-basis scale, although the 2008 study does provide factor analysis, which confirms the current finding of the expected split on the two types of belief-basis.

It worth noting here that the Cronbach's alpha is provided above chiefly as a standard measure of internal consistency. However, in this instance it is the factor analysis that is the more important analysis to focus on. This is all the more so due to the low number of items in the scale, which necessarily tends to reduce the size of Cronbach's alpha. Therefore, considering the small number of items in the scale and within each part of the scale, these reliability results and the factor analysis can be considered to indicate that the scale is useful (Lance, Butts, & Michels, 2016; Tavakol & Dennick, 2011; Toplak, West, & Stanovich, 2014). Reliability measures and low-item scales will be discussed further in relation to the 5-item Cognitive Reflection Test in Study 4.

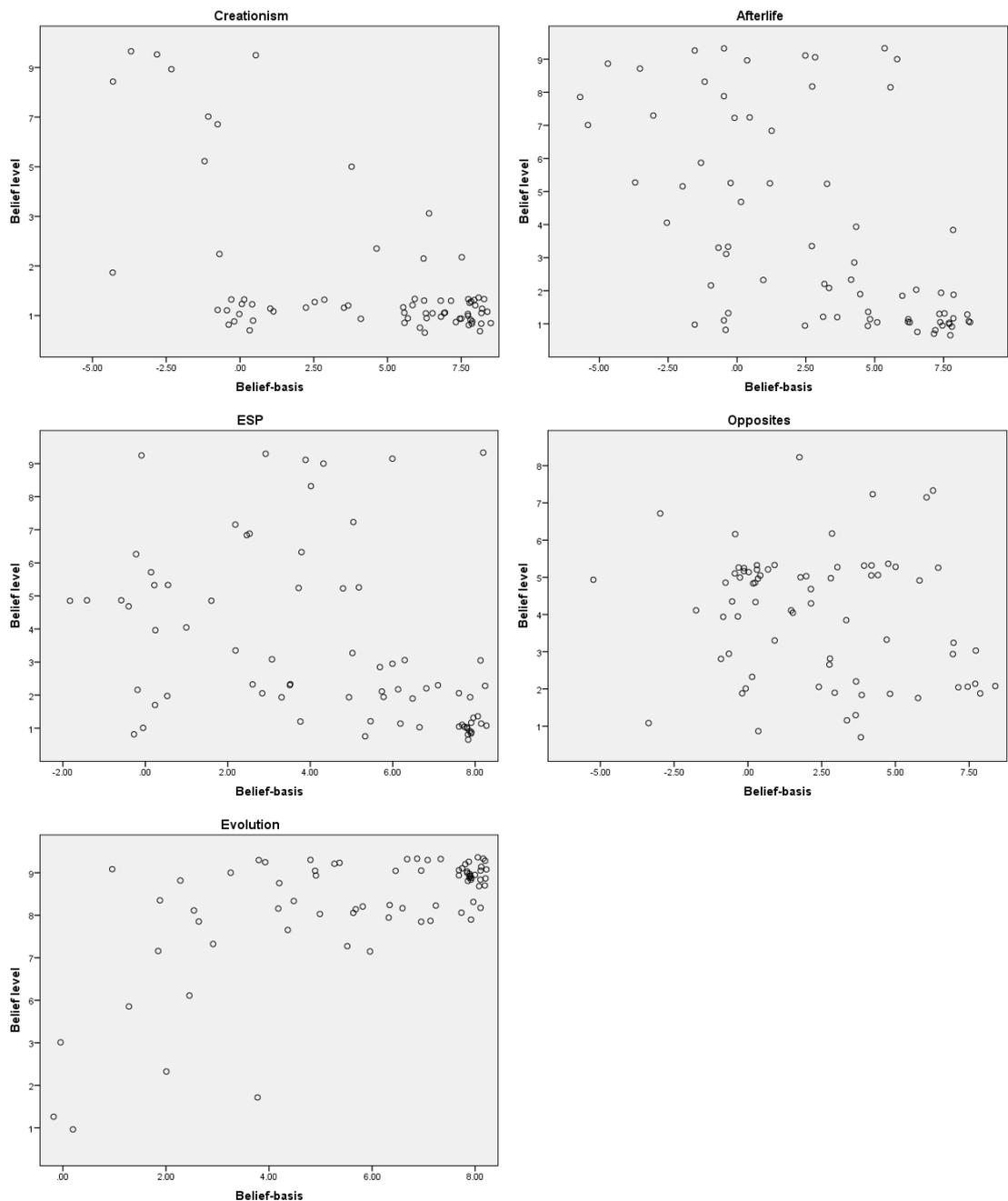
Hypothesis 1 predicted that belief-basis would correlate with belief in the topics in the same pattern as found in Griffin and Ohlsson’s study. A bivariate correlation of belief-basis and belief was conducted. A positive correlation indicates that belief in a topic has a more rational basis and a negative correlation indicates the belief has a more intuitive basis. The statistics given are from the non-parametric analyses. Where possible non-parametric analyses are used right across the programme in order to avoid issues with comparing disparate samples, as well as providing a tougher statistical test; if the results are significant then greater confidence can be attached. This is obviously at the risk of inflating type-2 errors, but generally speaking non-parametric analyses are not overly insensitive compared to parametric ones so this was considered to be an appropriate trade-off (Howell, 2007).

Table 3 presents the correlations between belief-basis and belief for each topic. All but Opposites show a significant effect at $p < .0005$. Opposites fails to correlate significantly at $\rho = -.192$, $p = .104$. Creationism, afterlife, and ESP all correlate negatively with belief-basis while evolution correlates positively, as found in Griffin and Ohlsson’s original study. They also found that Opposites correlated negatively, but this was not replicated here.

Table 3 - Correlations between belief-basis and belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman’s Rho	-.513	-.617	-.554	-.192	.593
Significance	<.0005	<.0005	<.0005	.104	<.0005

Figure 6 - Scatterplots of belief-basis vs belief



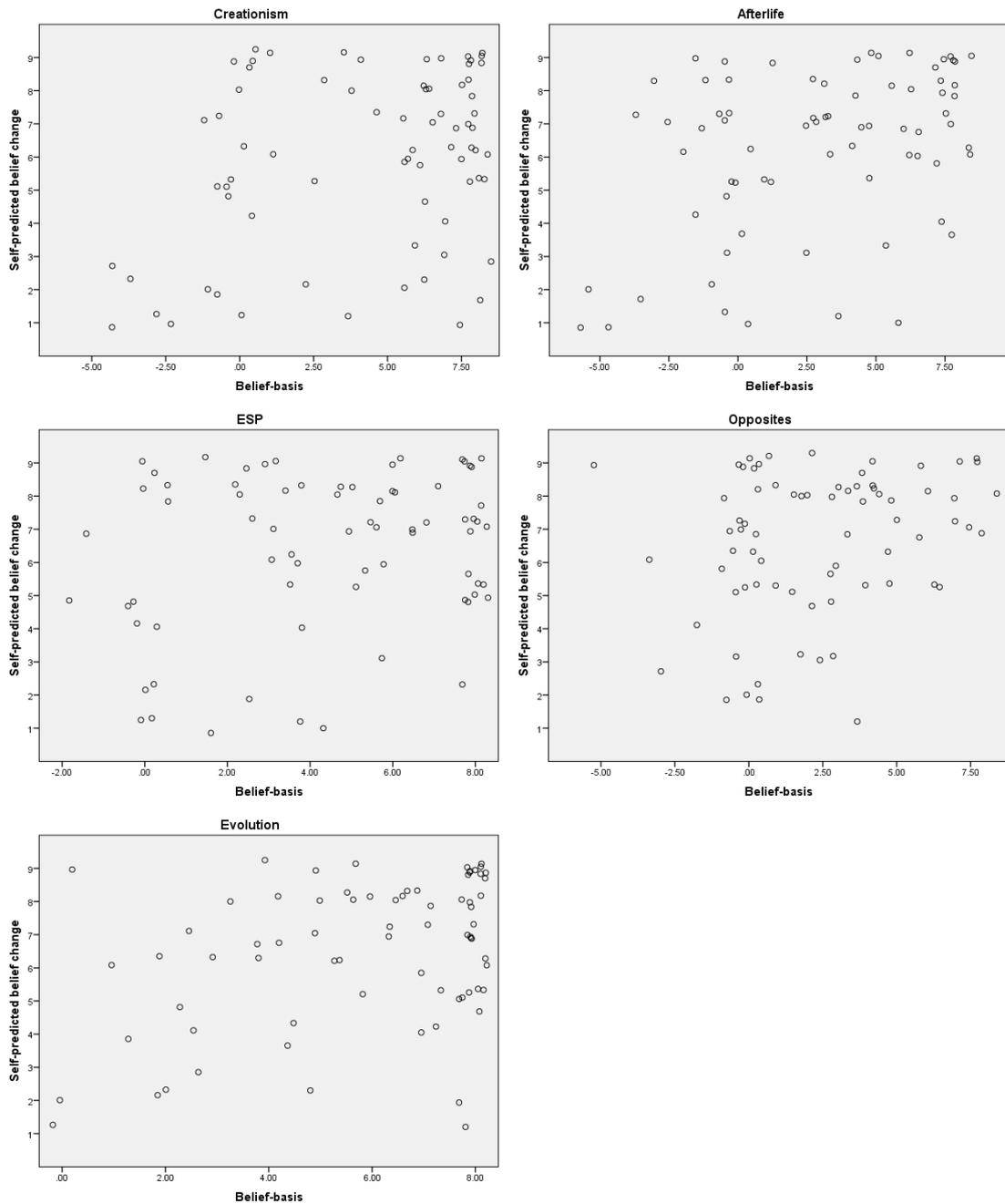
Hypothesis 2 predicted that a greater rational belief-basis would correlate with greater self-ratings of belief change likelihood. A bivariate correlation was conducted between belief-basis and self-predicted belief change. A positive correlation indicates that participants who report a greater rational belief-basis are more likely, than those with an intuitive belief-basis, to feel that they will change their view later if challenged by strong contradictory evidence, whereas a negative correlation indicates the opposite situation. For all topics, except ESP, there was a significant positive correlation

between self-predicted belief change and rational belief-basis (correlations ranging from .266 to .360, p-values from .046 to .002). Griffin and Ohlsson found this positive correlation significant for all topics, however, so the finding for ESP was not replicated here ($\rho = .148$, $p = .214$). This is shown in Table 4.

Table 4 - Correlations between belief-basis and self-predicted belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	.266	.360	.148	.234	.303
Significance	.023	.002	.214	.046	.009

Figure 7 - Scatterplots of belief-basis vs self-predicted belief change



Extending from the original analyses that Griffin and Ohlsson conducted, an exploratory bivariate inter-correlation of belief-basis was also conducted to look at whether participants presented a consistent belief style. As shown in

Table 5, belief-basis inter-correlated positively across all topics, ranging from rho = .324 to rho = .728 (p-values from .005 to < .0005).

Table 5 - Inter-correlations between belief-basis on each topic (Spearman's Rho)

	Creationism	Afterlife	ESP	Opposites	Evolution
Creationism		.575	.551	.442	.634
Afterlife			.728	.324	.450
ESP				.387	.541
Opposites					.454

Discussion

With some exceptions Griffin and Ohlsson's (2001) findings were replicated in Study 1. The belief-basis hypothesis was supported, with greater rational belief-basis correlating with greater self-reported likelihood of belief change. The exception to this was the topic of ESP, which did not show the predicted effect, although it was in the correct direction. Griffin and Ohlsson's other finding, that each topic correlated more with one type of belief-basis than the other, was also replicated. Therefore, while the sample of topics in the present study is small it seems plausible that the principle would generalise: topics will tend to have an associated 'belief profile'. The exception to this finding was for Opposites, which did not correlate with one type of belief-basis more than the other ($p = 0.104$), although it is unclear whether there was a good reason for this or whether it was a statistical fluke born of conducting multiple analyses on the data (cf. Study 2). Overall, however, despite drawing upon a very different population sample, these results generally confirm Griffin and Ohlsson's findings, suggesting that the reason people hold their beliefs influences how likely they are to change those beliefs and that topics vary consistently on belief-basis.

Going beyond the original Griffin and Ohlsson analyses, the most interesting finding was that, while belief-basis varied across topics, participants nevertheless seemed to have a preferred 'belief style'. This was demonstrated by the positive inter-correlation of belief-basis across all topics. This is, of course, an exploratory analysis, although the high degree of statistical significance does provide some confidence in the finding.

Overall, the findings of the present study add to the robust result found in the literature that belief-basis can vary for rational and intuitive reasons and be associated with a certain thinking style (Clarke, 1995; Legare et al., 2012; Lindeman, 1998). In this instance it might be referred to as a believing style, but the implication in terms of the path-dependency model is that consistency of belief style indicates an underlying consistency of processing style. Such consistency should further bolster the likelihood of detecting an effect in the next intervention study, since those participants with a more rational belief-basis in ESP will also be more likely to generally use a rational processing style, which will better help them to assimilate the rational disconfirmation presented in such an intervention. Indeed, this agrees with literature finding that cognitive style moderates the effects of reasoning biases. For example, across four studies Klaczynski, Gordon, and Fauth (1997) looked at various factors, such as critical reasoning skills, personal goals, and general intellectual ability, and found that thinking biases were predicted best by thinking style.

However, a striking anomaly in the present findings was the lack of a correlation between belief-basis and self-predicted belief change for ESP. This is notable in light of the participants' special interest in topics such as ESP. This result implies that people may respond differently to contradictory knowledge involving topics in which they have (or perceive themselves to have) substantial knowledge already. This would not be such an issue in a general population sample, but it is worth considering why it might have occurred. One idea that might be offered in relation to this finding is the 'backfire effect'. Betsch and Sachse (2013) demonstrated this effect in their paper on debunking vaccine myths. They found that strong beliefs meeting strong disconfirmation lead to an even stronger belief response instead of adjustment of the beliefs. This effect is generally explained as a defence against a core belief, much as people would defend themselves against a physical attack, more strongly the stronger the attack is. However, this would only be true for the present sample if they rated low on self-predicted likelihood of belief change (i.e. resistance to change), which a cursory look at the belief change graphs indicates is not the case; self-predicted belief change was similar to Griffin and Ohlsson's sample and actually presents some of the highest openness to belief change across the five topics. This apparent openness to belief

change also implies that ESP is not seen by participants as unfalsifiable, and thus ESP does not gain the advantages that Friesen, Campbell, and Kay (2015) argue such a property confers on a belief. Advantages, such as being easier to defend, tend to give unfalsifiable beliefs or belief systems an advantage in spreading. However, this does not appear to be the case here. The openness of the group to belief change also mitigates against the likelihood that they are engaged in motivated reasoning (Westen, Blagov, Harenski, Kilts, & Hamann, 2006). This type of reasoning is where individuals process information in line with their own goals, such as wanting ESP to be real, or not. Of course, there is always the possibility of demand effects and participants may have been responding in a way that they feel was expected of them as members of a group interested in anomalous phenomena – i.e. open mindedness. However, if this is the case then the demand effect clearly did not generalize to other topics outside of the specialist area. This is particularly interesting, since Afterlife is a topic in the study and is included in omnibus measures, such as the Paranormal Belief Scale (Tobacyk & Milford, 1983), yet the responses of participants differed substantially in this area. This may be due to religious connotations with that particular phenomenon, but it underlines the need to avoid treating paranormal beliefs as a homogenous group if it is possible to treat them separately in any given study.

All of the above relates to self-predicted belief change, however, and was also obtained under laboratory conditions online rather than actually testing belief change in the real world. It is worth heeding Mitchell's (2012) warning that laboratory research has a worrying tendency to fail in the real world. This is all the more concerning when the laboratory results rely upon self-predictions of future behaviour as people are known to be poor at this sort of prediction. This particular issue will be discussed in greater detail in the next chapter, but an example has already been encountered in the literature review for this thesis, with people showing biased predictions of their own behaviour even when they were aware of the base-rates involved (Nisbett & Borgida, 1975). This indicates that there may be validity issues when relying upon self-reports of future behaviours of the kind used in the present study.

Finally, the study also collected qualitative data on people's reasons for belief in the five topics. Analysis of this will be deferred to a later chapter, where it will be used as part of a refinement of the original belief-basis measure, which has a number of obvious shortcomings, such as the imbalance in the number of intuitive and rational items presented. This revised belief-basis measure will then be used for other studies in the programme, although not for the first intervention study as it is important that the results of that study can be compared directly with the present replication study, and Griffin and Ohlsson's original. Finally, the mode of the questionnaire did not seem to influence the results, thus, adding to the literature supporting equivalence of online and offline modes.

In conclusion, the present study demonstrated that Griffin and Ohlsson's findings largely replicate with a different sample and mode of presentation. This provided some nascent support for the path-dependent model of belief formation and change and indicated that the avenue was worth pursuing using a more naturalistic adaptation of the methodological template. The next step was therefore to adapt the methodology for use in an intervention study, which would be similar to existing intervention studies on reduction of paranormal belief. However, unlike those studies the aim was not simply to look at whether belief change occurs, but to investigate why it might be changing for some people more than for others.

Study 2 – Does Belief-Basis Influence Real World Belief Change?

Background

The previous study generally replicated Griffin and Ohlsson's (2001) finding that belief change was more likely when beliefs had a greater rational component to belief-basis. It also confirmed that belief-basis profiles vary across topics, with belief in ESP being more intuitively based. With respect to belief change, the study only looked at self-predicted likelihood of belief change. However, there are problems with relying upon self-prediction, and self-report more generally. Therefore the present study measured real belief change rather than self-prediction of belief change and did so in a naturalistic setting.

In their classic paper, Nisbett and Wilson (1977) take an anti-introspectionist view, raising doubts about the validity of self-reports of higher-order cognitive processing. They argue that it may be true that people can report accurately on higher-order cognitive processes when the stimuli are salient and are also probably causes of the responses. However, when this is not the case, when stimuli are not salient to the person or salient stimuli are not actually the causes of responses, then this sort of self-report cannot be relied upon. They compare the common use of self-report of higher-order thinking processes with the absurdity of asking people to introspect upon lower level processes, such as how much they are using parallel line convergence when judging distances.

This problem was demonstrated by Nisbett and Borgida (1975) when they investigated teaching students about classic studies with non-intuitive results, such as bystander apathy and experiments involving delivering electric shocks. They found that whether or not they presented students with the base-rate information about how likely people were to help or not, it did not alter the students' predictions of their own behaviours or their attributions about the personalities of people in the studies. Nor did any of the

students make reference to the participants in the studies when explaining the predictions of their own behaviour. In other words, the students showed a complete disregard for information that was useful in predicting their own behaviours and which therefore should have caused them to adjust their predictions. They remained biased in predicting their own behaviours, predicting that they would be nicer people than those in the studies they had been taught about. This raises the question of whether Griffin and Ohlsson's (2001) findings regarding self-predicted belief change are simply a case of biased responding.

As it stands, however, the study by Nisbett and Borgida could be written off as an insufficient test, since the participants in the study really might have behaved differently had they themselves taken part in bystander or shock test studies, even though the statistics from many such studies suggest this is unlikely. Stronger evidence of the problem of relying upon self-prediction, however, comes from a study by Balcetis and Dunning (2013). They looked at two psychology study situations: variations in group size in bystander helping situations, and the effect of mood on giving a charitable contribution. They found that people were more accurate when predicting other people's likely behaviours in these two situations than in predicting their own likely behaviour. Unlike in Nisbett and Borgida's study, however, the students were (unbeknownst to them) being told about results of studies their peers had actually taken part in. This meant that the students making the self-predictions about their own behaviour in those situations were, on average, expected to behave in the same way as their peers did, thus removing the excuse that those making the predictions may really be so different that their optimistic self-predictions were actually accurate.

The phenomenon of choice blindness adds further reason to heed Nisbett and Borgida's (1977) warning. It turns out that people not only make errors in predicting potentially far future behaviours, but they also find it hard to report accurately on current behaviours that have only just been completed. In the choice blindness paradigm, Johansson, Hall, Sikstrom, Tarning, and Lind (2006) demonstrate that people are 'blind' to choices they have only just made. This effect was achieved by

asking participants to decide which of two female faces they like more and then placing the cards on the table face down. When the chosen card is lifted up again it has the other face on it, which was not the one chosen. This is achieved by use of a very simple card trick and participants were generally unaware of the switch (see also 'change blindness' - e.g. Simons & Levin, 1998). Participants then proceed to explain their choice to the experimenter, creating a justification for why they chose the face that they did not really choose. The same effect has also been demonstrated in self-transforming surveys on topics, such as political views (Hall, Johansson, & Strandberg, 2012). Again, using a simple trick, participants' responses are reversed, yet they proceed to explain why they chose the opposite response to the one they had really chosen. In doing so, participants often gave perfectly coherent and even strong arguments in support of their illusory choice, which could be in direct contradiction to their actual choice. The lesson for the present research programme from choice blindness and self-prediction studies is that people may say one thing now, but this does not reliably predict what they will do or say in the future – even if that future is only seconds away from the present.

The current study therefore used a lecture-based intervention in order to measure real-world belief change, drawing upon an existing lecture session for first year students at Goldsmiths College, University of London. This also presents a naturalistic intervention, since the presentation of rational counterevidence and argument is exactly the sort of thing sceptics of the paranormal are thinking of when they make recommendations on belief change – i.e. typically the approach is a deficits one, usually regarding a knowledge gap. As already mentioned in the general background, there is a precedent for the use of interventions, such as lectures, to induce belief reduction.

For example, Harrington (2013) used an intervention study to change the beliefs of biology students about a selection of topics in biology. The changes in belief were moderate, but detectable and in line with course objectives – i.e. incorrect beliefs tended to change in the direction of correct beliefs, rather than vice versa. The present study hoped for similar results, demonstrating a reduction in belief in ESP after the intervention. Indeed, Jones and Zusne (1981) specifically provided an intervention on

paranormal topics, including ESP, and found that this led to the expected reduction in paranormal belief. As with Harrington's study, this one used a course-length intervention. Banziger and College (1983) demonstrated the same belief reduction effect in a course-length intervention with older participants (mean age of 67 years old), demonstrating that the effect is not limited to younger, student samples. The course itself was not a typical university course, but was similar. The course covered topics of an anomalous nature for 1.5 hours per day. At 6 months after the intervention, belief reduction still remained, a reduction on the Paranormal Belief Scale (Tobacyk & Milford, 1983) of about 7 to 8 points (the scale being scored from 0 to 100).

McLean and Miller (2010) included the addition of a standard research methods course in their study, as a comparison with their anomalistic psychology course, in order to control for skill acquisition versus specific knowledge acquisition. Both courses showed improvements in critical thinking skills. However, only the anomalistic psychology course showed reduction in paranormal beliefs, indicating that it is subject-specific knowledge that leads to reduction in paranormal belief rather than thinking skills. Morier and Keeports (1994) presented similar results in their own study, also using a control group, this time students studying a course on psychology and law vs students studying a course on science and pseudoscience. Once again, belief in the paranormal was reduced and the implication was that topic-specific interventions are required for belief change to happen.

It might be, however, that students in the courses focusing on anomalistic topics are responding with lower post-test belief levels due to a demand effect, based upon being on that particular course. A different approach was therefore taken by Kane, Core, and Hunt (2010) in order to address this concern. Their novel approach was to use a cognitive bias as a measure of belief change. The specific bias they used was the hindsight bias, where people tend to think that their previous belief states are more similar to their current belief states than they actually are. In this way asking participants about their *previous* belief state actually gives a good indication of their *current* belief state, thanks to the biased responding. With this technique they aimed to avoid a response bias in participants' post-intervention belief ratings, because

participants are not being directly asked about their current level of belief. A limitation of this approach is that the belief level reported is likely to be higher than the real current belief level, which reduces the power to detect belief reduction. However, as a means of determining if belief change is due to a demand effect it was useful, and there was sufficient power that the study in question did indeed show that belief reduction occurred.

There is therefore a clear precedent for the use of interventions for belief change in the present study. However, a key difference is that the above studies all used extensive, course-length interventions, whereas the present study planned to use a single one-hour lecture on anomalistic psychology. The difference in the amount of knowledge that can be communicated in a one-hour lecture compared to a full course of lectures is obvious and the difference might well be expected to reduce the size of the effect and thus the power to detect an effect. However, there is precedent for the use of a 'single-dose' intervention technique. Happs (1991) found long-term belief change after one such intervention with trainee primary school teachers. Happs showed participants videos of water dowzers repeatedly failing to succeed under controlled conditions. Dowsing involves using sticks that apparently move when there is water, or some other desired substance, nearby. However, there is no real mechanism for this and it has not been shown to work under scientifically controlled conditions (French, 2014). Nevertheless, it is a common paranormal belief. Encouragingly for the present study, Happs found that, even though the intervention was short, there was long-term reduction of belief.

However, none of these studies addresses the variance in belief change across individuals, yet in none of the studies was belief change black and white. Not everyone changed their beliefs and when they did the belief change was only partial. This is the kind of variance that the path-dependent model attempts to account for and which the present study is therefore designed to investigate. The present study therefore applied the same measures from the previous study as pre- and post-test measures within an intervention paradigm. The belief-basis measure was not updated at this point, in order to ensure the real-world intervention results could be directly

compared with the online replication study. However, the self-predicted belief change question was omitted in order to avoid any potential demand effects that would not be present in the online study. Similarly, for practical reasons, the free response questions were omitted to shorten the questionnaire. All five topics from the previous study were included, with the intention that the non-ESP topics would act as a check on whether the intervention was specifically influencing ESP. Additionally, they provided a broader range of data for the pre-intervention analysis, allowing fuller comparison with the previous study. Predictions and related rationale remained the same as for the previous study except that the measure of belief change was actual belief change rather than self-predicted belief change.

Hypotheses

H1 – pre-intervention belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson’s study.

H2 - Belief in ESP would be lower after the lecture than before.

H3 - The more rational the basis for their belief in ESP before the lecture, the more likely participants would be to reduce their belief in ESP afterwards.

Method

This study extended the methodology from Study 1 for use in an intervention paradigm. There were two variables measured pre- and post-intervention: belief-basis and belief-level, each of which was measured across the five topics used previously: creationism, afterlife, opposites attract, ESP, and evolution. In contrast to Study 1, there was no free-text response option and no self-predicted belief change question. Belief change was measured directly as the difference between pre- and post-intervention belief levels.

Participants

Participants were first year students enrolled in a research course, which included a one-hour slot each week where students participated in questionnaire-based research for course credits. The course also included 5 one-hour lectures, one of which was an

introduction to anomalistic psychology. The original sample size was 112, but 32 were removed due to incomplete datasets or not taking part in both the pre- and post-intervention questionnaires. This left a sample of 80 participants for the analysis. There were 22 male and 58 female participants, ages ranging from 17 to 43 (mean 21.4, SD = 4.888).

Materials

The questionnaire from Study 1 was reused for the present study, although presented in paper and pencil format. The free-response questions and the self-predicted belief change question were omitted, however. Free-response questions were omitted to make the questionnaire quicker to complete, since it was not the only questionnaire that students were completing within the one-hour research participation session. Self-predicted belief change was omitted in order to limit the potential for demand effects. Although Kane et al. (2010) did not find evidence of a demand effect in their sample, it was deemed better to limit the possibility anyway, in order to have greater confidence in the results when comparing them with the non-intervention versions of the present study. Asking a question about belief change before the intervention adds unnecessary risk of generating a demand effect. The original belief-basis measure was also used in the study in order to best facilitate comparison with the non-intervention studies – this measure was refined for use in later studies in the programme, but at this point it was more appropriate to use the original measure, despite the presence of some potential issues, such as imbalance in the number of each type of item. Finally, the intervention itself consisted of a single one-hour lecture, presented as an introduction to anomalistic psychology. The lecture covered disconfirming material (i.e. sceptical explanations) across a wide range of topics, including dowsing, UFOs, ESP, ghosts, waking sleep paralysis, and so on. Presentation of the material used multiple media types: text, images, video, and audio, and presentation style was engaging. Overall, the content and presentation were such that students would be expected to enjoy learning about the material and to engage with the disconfirming material that was presented.

Scoring

Belief in each topic was measured in the same way as in Study 1.

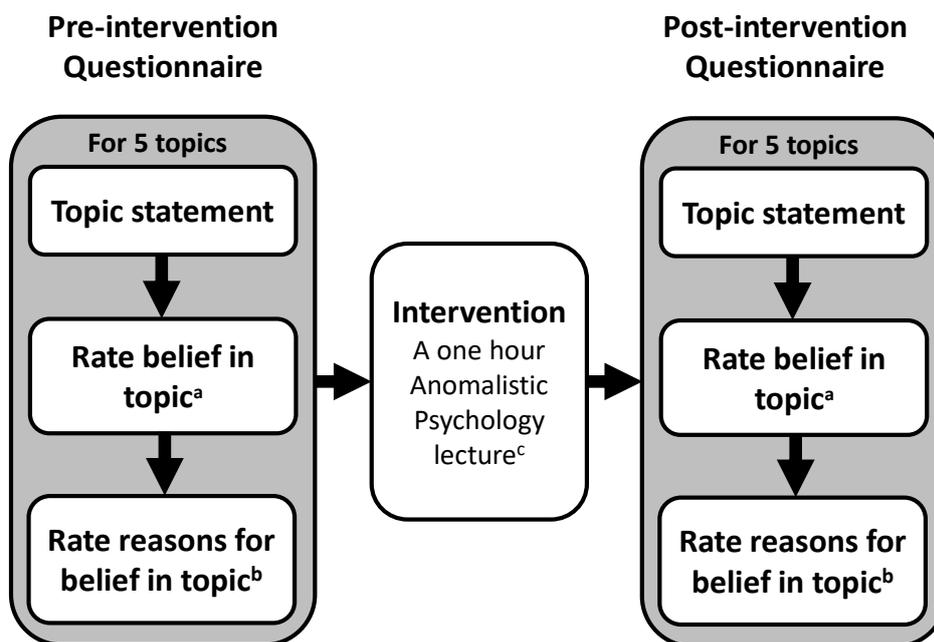
Belief-basis on each topic was also measured in the same way as in Study 1.

Belief change on each topic was calculated by subtracting belief after the intervention from belief before the intervention. The score ranged from -8 to +8, where -8 represents the greatest possible decrease in belief and +8 represents the greatest possible increase in belief.

Procedure

The time sequence of the study is illustrated in Figure 8. Participants completed the questionnaires in a special research session that they attended weekly to complete research questionnaires for course credits. This session was one hour long and the students filled in multiple questionnaires in a single session. The printed questionnaire included a briefing sheet and consent form (Appendix 2), which was signed by them. The consent sheet was removed from the rest of the questionnaire after data collection and stored separately in order to provide anonymity to the participants. The briefing included being told that they would be asked about such views as the ones in the questionnaire at multiple points during the year – they did not know that this was an intervention study, but simply presenting a second questionnaire later without prior explanation may have been suspicious, leading to participants catching on to the aims of the study and producing unwanted demand effects. Approximately two weeks after the first questionnaire the participants attended a one-hour lecture introducing anomalistic psychology. After another two weeks they filled in the questionnaire again. This time, after they had completed the questionnaire they were given a debriefing sheet (Appendix 2). As always the study followed BPS ethical guidelines (BPS, 2018) and students were told of their right to exit the study. This study was approved by the ethics committee at Goldsmiths College, University of London.

Figure 8 - Time sequence and measures for Study 2



^a **Belief** in topic rated from 1-9 (none to completely).

^b **Belief-basis** – calculated from 5 ratings of reasons for belief (1-9, from not at all to completely). Mean rating for the three intuitive items is subtracted from the mean rating for the two rational items, giving an overall rating from 1-9 (from intuitive belief-basis to rational belief-basis)

^c There was a one to two week gap separating the lecture from each questionnaire.

Results

As in Study 1, graphs of the belief-basis in each topic for believers and non-believers are presented, compared alongside the results from Griffin and Ohlsson’s (2001) original study (see Figures 9 and 10). A close visual match can be seen between the present sample and Griffin and Ohlsson’s sample. This holds for both believers and non-believers across all of the topics, despite variations in the number of participants contributing to the columns in the graph (the bracketed numbers indicate how many participants’ data is being charted – USA sample on the right-hand side). For example, the current study had only 7 believers in creationism, whereas the USA sample had 59 believers, yet the belief profile for this topic was almost identical.

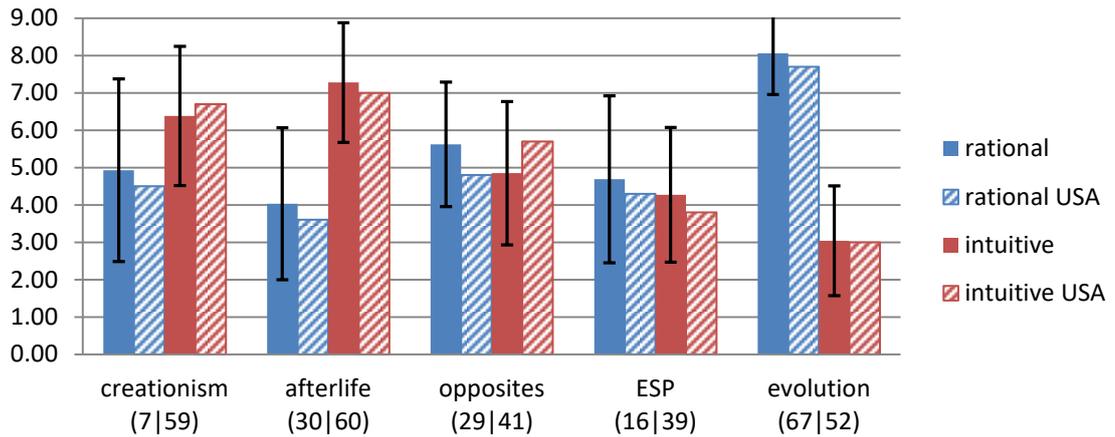


Figure 9 - Comparison between Study 2 and Griffin and Ohlsson's (2001) USA sample for believers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

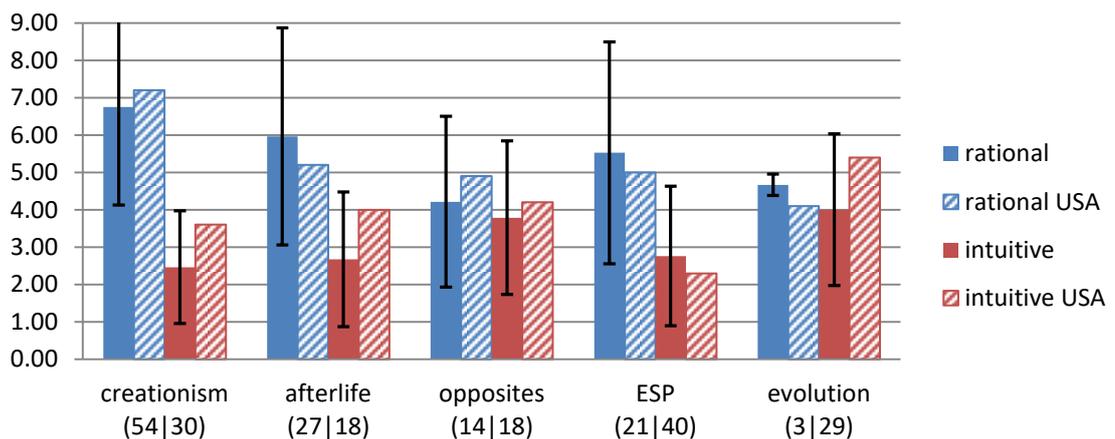


Figure 10 - Comparison between Study 2 and Griffin and Ohlsson's (2001) USA sample for disbelievers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

Prior to statistical analysis of the results, the integrity of the belief-basis measure was checked. The overall Cronbach's alpha was .558. Factor analysis showed two factors with the expected items. Cronbach's alpha for the intuitive items was .721 and for rational items it was .807.

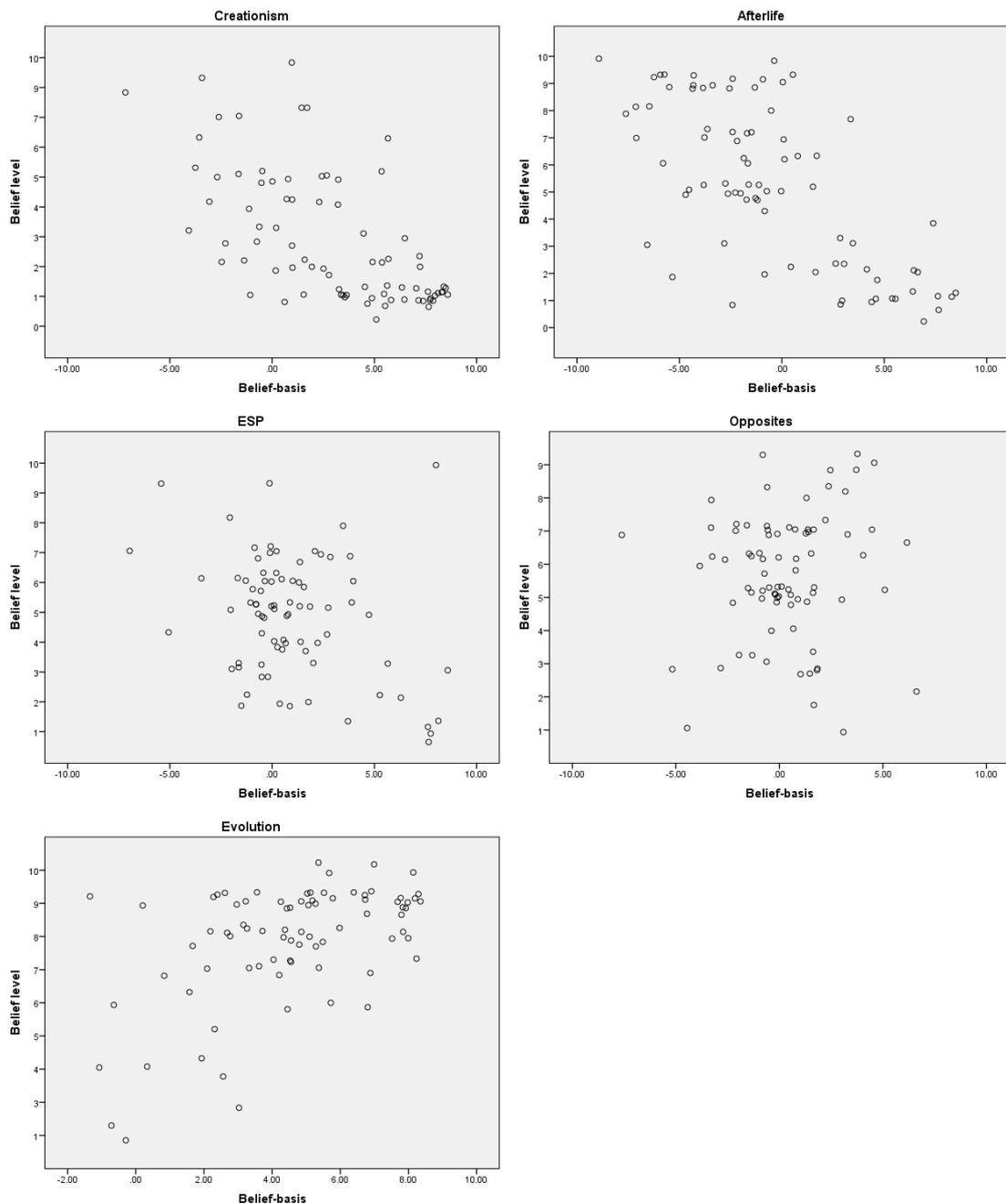
Hypothesis 1 predicted that pre-intervention belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson's study. A bivariate correlation of belief-basis and belief was conducted. Table 6 presents the correlations between belief-basis and belief for each topic. A positive correlation indicates that belief in a topic has

a more rational basis and a negative correlation indicates the belief has a more intuitive basis. All but Opposites show a significant effect at $p < .0005$, with $p = .035$ for ESP. Opposites fails to correlate significantly at $\rho = .093$, $p = .414$. Creationism, afterlife, and ESP all correlate negatively with belief-basis while evolution correlates positively, as found in Griffin and Ohlsson's original study and in Study 1 of the present programme. Griffin and Ohlsson also found that Opposites correlated negatively, but this was not replicated here although this does replicate the result from Study 1.

Table 6 - Correlations between belief-basis and pre-intervention belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.674	-.658	-.236	.093	.494
Significance	<.0005	<.0005	.035	.414	<.0005

Figure 11 - Scatterplots of belief-basis vs pre-intervention belief



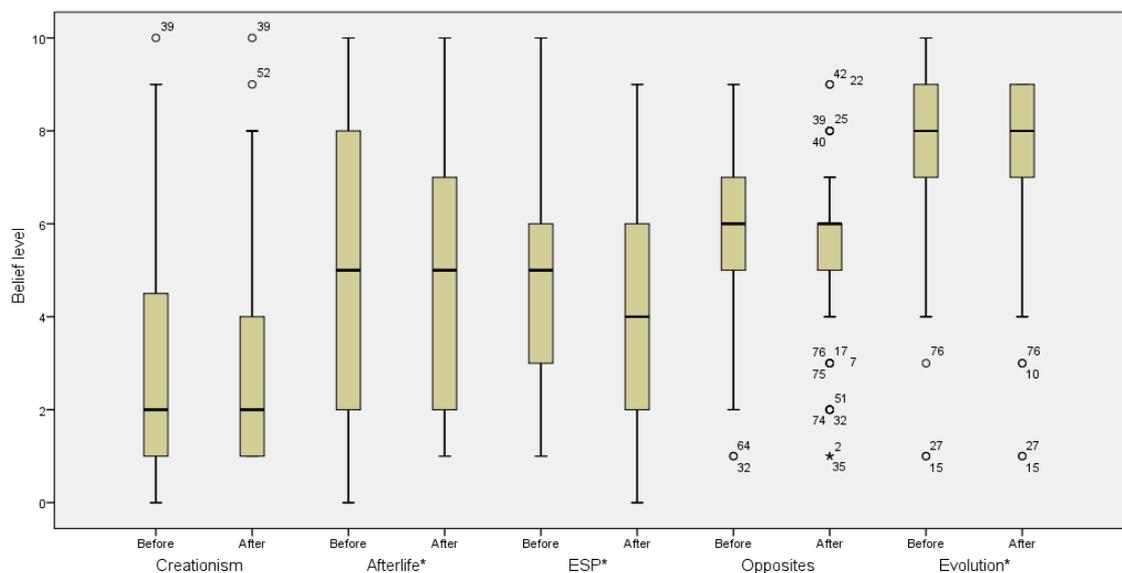
Hypothesis 2 predicted that belief in ESP would be lower after the lecture than before. A Wilcoxon test of belief ratings before and after the intervention was conducted (the Wilcoxon test is a non-parametric version of a paired samples t-test). Belief reduction was observed in three of the topics. Belief in ESP reduced the most, from 4.81 to 3.94 (-.88), $Z = -3.653$, $p < 0.0005$, while belief in evolution reduced from 7.78 to 7.41 (-.36), $Z = -2.737$, $p = .005$, and belief in afterlife reduced 5.18 to 4.74 (-.44), $Z = -2.459$, $p = .013$.

Belief in creationism did not show any reduction: $Z = -.584$, $p = .569$, nor did belief in opposites attracting: $Z = -1.109$, $p = .27$. This is shown in Table 7.

Table 7 – Belief change after the intervention

	Creationism	Afterlife	ESP	Opposites	Evolution
Mean belief change	-.06	-.44	-.88	-.19	-.36
Significance (exact 2-tailed)	.569	.013	<.0005	.271	.005

Figure 12 - Boxplots of belief for each topic, before and after the intervention



* the difference in belief before and after the intervention was significant, $p < .05$

Since there was significant belief change observed in ESP, additional analysis was conducted to determine if ESP was actually reducing more than belief in the other topics that were not targeted by the intervention. Wilcoxon tests between ESP belief change and belief change in each other topic were conducted. The results are displayed in Table 8 below. The results largely support the idea that ESP belief reduced more than the other beliefs. This was indisputably the case in relation to evolution and creationism, but compared to opposites and afterlife, the effect was of

borderline significance ($p = .051$ and $p = .053$, respectively). Given the number of analyses conducted, this does not warrant disregarding the ESP belief reduction in the present study, however.

Table 8 - Differences in belief change between ESP and the other topics

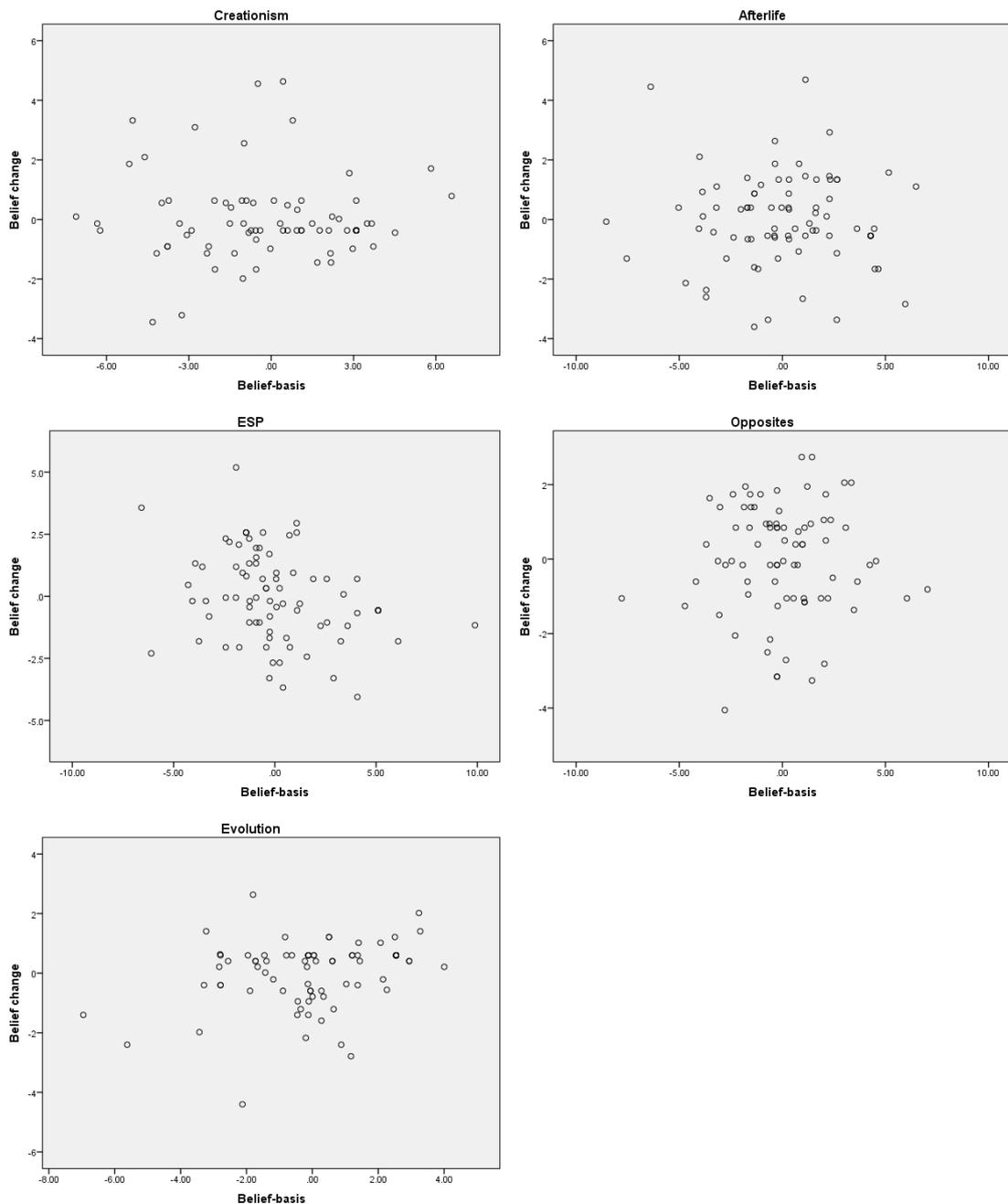
	Creationism	Afterlife	ESP	Opposites	Evolution
Belief change difference ([topic]-ESP)	.81	.43	n/a	.69	.52
Significance (exact 2-tailed)	.004	.053	n/a	.051	.029

Hypothesis 3 predicted that the more rational the basis for participants' belief in ESP before the lecture, the more likely they would be to reduce their belief in ESP afterwards. For each topic a partial correlation between belief-basis and belief change was conducted, controlling for pre-intervention belief level. While ESP was the focus of the hypothesis, some other topics had shown belief reduction as well and therefore all topics were included in the analysis for comparison. As shown in Table 9, ESP showed the predicted effect of greater belief reduction when belief-basis was more rational, $r = .303$ $p = .007$. The topic of Evolution also showed a correlation, however: $r = .304$, $p = .006$. No other topics showed a significant correlation.

Table 9 - Correlations between belief-basis and belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Pearson's r	-.024	-.028	-.303	-.021	-.304
Significance	.832	.808	.007	.854	.006

Figure 13 - Scatterplots of belief-basis vs belief change (pre-intervention belief partialled out)



Finally, the analyses were once again extended to include a check on the belief style of the participants. To this end a bivariate inter-correlation was conducted on belief-basis across all five topics. With the exception of two correlations with evolution the topics were all positively correlated, with a high degree of statistical significance. The correlations between evolution and afterlife, and between evolution and opposites were not significant, although the effect sizes remained in the same direction as the other correlations. This is shown in Table 10.

Table 10 - Inter-correlations between belief-basis on each topic (Spearman's Rho)

	Creationism	Afterlife	ESP	Opposites	Evolution
Creationism		.424	.394	.237	.612
Afterlife			.399	.424	.180 (p=.111)
ESP				.460	.319
Opposites					.150 (p=.185)

Discussion

The main hypothesis gained some initial support in a real-world test of belief change. Belief in ESP reduced after the intervention and this was associated with a greater rational belief-basis. Therefore the previous findings regarding self-predicted belief change do, at first glance, appear to replicate in a real-world scenario. However, Afterlife and Evolution also showed belief reduction, but only changes in belief in Evolution were associated with belief-basis. These conflicting results add a note of caution to acceptance of the hypothesis. Nevertheless, other aspects of the findings did more clearly replicate those of previous studies. The findings showed that beliefs are held for different reasons and that these can be usefully divided into intuitive and rational. Furthermore, it showed that individuals tend to have a consistent belief style across multiple topics.

The present study has shown, once again, that belief-basis and processing style are robust effects. Aside from the topic of opposites attracting, belief-basis was consistent with the findings of the previous study and Griffin and Ohlsson's (2001) original findings. The belief profiles thus shown were also consistent with what wider literature would predict for them, with ESP being related to a greater intuitive belief-basis, as was afterlife, and creationism, both of which are largely religious beliefs (Aarnio & Lindeman, 2005; Boden et al., 2012; Clarke, 1995; Irwin & Young, 2002; King

et al., 2007; Wolfradt et al., 1999). On the other hand, belief in evolution was consistently associated with a greater rational belief-basis. This can be expected since knowledge of evolutionary theory is arguably more likely to arise due to encountering rationally-based material on the topic. In particular, the present and previous research findings combine to cast doubt on Schouten's (2010) finding that there was no correlation between paranormal belief and intuitive belief-basis. In contrast, the present findings provide evidence that different topics tend to maintain a particular belief-profile across multiple sample groups (three so far: USA students, UK non-students, UK students).

Furthermore, while the belief-profile findings of Griffin and Ohlsson (Griffin, 2008; Griffin & Ohlsson, 2001) and Study 1 have been replicated and seem likely to be robust, there is also some initial indication that their belief change findings do generalise to the real world. The present study held the materials and relevant factors as close as possible to the original studies, and succeeded in finding a differential effect of belief-basis on belief change, in line with the predictions of the path-dependency model. This interpretation of the results must be tempered, however, by the observation that observed changes in belief for Afterlife and Evolution were not consistent with the hypothesis: Evolution showed the expected correlation, but Afterlife showed no correlation at all. The fact that belief in other topics varied is certainly plausible in itself, since participants will have been exposed to more than just the intervention lecture within the time period of the study. However, if this was the case then one would still predict that the hypothesized correlations for Afterlife and Evolution, but the results were, in fact, inconsistent on this point. Doubt is therefore cast upon the extent to which the path-dependent belief change hypothesis can be accepted.

It may be, as Alcock (2018) states, that beliefs are all the same kind underneath, no matter how they were arrived at. For example, it may be that beliefs are simply highly resistant to change in general, and that this general resistance overshadows much subtler influence, such as belief-basis or even cognitive processing style. Green and Donahue (2011) found this Spinozan type of effect in their study on people's judgements about characters in stories they read. Green and Donahue arranged it so

that participants found out that the original story was incorrect. This inaccuracy was explained as either being an accident on the part of the author or deliberate on the part of the author. Participants were quick to derogate the author who intentionally provided false details. But, surprisingly, finding out that the stories were incorrect did not cause participants to change their story-based judgments (e.g. their beliefs about characters in the stories). It did not matter if the inaccuracy was known to be deliberate. Nor did it matter if the story was presented as fictional or factual. In short, once people's beliefs about the characters in the stories were formed, they did not easily change. Derogation of a lying source did not extend to correction of story-based beliefs. This showed that countering people's beliefs may have no effect even when they *know* the original source was misleading. If beliefs about stories, some of them fictional, can be this hard to change, then it is plausible that real world beliefs may be even harder to change. Effects, such as those predicted by the path-dependency model, might exist but be too subtle to detect, or simply not have a chance to influence belief change at all.

However, the present study did induce belief reduction; it was not the case that beliefs were resistant to change per se, but that there is some doubt regarding the robustness of the differentiation that was found. Therefore, another possibility is that the rational actor approach is, in fact, correct and that people *are* rational actors generally speaking. In which case, how people arrived at their beliefs may be less important than the new information that they are being presented with – i.e. the closure of a knowledge gap (Anderson & Rausch, 2009; Bucher et al., 2014; Hample, 1979; Lange & Fishbein, 1983; McFarland & Thistlethwaite, 1970; Morris, 1996). This would, of course, also cast doubt upon rational actor theories that take path-dependence into account, such as Bleile's (2014) proposal. On the other hand, it may be simply that the path-dependency model is overly simple or missing important parts and this will be tackled in the next study.

Furthermore, should the nascent support for the path-dependent hypothesis fail to replicate then this would also raise important issues regarding researching real belief change rather than self-predicted belief change. It certainly seems that people are

predictably bad at self-prediction (Balcetis & Dunning, 2013; Johansson et al., 2006; Nisbett & Borgida, 1975; Nisbett & Wilson, 1977). On the other hand, if the findings replicate, then this would mean that simpler and cheaper laboratory based studies can be conducted instead of logistically more demanding real-world studies, such as the one conducted here. For now, however, the present recommendation must be that real-world study of belief change is to be strongly preferred in order to avoid the possible confound that self-prediction may introduce. The next study in the current programme was therefore another naturalistic intervention study, both for the above reasoning and to test whether the current study's findings replicated.

Methodologically, the present study was successful. While most existing intervention studies have used course-length interventions, the present study detected belief reduction after just a single one-hour lecture (Banziger & College, 1983; Harrington, 2013; Jones & Zusne, 1981; McLean & Miller, 2010; Morier & Keeports, 1994). This adds to the findings of Happs (1991), suggesting that single-dose interventions can be an effective way to study belief change. This is encouraging for research on belief change interventions generally, as it is clearly much easier, faster, and cheaper to administer a single one-hour lecture intervention than an entire course.

In conclusion, the findings of the present study were mixed, but promising. Robust dual-process related findings garnered further support, while the key hypothesis of the proposed dual-process model received cautious initial support. Assuming that the model is not fundamentally wrong it may be that the model is overly simplistic and the next study introduced an additional factor that emerges from the dual-process literature as important: the primacy of intuitive thinking and the consequent need to inhibit it in order for rational thinking to have its influence. Finally, due to the mixed nature of the findings in the present study regarding the potential unreliability of self-predictions, it was decided that all future studies in the programme would focus on measuring real belief change.

Refining the Belief-Basis Measure

Background

Before embarking on further studies, the belief-basis measure was in need of refinement. It was not used in the previous study because of the need to avoid varying too many parameters in the study, so that confidence could be placed in the results when comparing real-world belief change effects with self-predictions measured in the lab; moving from the laboratory to the real world is a big enough change in itself and modifying a measure is also non-trivial. It was reassuring to know that the belief-basis findings were still replicated and that the study was all but identical to the non-intervention study. However, there remained a number of issues with the current measure that were addressed for use in further studies in the series.

Firstly, it can be observed that the original belief-basis measure is not balanced in terms of the number of items (Griffin, 2008; Griffin & Ohlsson, 2001). There are three items for intuitive reasons, but only two items for rational reasons. A second issue is that the evidence-based reason presented for participants to rate is not specified as being rational or intuitive. However, people can perceive their personal experiences as 'evidence' (Clarke, 1995) or they might be referring to scientific evidence. This clearly confounds the meaning of the item. Indeed, Griffin (2008) does note that types of evidence are collapsed within the belief-basis measure, but cites this as an advantage, since it does not limit participants to only rational evidence. However, it is unclear how this achieves the aims of measuring the relative contribution of intuitive and rational reasons for beliefs since it is not possible to determine if a participant's response to that item is intended as relating to rational or intuitive evidence. In fact, Griffin (2008) goes on to state that:

“It is important to note that while the last item refers specifically to “Science”, the item labeled “Evidence” provides no constraints on how respondents interpret the meaning of “evidence” and the phrase “that I am personally aware of” was

included to encourage respondents to include anything they would consider a type of “evidence”. Testing revealed that the Evidence and Science items are only correlated at $r = .50$, meaning that 75% of the variance in Evidence ratings is independent from the Science item.” (p.3)

Here the correlation confirms the suspicions that the evidence item is confounding the two types of evidence that a path-dependent model of belief change would be seeking to separate.

Finally, from the replication data it was noted that the faith item was essentially a subset of ‘head versus heart’. Only 7% of responses rated faith as higher than head/heart as a reason for belief or disbelief. This implies that the two items need conflating into a single item rather than doubling up on the intuitive belief-basis scoring and artificially influencing the overall score.

The refinement proposed in the present chapter therefore aimed to provide a more balanced belief-basis measure. In doing so, the free-response text from the replication study was also drawn upon, similarly to how Griffin and Ohlsson (2001) did in their original study to produce their original items. The aim was not to develop a completely new measure, however, it was merely to refine the existing one in a logical and careful way. Part of this process involved qualitative analysis of the free-response text, but it was not limited to this.

Materials

As a convenience to the reader the original belief-basis items are replicated in Table 11, for ease of reference. This was the base from which the present refinement developed.

Table 11 - Original belief-basis measure items

Intuitive	Rational
My belief about [topic] makes me feel good or is comforting.	My belief about [topic] is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.
When it comes to issues like [topic], I trust my 'heart', not my 'head' to tell me the truth.	My belief about [topic] is supported by current scientific knowledge.
I don't need proof, I have faith that my belief about [topic] is correct.	

The only other material used directly in the revision was the free-response text from Study 1, which can be found in full in Appendix 3. As stated in Study 1 the sample size for the study was 72, consisting of 30 men and 42 women, ranging in age from 20 to 70 (mean 36.16, SD = 14.873). All free-text responses by participants were checked for anonymity before including in Appendix 3 (no redactions were required).

Analysis

The responses were analysed using an inductive (bottom-up) thematic analysis, looking for semantic (explicit-level) themes, following the basic process outlined in Braun and Clarke (2006). Points of interest in the responses were noted before bringing them together under initial higher level themes, trying to allow the data to speak for itself and not fall into the trap of using the question/prompts as ready-made categories, although it must be acknowledged that the original items from Griffin and Ohlsson

(2001) could not be completely ignored. Indeed, one would expect to find similarity. The responses were then recoded in terms of the themes, before revisiting the responses and distilling the themes further (what Braun and Clarke refer to as 'define and refine'). At this point, typical thematic analysis would proceed to attempt to link the themes together into an overarching 'story' that explains the results. However, for the purposes of the present study it was sufficient to identify key themes that might form the foundation of any new items. In the end only one such additional theme was produced by the analysis and this was "internal consistency". This was a rational reason for not holding competing points of view or for disbelieving in a particular view. This kind of thinking often centred around contradictions in Bible scripture, for example, with participants stating that:

"The Bible is even internally inconsistent. There are two creation stories in Genesis that contradict each other."

"The bible stories of creation have internal contradictions."

This was not a theme that emerged due to being numerous in the responses, but it was one that came out as critical to some reasons for belief or disbelief and thus had importance overall. In thematic analysis the importance of a theme needs to be considered rather than just frequency (which is a different kind of analysis). The ultimate aim in a typical thematic analysis is to tell a meaningful, and hopefully accurate, story. Individual items can carry more weight than multiple other items in such a scenario therefore and internal consistency was deemed to be one such theme.

In addition to analysing the free-response data there was also some modification of the existing belief-basis items. The original scale is unbalanced, with 3 intuitive items and 2 rational items, as well as omitting personal experience, which is a known correlate of paranormal belief. One of the aims was therefore to balance the items and also include personal experience. It was also noted that the item on evidence did not specify what type of evidence, however, so this was split into two items, one on subjective evidence (including personal experience) and one on objective evidence, because 'evidence' may mean different things to different people, as illustrated by the colloquial parlance of

believing the evidence of one's own eyes. This provided an item on personal experience while at the same time separating out the types of evidence. In contrast, two of the intuitive items were collapsed down to one item. The original item on faith was removed as this was deemed to be a subset of 'head versus heart' (only 7% of responses rated faith as higher than head/heart as a reason for belief/disbelief). The internal contradiction theme found in the thematic analysis was also added as a rational item, balancing out the number of items of each type. Also influenced by the free-response Study 1, the 'scientific knowledge' item was changed to just 'science' to allow a broader scope of application. Finally, the question prompt itself was changed from using the term 'belief' to using the term 'view'. This was done to bring the usage more in line with academic operationalisation of belief and avoid cultural connotations the term may hold for some people, such as conflating it with 'faith'. In the colloquial sense, some people may argue that one does not 'believe' in a scientific theory, for example, since faith is not required. Table 12 (see next page) presents the final items used in the revised belief-basis measure.

Table 12 - Predefined reasons for belief and disbelief

Intuitive	Rational
I hold my particular view about [topic] because that view of things makes me feel good or is comforting.	I have arrived at my particular view about [topic] after careful evaluation of the objective evidence both for and against my view.
Personal experience or observation is the reason for my particular view about [topic].	Science is the reason that I hold my particular view on [topic].
When it comes to issues like [topic], I trust my 'heart', not my 'head' to tell me the truth.	I hold my particular view on [topic] because the arguments offered for other points of view are internally inconsistent – <i>i.e. the arguments contain contradictions within themselves and so cannot be true.</i>

Discussion

The aim of this chapter was to modify the belief-basis measure to allow participants to better express their reasons for belief. The refined measure achieved the aims set out for it. It is balanced in terms of the number of items. Conflated items have been separated and 'doubled' items have been conflated. And where necessary new elements have been introduced, such as personal experience and internal consistency. The terminology has also been changed from 'belief' to 'view' in order to use a more neutral term that does not imply any of the cultural connotations that some people may associate with the term, such as faith versus knowledge. Academics may operationalise such terms as belief, but it is important that when gathering responses

from participants, that appropriate terms for the audience are used – this is long known as an issue in cross-cultural studies (van de Vijver & Leung, 2016) and it could be argued that academia is itself a culture with its own language, so care is needed.

There is, of course, with any qualitative analysis or measure refinement, a tension between letting the data speak for itself and the agenda of the researcher in creating a new scale. So, in this instance, for example, the free-response text could not be neutrally analysed, since there was already knowledge of the existing items from the original belief-basis measure, and there was also some expectation of developing a scale with an equal number of items for intuitive and rational belief-basis. It is hoped, however, that the resulting treatment of the belief-basis measure has achieved the balance of fairly representing the data, whilst also achieving refinement of the measure. The full list of free-response texts is included in Appendix 3, so that the reader is free to draw their own judgments upon this matter.

In conclusion, the belief-basis measure is now arguably more balanced than the original, and suitable for use in further intervention studies in the research programme. The present chapter only covers the refinement of the measure and has not included any testing of it. The measure has good face validity, however, and was tested in the next intervention study. That study was almost identical to the first intervention study other than the inclusion of a new factor (inhibition of intuitive cognition) and the self-predicted belief change question being reinstated. It was not expected that the results would change dramatically. It was expected that the same belief-profiles would be seen, since the general belief-basis finding is robust not just within Griffin and Ohlsson's (2001) paradigm, but within the wider literature as well. However, the revised measure would hopefully provide a greater chance of detecting real effects due to the revised construction of the measure in terms of intuitive and rational belief-basis items.

Study 3 – Does Inhibition of Intuition Contribute to Belief Change?

Background

It has been argued in this thesis that dual-process accounts of cognition have good empirical support. In this respect, the present research programme has so far added to this body of literature by providing support for the idea that beliefs have varying belief-bases – in particular, that paranormal belief, in ESP, is associated with a greater intuitive component to belief-basis. Furthermore, the path-dependent belief change hypothesis has received some early support, albeit that this needs interpreting with a note of caution. The path-dependent model proposed was deliberately simple, however, only introducing the factors that were thought to be needed to predict variation in belief change, whereas, dual-process accounts of cognition include another key factor that was not included in the original model. This factor is the evolutionary primacy of intuitive cognition. In dual-process accounts it is generally agreed that intuitive cognitive processing comes more easily and/or prior to any rational cognitive processing (see the *General Background* chapter for a detailed discussion of this). With regards to the present study, it will be argued that in order for rational cognition to take centre stage and have an effect, intuitive cognition must be inhibited and that therefore this factor will need to be included in the model if it is to accurately predict belief change.

The classic incarnation of rational thinking is critical thinking, defined by Ennis (Ennis, 1991, 2018) as “... reasonable reflective thinking focused on deciding what to believe or do ...” (p.1). Indeed, Aarnio and Lindeman (2005) argue, based upon their study on educational level and paranormal beliefs, that it is the stronger preference for analytical thinking (i.e. critical thinking) that leads to a reduction in levels of paranormal belief as educational level gets higher. However, while their data did find the association between educational level and thinking style, it remains an assumption that education

or educational ability is associated with a greater tendency for analytical thinking style. There is also the problem that the assumption refers only to preferences for an analytical thinking style, rather than a tendency to actually apply it. Under academic conditions of study or examination it seems obvious that people's thinking style might be cued (Inbar et al., 2010) and the person could choose to apply their preferred style of analytical thinking. However, paranormal beliefs may not necessarily form in situations where cueing is available within the situational context and in this sense it would be better to talk of a tendency to apply rational thinking. Indeed, it is possible to read Aarnio and Lindeman's (2005) 'preference for analytical thinking' as equating to 'tendency for analytical thinking'. Semantically it may be clearer to avoid the implication that people are consciously choosing the type of thinking to apply.

Interpreted in this way, Aarnio and Lindeman's (2005) suggestion finds some support from a study by Rogers, Davis, and Fisk (2009). They tested believers and non-believers in the paranormal on conjunction tasks relating to both paranormal and non-paranormal events. They found that believers made more errors on both topics, implying that they had a lesser tendency to apply rational thinking to the problems, as suggested by Aarnio and Lindeman. Indeed, this is interesting in relation to the inverse association with educational level that Aarnio and Lindeman found. While educational level does, of course, act as a proxy for intellectual ability in many cases, Aarnio and Lindeman did not conclude that it was intellectual ability that correlated with lower paranormal belief. Instead, they refer to a preference or tendency, or simply a difference in thinking style, but not a difference in ability.

There is good reason for such a hesitancy to equate paranormal belief with intellectual mediocrity, largely because the body of literature on thinking skills and thinking errors demonstrates that the two tend to dissociate more often than not. In short, it is one thing to have thinking skills, but it is quite another thing to actually apply them. This dissociation is evidenced again and again in the literature. For example, Blackmore (1997) found that the thinking error of misjudging probabilities is not correlated with greater paranormal belief. This suggests that there is no difference in the abilities of the believers and non-believers. Similarly, Dagnall et al. (2007) found few differences

between believers and sceptics on a range of probabilistic reasoning tasks. The only exception was on the perception of randomness, in which believers tend to see more meaning. This is arguably less of a thinking error, however, and more one of perception. Indeed, they refer to the test as being “perception of randomness” and it was conducted by asking participants to make judgments about the likelihood of various sequences of coin tosses. However, they also tested participants on the use of base rate information, the conjunction fallacy, and derivation of expected value, all of which are very much non-perceptual tasks. There was no difference between sceptics and believers on these tasks, suggesting they share similar thinking abilities on these particular problems.

Critical thinking and reasoning skills are also found to dissociate from thinking errors. Hergovich and Arendasy (2005) found no relationship between critical thinking skills and paranormal belief, using the Cornell Critical Thinking Test and Watson–Glaser Critical Thinking Appraisal. And while they do claim an inverse correlation between reasoning skills (measured on the Wiener Matrizen-Test), this was only true for a few of the paranormal beliefs that were investigated, making it less likely that this is a real effect rather than a statistical artefact, since the specific pattern of correlations and non-correlation was not predicted in advance. Similarly, Royalty (1995) looked at critical thinking skills (measured on the Cornell Critical Thinking Test) in relation to paranormal belief and concluded that there is indeed a difference between having such skills and applying them.

In addition to the above examples, the general background chapter of the present thesis also presented evidence that thinking ability is independent of the likelihood of falling foul of thinking errors (Stanovich & West, 2007, 2008a, 2008b). Furthermore, in the same chapter, it was seen that even experts fall foul of these types of errors (Schwitzgebel & Cushman, 2015), such as the ethics philosophers who did no better than lay participants on reframed, structurally identical versions of classic ethical problems, such as the trolley problem or the Asian disease problem. All it took was a change of framing or ordering of the scenarios. Nor was there any pressure for a speeded response; the experts were free to take their time. This suggests that intuitive

cognition has primacy over rational cognition and that the former is not easily suppressed. Speeded response tests add further weight to the argument for evolved primacy of intuitive cognition, however (e.g. Kelemen et al., 2013). The general finding here was that when cognitive resources were reduced due to time constraints, experts did no better than lay people on physics problems. In short, rational thinking takes time. However, by the time the rational system has put its boots on, the intuitive system has already arrived with an answer, unless the intuitive system is inhibited somehow. An alternative solution is to reject the initial intuitive answer once the rational system catches up. However, in a speeded test, this means that the rational system simply never stands a chance. Indeed, even in an unspeeded test, it has a distinct disadvantage.

The general theme emerging from the preceding discussion is that it is therefore not enough to simply have the ability think rationally; this type of thinking must also be applied. Even in the case of experts, it is possible to construct conditions where they fall back on intuitive cognition (Kelemen et al., 2013). Most people are not experts in the paranormal and it is therefore reasonable to expect people to fall back on intuitive cognition unless they have a tendency to use a rational thinking approach generally. Indeed, the reference to an *internal* tendency to apply rational thinking is deliberate here. While there is also an argument for external cueing of rational thinking (Inbar et al., 2010), it seems unlikely that in real world situations, where paranormal beliefs might form, that such rational thinking cues would be present. Most people will not be forming their belief in the paranormal based upon academic papers, such as Cardena's (2018) recent review. The individual must therefore rely upon their own cognitive style; their tendency to think in a certain way.

Direct support for this suggestion is found in a study by Irwin and Young (2002) who found that intuitive thinking style (measured by the Rational-Experiential Inventory) correlated with greater paranormal belief. A tendency for an individual to inhibit intuitive thinking therefore seems to be an appropriate factor to incorporate into the path-dependency model of belief formation and change. Support for this specific suggestion is found in the literature for the existence of this kind of inhibition. For

example, Lindeman, Svedholm, Riekkki, Raij, and Hari (2013) provide fMRI evidence of greater activation in sceptics of areas of the brain previously associated with inhibition, when asked whether they thought that there was meaning in pictures unrelated to a story. This kind of inhibition, the ability to inhibit seeing meaning where there is none, is appropriate with respect to cognitive processing styles being investigated in the present study, but not all inhibition is the same and it is therefore worth briefly delineating the difference.

A study by Lindeman, Riekkki, and Hood (2011) illustrates the difference well. This study aimed to investigate whether believers and sceptics of the paranormal differed in their tendency to inhibit default (i.e. intuitive type) responses. Participants were therefore tested using the Wisconsin Card Sorting Test (WCST) and the Stroop Colour-Word task. In the card sorting test, participants are trying to guess a card sorting rule and get feedback for each card they place. However, once they get it right ten times in a row the rule is changed, unbeknownst to the participants. This tests their *tendency* to inhibit continuing with the old rule even though it is now incorrect. The Stroop task requires participants to name the colour that a word is printed in. This is made harder when the word is itself the name of a colour that is different from the colour it is printed in. This measures a participant's *ability* to inhibit their low-level automatic reading processes – name the colour, do not read the word. The study found that sceptics demonstrated a greater *tendency* to inhibit the use of the rule set in the card sorting test, but that there was no difference in the *ability* of sceptics and believers to inhibit their reading processes on the Stroop task. If one took the results of the Stroop test on their own this might be taken to show that believers and sceptics do not differ in their tendency to inhibit intuitive thinking. Or if taken together, the study presents a mixed result at best.

However, on this point the study has confounded two types of inhibition. In the above discussion the words 'tendency' and 'ability' were highlighted in italics. This is because the two tests are measuring two different things, one of which is far more relevant to inhibition of intuitive thinking than the other. The card sorting test measures the *tendency* of people to inhibit a higher order cognitive process (guessing

and applying a rule); they do not know that the rule has been changed so they are not consciously deciding to inhibit their response. Whereas the Stroop task measures people's *ability* to inhibit a low-level, automatic cognitive process; people know ahead of time that they need to try to inhibit one response so it is measuring ability not just tendency and the inhibition was extremely low level rather than influencing higher-order cognitive thinking. It was therefore important for the present study to select a test that would measure the appropriate kind of inhibition.

Although the REI (e.g. Irwin & Young, 2002) has been used in relation to paranormal beliefs before, it was considered too long for inclusion in the present study. Instead, a short, 3-item test called the Cognitive Reflection Test (CRT) was chosen to fill the role. The CRT measures people's tendency to inhibit default, intuitive responses to three relatively simple questions (Frederick, 2005). Such as:

A bat and a ball together cost £1.10. The bat costs £1 more than the ball. What does the ball cost?

The intuitive answer is 10, while the correct answer is 5. Neither answer is difficult to work out, but the first answer tends to spring to mind with less effort. Participants are required to inhibit this default response, however, and reflect upon the problem to get the correct answer.

The test is extremely short, and has been validated against large samples (Frederick, 2005; Oechssler, Roider, & Schmitz, 2009). The CRT will be discussed in far greater detail in the next chapter, which details a study programme designed to extend the CRT to improve its validity further. The rest of the present Study will therefore be using the CRT5, the 5-item extended version of the CRT, that aims to correct for issues, such as the numeracy bias in the original (see the next chapter for detailed discussion).

The expectation was that those scoring higher on CRT (i.e. greater inhibition of intuitive cognition) would be less likely to believe in ESP. In accordance with research showing a greater intuitive element to paranormal belief, they would generally be less likely to hold beliefs for intuitive reasons due to their processing style tending to be

less intuitive than average. Furthermore, they would be more likely to reduce their belief in response to rational counterevidence.

Finally, the current study reintroduced the self-prediction measure, previously omitted to avoid potential demand effects. The finding in the previous study was that the main hypothesis received only cautious support in relation to real-world belief change. It therefore remains unclear whether self-predictions of belief change are accurate in relation to real-world belief change and a more direct comparison would be useful. The current study therefore looked at both actual and self-predicted belief change, along with belief-basis, and tendency to inhibit intuitive, default cognitive processing. Based upon previous findings in the research programme and the wider literature, the following hypotheses were tested:

Hypotheses

H1 – pre-intervention belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson’s (2001) study.

H2 - Belief in ESP would be lower after the lecture than before.

H3 - The more rational the basis for their belief in ESP before the lecture, the more likely participants would be to reduce their belief in ESP afterwards.

H4 – In line with the original replication study, it was predicted that for each topic, a greater rational belief-basis would correlate with greater self-ratings of belief change likelihood.

H5 – Self-predicted belief change would correlate with actual belief change.

H6 – it was predicted that greater (i.e. more rational) belief-basis scores would correlate with greater CRT5 scores.

H7 – it was predicted that higher CRT5 scores would correlate with lower ESP belief.

H8 – higher CRT5 scores would correlate with greater belief reduction in ESP.

H9 – CRT5 would interact with belief-basis, leading to greater reduction of ESP belief when belief-basis was rational and CRT5 scores were higher.

Note: CRT validation hypotheses and the rationale for them are presented in the next chapter. The results of validation analyses will also be discussed there.

Method

This study used the same the intervention paradigm used in Study 2. However, in addition to belief-basis and belief-level, the self-predicted belief change question was also included, measured on a 9-point scale. This was only included in the pre-intervention measures, however. The CRT5 was also included as a measure of tendency to inhibit default responses (i.e. intuitive thinking) and CRT validation measures were also included: delay of reward and loss-aversion (see Study 4 for details).

Participants

As in Study 2, the Participants were first year students enrolled in a research course, which included a one-hour slot each week where students participated in questionnaire-based research, for course credits. As before, the course also included 5 one-hour lectures, one of which was an introduction to anomalistic psychology. The sample in the present study were from the cohort in the year following the sample in Study 2. 125 participants took part in both halves of the intervention. 36 were removed due to one or more missing responses, leaving 89 for analysis. There were 31 male, 58 female participants, aged 17 to 45 (mean 20.60, SD = 5.066).

Materials

The present study used the revised belief-basis measure developed and presented in the previous chapter (see that chapter and Appendix 4 for details of the measure – this included changing the questions to use the term ‘view’ instead of ‘belief’). The study also used the CRT5, which is covered in detail in the next chapter, detailing the research programme aimed at extending the original CRT measure (see the following chapter and Appendix 4 for details on the content of the CRT5). The CRT5 was accompanied by 4 additional questions, two of which tested delay of reward, and two

of which tested loss-aversion (details of the questions and the rationale for their inclusion are presented in the following chapter – Study 4). The CRT5 validation items were only included in the pre-intervention questionnaire, as they were not necessary post-intervention. Finally, the self-prediction question from the replication study (Study 1) was reintroduced, but with the term ‘belief’ changed to the term ‘view’. This measure was also only present in the pre-intervention questionnaire. The intervention itself was the same lecture for the same course, had the same title, and was almost identical in content to the one presented in Study 2. It was also presented by the same lecturer and presented in a similar manner as previously.

Scoring

Belief in each topic was measured in the same way as in Study 1.

Belief-basis on each topic was scored in the same way as in Studies 1 and 2, except that the average for the rational component was divided by 3 instead of 2, due to the additional item introduced in the revised belief-basis measure. The range and meaning of the resulting score remain the same as in Studies 1 and 2.

Belief change on each topic was measured in the same way as in Study 2.

Self-predicted belief change on each topic was measured in the same way as in Study 1.

CRT5 was scored as detailed in Study 4. One point was assigned for each correct answer and this was added together for an overall score between 0 and 5. Where 0 indicates a low tendency to inhibit default responses and 5 indicates a high tendency to inhibit default responses.

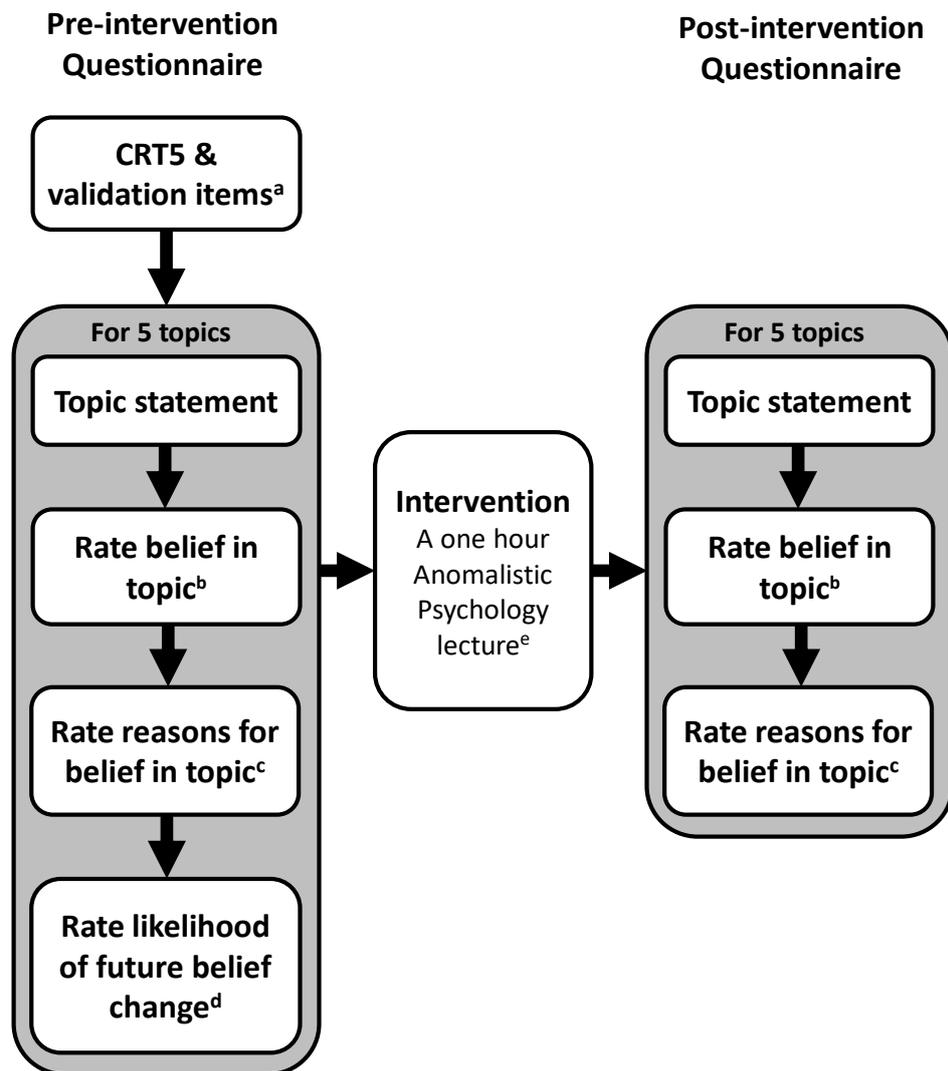
CRT validation measure was not analysed in the present chapter. Analysis and scoring of this measure are deferred until the chapter on Study 4.

Procedure

The time sequence of the study is illustrated in Figure 14. The procedural details were almost identical to those of Study 2, other than the different measures included in the questionnaire. In particular, the pre- and post-intervention questionnaires differed in

the items they presented, with the post-intervention questionnaire omitting CRT5, the associated validation items, and the self-predicted belief change question. The first questionnaire therefore took slightly longer to complete than the one presented in Study 2, whereas the second questionnaire was almost identical to the one presented in Study 2 – the revised belief-basis measure adding a total of only five additional items, one for each of the five topics. As in all studies in the programme, BPS ethical guidelines (BPS, 2018) were followed, and participants' data was anonymous. All participants were briefed, informed consent obtained, and debriefed after completion of the second questionnaire (Appendix 4). This study was approved by the ethics committee at Goldsmiths College, University of London.

Figure 14 - Time sequence and measures for Study 3



^a **CRT5** – one point for each correct answer, added together for a range of 0-5 (low to high tendency to inhibit default responding). Two **validation items**, on delayed reward, providing a range of 0-2 (low to high preference to accept a delay for a greater reward).

^b **Belief** in topic rated from 1-9 (none to completely).

^c **Belief-basis** – calculated from 6 ratings of reasons for belief (1-9, from not at all to completely). Mean rating for the three intuitive items is subtracted from the mean rating for the three rational items, giving an overall rating from 1-9 (from intuitive belief-basis to rational belief-basis)

^d **Self-predicted belief change** on a topic rated from 1-9 (not at all to very likely).

^e There was a one to two week gap separating the lecture from each questionnaire.

Results

As in the previous studies, graphs of the belief-basis in each topic for believers and non-believers are presented, compared alongside the results from Griffin and Ohlsson's (2001) original study. Once again, there is a close visual match between the present sample and Griffin and Ohlsson's sample. This holds for both believers and non-believers across all of the topics, despite variations in the number of participants contributing to the columns in the graphs – once again, the UK sample (11) have a much lower number of believers in creationism than the USA sample (59), yet the belief profile for creationism is almost identical between the two samples.

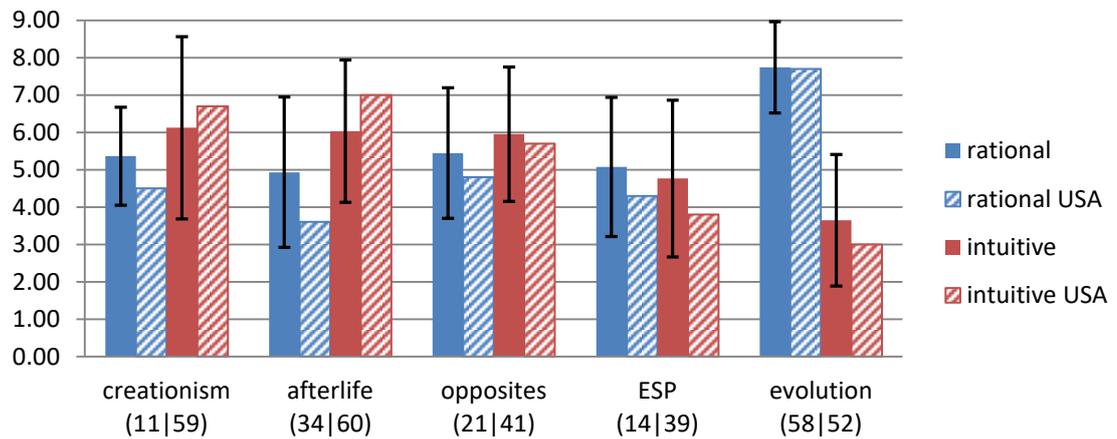


Figure 15 - Comparison between Study 3 and Griffin and Ohlsson's (2001) USA sample for believers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

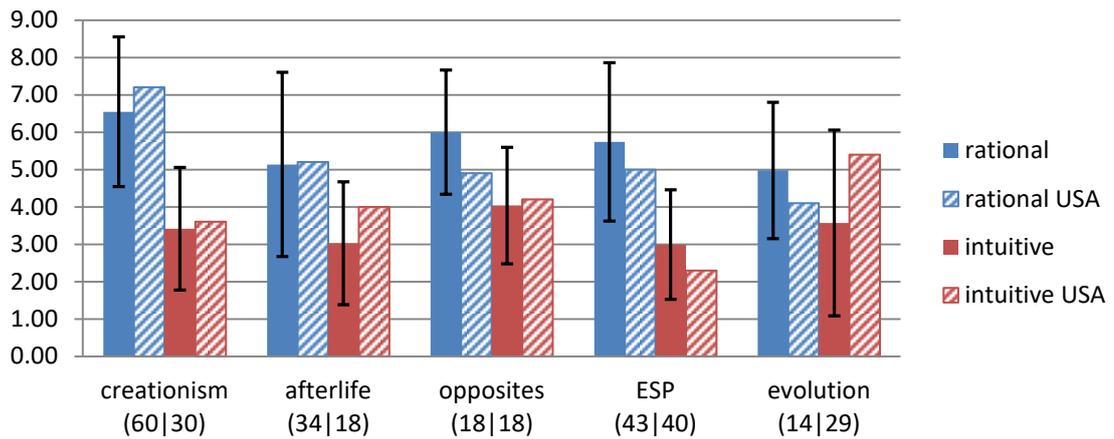


Figure 16 – Comparison between Study 3 and Griffin and Ohlsson's (2001) USA sample for disbelievers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

Prior to statistical analysis of the results the integrity of the belief-basis measure was checked. The overall Cronbach's alpha was .467. Factor analysis shows two factors, with the expected items generally loading on the two factors. Intuitive (items 1 & 3) = 0.684 and Rational (items 2, 4, 5 & 6) = 0.629. However, item 4, which is on intuitive evidence (such as personal experience), loaded on the rational factor, although it was not loading strongly. Indeed, rotation clarified this situation, showing item four was actually more clearly loaded on the intuitive items. After rotation Intuitive (items 1, 3 & 4) = 0.538 and Rational (items 2, 5 & 6) = 0.637. The findings from additional studies in the programme will also add to evaluation of the revised belief-basis measure. The discussion of reliability analyses for low-item scales is covered in Study 4 and the results section of Study 1. For the CRT5, the reliability and validation analyses are collectively discussed in the Study 4 results section, together with those from other studies in the programme, since Study 4 was dedicated to evaluation of the CRT5.

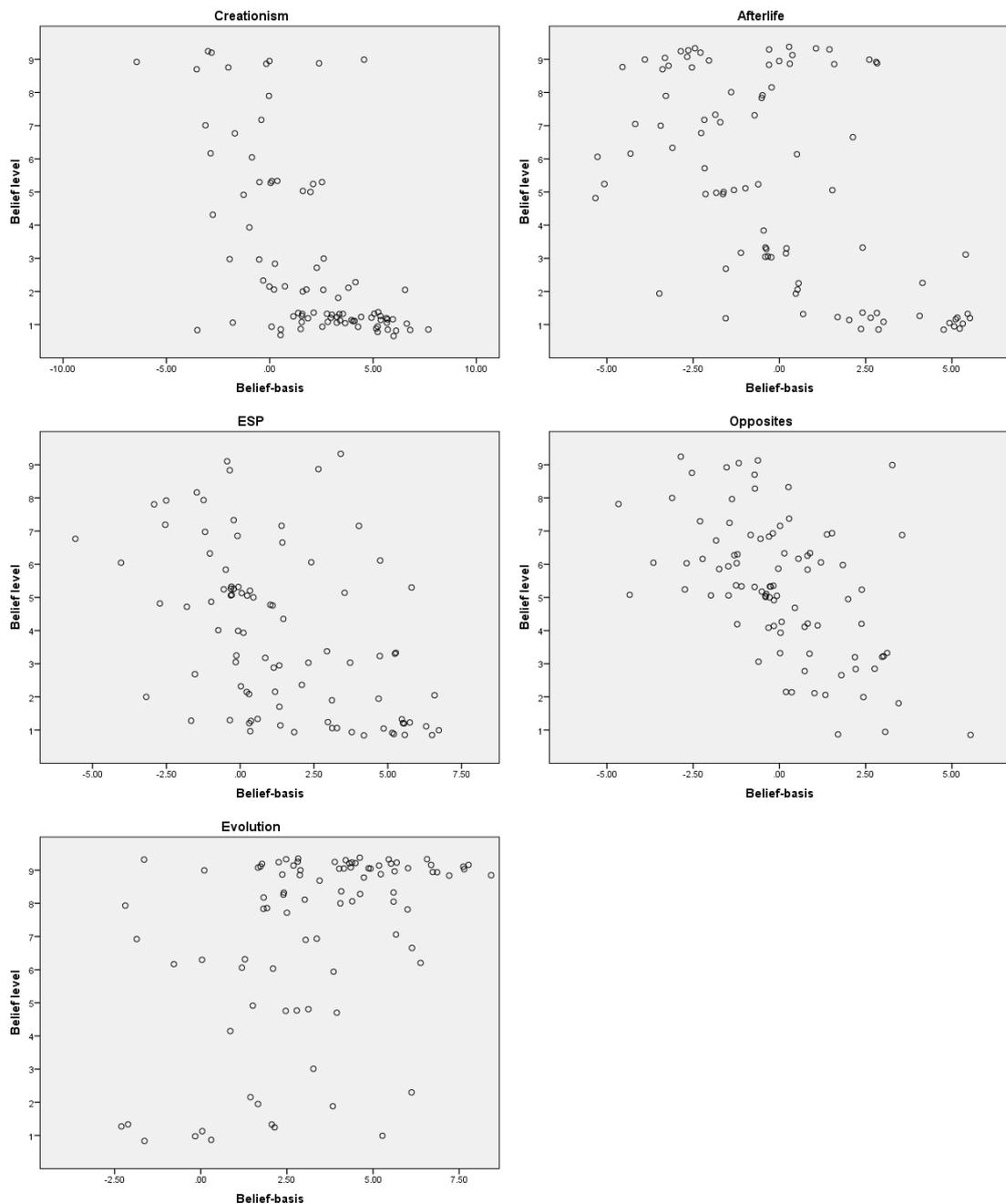
Hypothesis 1 predicted that pre-intervention belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson's (2001) study. A bivariate correlation of belief-basis and belief was conducted. Table 13 presents the correlations between belief-basis and belief for each topic. A positive correlation indicates that belief in a topic has a more rational basis and a negative correlation indicates the belief has a more intuitive basis. All of the topics showed the predicted correlations: positive correlation for evolution and negative for the other four topics. Rho ranged from .460

to -.644 and for all topics $p < .0005$. This represents a clear replication of Griffin and Ohlsson's (2001) original findings.

Table 13 - Correlations between belief-basis and pre-intervention belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.644	-.535	-.511	-.515	.460
Significance	<.0005	<.0005	<.0005	<.0005	<.0005

Figure 17 - Scatterplots of belief-basis vs pre-intervention belief

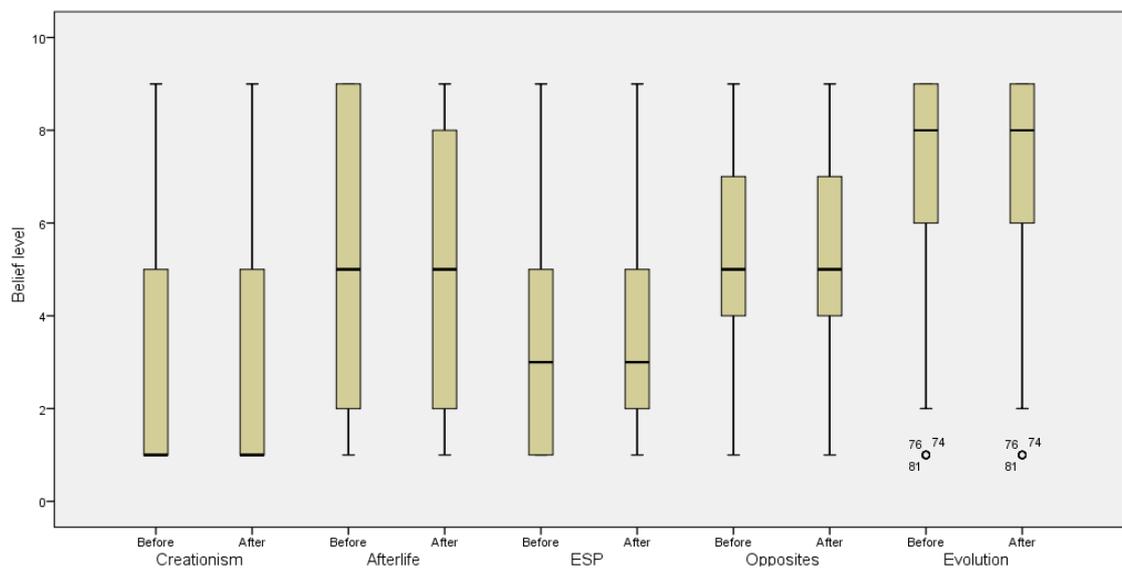


Hypothesis 2 predicted that belief in ESP would be lower after the lecture than before. A Wilcoxon test of belief ratings before and after the intervention was conducted. Statistically significant belief reduction was not observed in any of the topics, although ESP did show the largest effect size in the correct direction (-.36). This was substantially lower than in the previous study, however (-.86 for belief in ESP). P-values ranged from .117 to .590, with $p = .185$ for ESP. This is shown in Table 14.

Table 14 - Belief change after the intervention

	Creationism	Afterlife	ESP	Opposites	Evolution
Mean belief change	-0.26	-0.11	-0.36	-0.10	-0.10
Significance (exact 2-tailed)	.117	.590	.185	.441	.484

Figure 18 - Boxplots of belief for each topic, before and after the intervention



Hypothesis 3 predicted that the more rational the basis for participants' belief in ESP before the lecture, the more likely they would be to reduce their belief in ESP afterwards. The association between belief-basis and belief change was tested with a partial correlation controlling for pre-intervention belief level. Belief change was calculated as the difference between pre- and post-intervention belief levels on each topic. A positive correlation indicates that participants who report a greater rational belief-basis are more likely, than those with an intuitive belief-basis, to change their view after the intervention, whereas a negative correlation indicates the opposite situation. As can be seen in

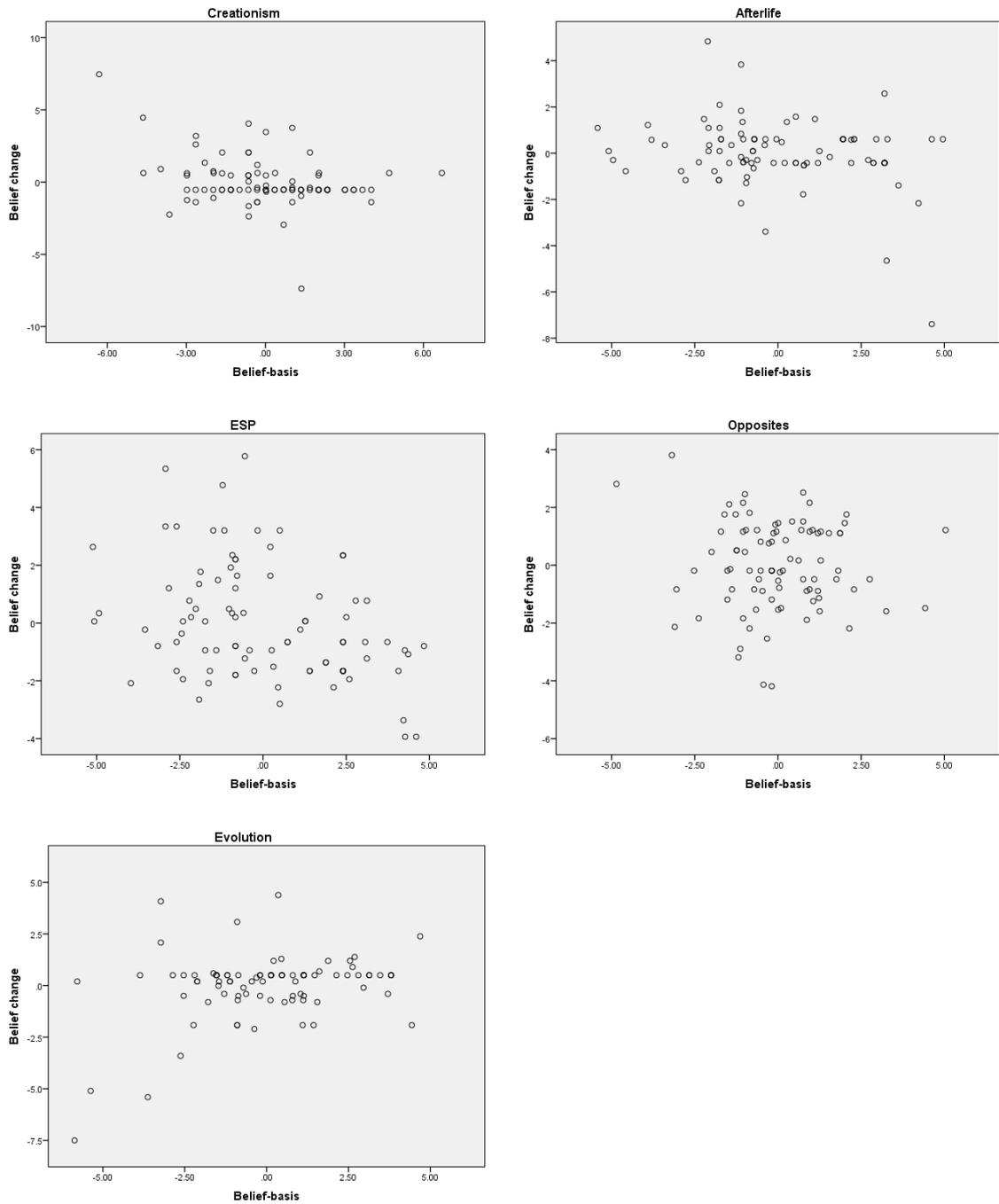
Table 15, reduction in ESP belief correlated with a greater rational belief-basis, as expected: $r = .357$, $p = .001$. However, with the exception of Opposites, belief change in

all other topics also correlated with belief-basis as would be expected for each topic: all negatively correlated apart from Evolution, which is associated with a greater rational basis for belief.

Table 15 - Correlations between belief-basis and actual belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Pearson's r	-.315	-.238	-.357	-.068	.323
Significance	.003	.025	.001	.530	.002

Figure 19 - Scatterplots of belief-basis vs actual belief change (pre-intervention belief partialled out)



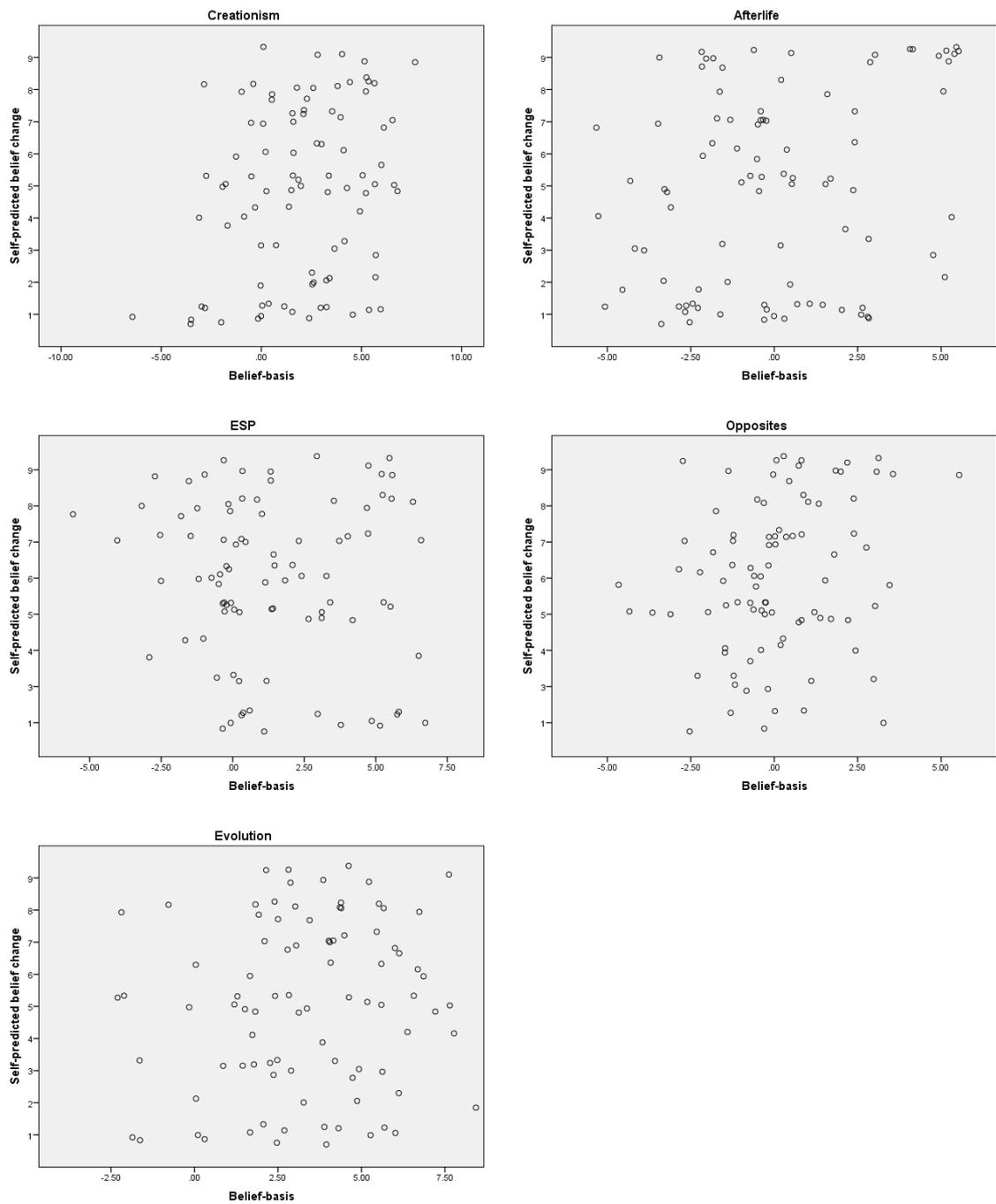
Hypothesis 4 predicted that a greater rational belief-basis would correlate with greater self-ratings of belief change likelihood. A bivariate correlation of belief-basis and self-predicted belief change was conducted (see Table 16). A positive correlation indicates that participants who report a greater rational belief-basis are more likely, than those with an intuitive belief-basis, to feel that they will change their view later if challenged by strong contradictory evidence, whereas a negative correlation indicates the opposite

situation. As expected the correlation was positive for creationism ($\rho = .257, p = .014$) and opposites ($\rho = .245, p = .021$), with afterlife approaching significance ($\rho = .204, p = .055$). Evolution did not correlate significantly ($\rho = .145, p = .176$) and the correlation with ESP was extremely weak, in contrast to Griffin and Ohlsson's original findings ($\rho = -.083, p = .473$). These results therefore offer only a partial replication of the original findings. The results map more closely to the replication study in the current programme, which also found no correlation for ESP.

Table 16 - Correlations between belief-basis and self-predicted belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	.257	.204	-.083	.245	.145
Significance	.015	.055	.473	.021	.176

Figure 20 - Scatterplots of belief-basis vs self-predicted belief change



Hypothesis 5 predicted that self-predicted belief change would correlate positively with self-reported actual belief change. The correlation between self-predicted belief change and actual belief change was tested with a partial correlation controlling for pre-intervention belief level. As shown in Table 17, this demonstrated no correlation on any of the topics, with the correlation coefficient being extremely low across them all (ranging from $\rho = -.105$ to $\rho = .020$). P-values ranged from .326 to .939. For ESP

specifically, $\rho = .020$, $p = .850$. This does not support the idea that self-predicted belief change is an accurate prediction of actual belief change in the real world. However, the lack of a general actual belief change effect does mean that the power of this analysis to detect any correlation is substantially weakened and a significant correlation would not generally be expected in this scenario.

Table 17 - Correlations between self-predicted belief change and actual belief change

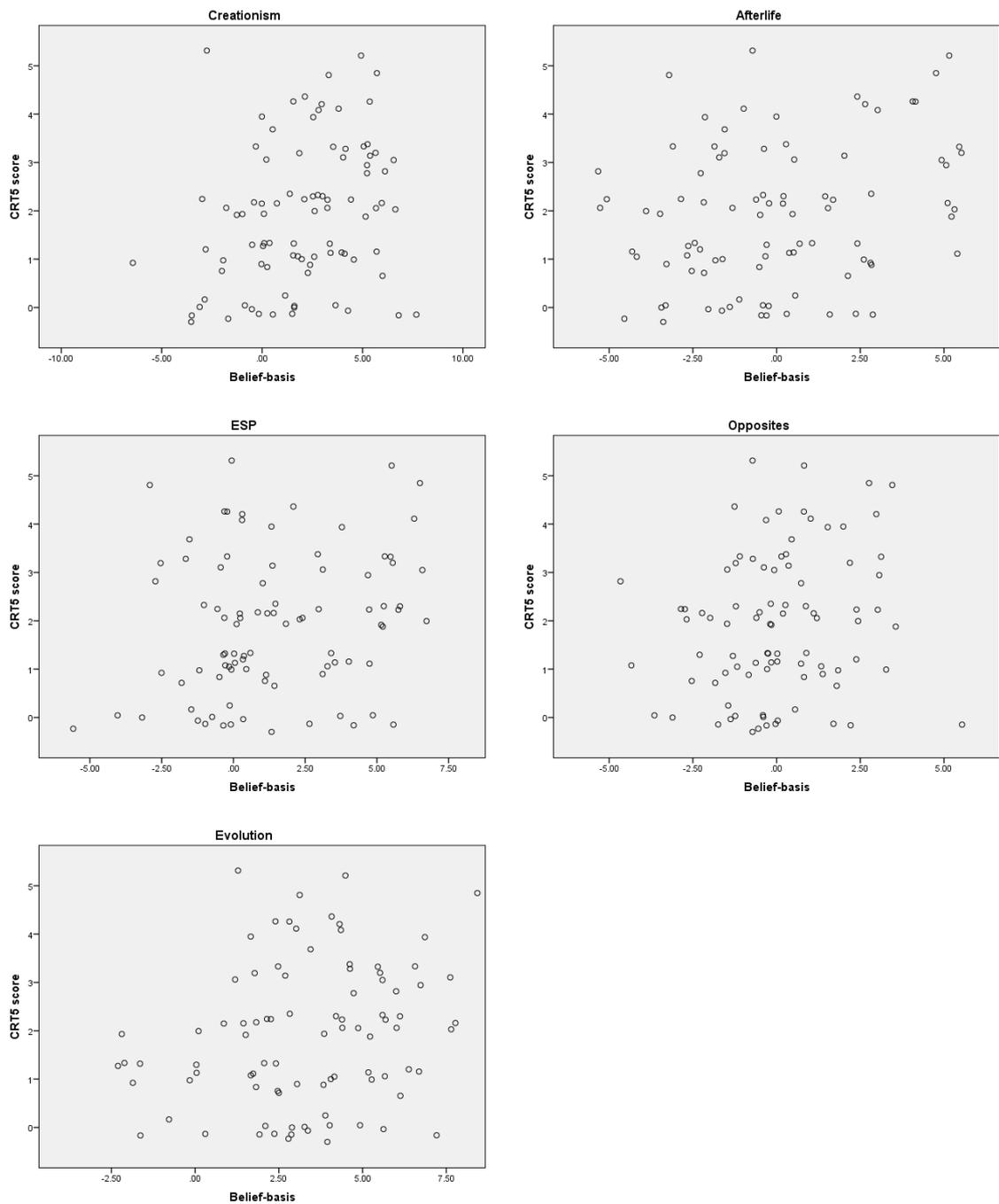
	Creationism	Afterlife	ESP	Opposites	Evolution
Pearson's r	-.187	-.065	.189	-.094	.124
Significance	.082	.459	.078	.382	.251

Hypothesis 6 predicted that greater (i.e. more rational) belief-basis scores would correlate with greater CRT5 scores. A bivariate correlation was conducted between belief-basis and inhibition (as measured on the CRT5). A positive correlation indicates that participants who have a greater tendency to inhibit default responding are more likely to have rational reasons for their beliefs. Across all five topics belief-basis correlated positively with tendency to inhibit intuitive thinking (see Table 18). Correlations ranged from $\rho = .211$ to $\rho = .240$. P-values ranged from .002 to .047.

Table 18 - Correlations between belief-basis and inhibition

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	.327	.211	.233	.240	.239
Significance	.002	.047	.028	.024	.024

Figure 21 – Scatterplots of belief-basis vs inhibition



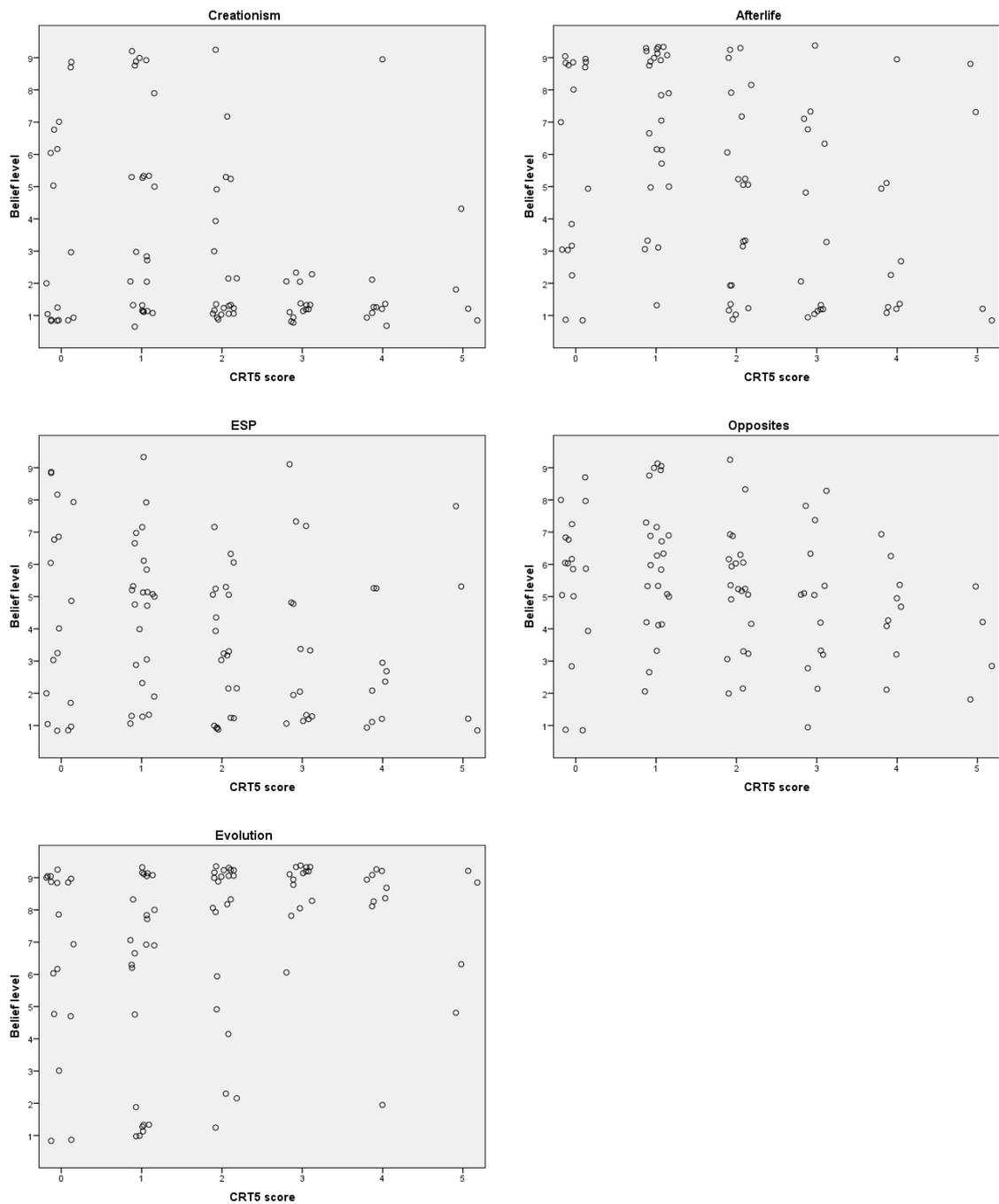
Hypothesis 7 predicted that higher CRT5 scores would correlate with lower ESP belief. A bivariate correlation was conducted between CRT5 scores and belief in each topic. A negative correlation indicates that participants were less likely to believe in a topic if they had a greater tendency to inhibit default processing, whereas a positive correlation indicates that participants were more likely to believe in a topic if they had a greater tendency to inhibit default responding. As can be seen in Table 19, CRT5 scores and pre-intervention belief levels correlated negatively, across all topics except

evolution, which correlated positively, ranging from $\rho = -.371$ to $\rho = -.232$, and $p < .0005$ to $p = .028$, and for Evolution $\rho = .239$, $p = .19$.

Table 19 - Correlations between belief level and inhibition

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.303	-.371	-.232	-.297	.249
Significance	.004	<.0005	.028	.005	.019

Figure 22 - Scatterplots of belief level vs inhibition



Hypothesis 8 predicted that higher CRT5 scores would correlate with greater belief reduction in ESP. This was tested with a partial correlation between CRT5 scores and real-world belief change, controlling for pre-intervention belief level. A negative correlation would indicate that belief in a topic reduced more for those participants with a greater tendency to inhibit default responding, whereas a positive correlation would indicate that belief reduction is associated with a lower tendency to inhibit

default responding. As shown in Table 20, no significant correlation was found for ESP: $r = -.070$, $p = .520$. Across all topics, only Evolution showed a significant correlation ($r = .254$, $p = .017$), but this result would not withstand correction for family-wise error rate.

Table 20 - Correlations between inhibition and actual belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Pearson's r	.140	.037	-.070	-.080	.254
Significance	.193	.735	.520	.458	.017

Hypothesis 9 predicted that CRT5 would interact with belief-basis, leading to greater reduction of ESP belief when belief-basis was rational and CRT5 scores were higher. The interaction between CRT5 scores and belief-basis was therefore analysed with respect to belief change. The interaction term was calculated after centering of the CRT5 and belief-basis variables, and a partial correlation was conducted between the interaction term and belief change, controlling for pre-intervention belief level. A positive correlation would indicate that when participants report greater rational belief basis in a topic at the same time as having a greater tendency to inhibit default responding, then they would be more likely to reduce their belief after the intervention. However, no significant interaction was found: $r = .115$, $p = .285$.

Discussion

The robust effect of belief-profiles across the five topics was once again supported in the present study, with all topics correlating with belief-basis as previously (the topic of 'opposites attract' having the least stable belief-profile). This time the study was also able to provide direct support for thinking style, however, with a greater tendency to inhibit intuitive thinking correlating with greater rational belief-basis, and with lower belief in ESP. No general belief reduction effect was found for belief in ESP in this

study. Nor was there any specific belief reduction effect associated with inhibition, or the interaction between inhibition and belief-basis. However, there was a specific belief reduction effect found for ESP in relation to belief-basis on its own, although this is tempered by the fact that the same association was found for all other topics except Opposites. Finally, Griffin and Ohlsson's (2001) original association between self-predicted belief change and belief-basis was partially replicated.

Looking at the belief-basis graphs shows the same pattern as in Griffin and Ohlsson's original study and the previous intervention study in the current programme (Study 2). This provides confidence that the revised belief-basis measure, used in the current study, is effectively measuring the same thing, albeit with improved items. The statistical analyses of belief-basis against belief also support this conclusion. In particular, it was interesting to see that belief in opposites attracting did not correlate significantly with either rational or intuitive belief-basis, replicating the finding from Study 1, and suggesting that the belief-basis for this topic is less stable or simply more borderline between intuitive and rational than the belief profiles for the other four topics.

Unfortunately, however, the present study was not able to come to a conclusion regarding the direct comparison of self-predicted belief change and actual belief change. Due to the lack of a general belief change effect, the power is lacking to detect any relationship between self-predicted and actual belief change should one exist. This lack of a general belief change effect may have been due to the initial belief levels of the participants in the present study being lower than that of the participants in Study 2 (3.82 in the present study vs 4.81 in Study 1). This also potentially reduces the power to detect correlations between belief-basis and actual belief change, as well as CRT5 and actual belief change. However, these are individual differences factors rather than group-level ones, and therefore it remains valid to consider those particular findings, especially in the light of concurring findings from Study 1, where general belief change was successfully induced.

In this respect, there was a significant association between belief-basis and belief change, which initially appears to indicate that Griffin and Ohlsson's findings do

generalise to the real world. Although there was no general effect of belief reduction, it might still be expected that there would be a specific reduction effect for those participants whose ESP belief profile was relatively more rational, although power to detect this would be reduced. Nevertheless, doubt is cast upon this finding by the fact that the association was also found with three of the other four topics. This suggests that one possible explanation for the finding is a demand effect, where participants reporting greater rational belief-basis are also modifying their reported beliefs in line with what they might deem to be expected or socially desirable. Indeed, self-predicted belief change did still correlate with belief-basis as expected on a number of the topics, although not for ESP. This latter result replicates the results from Study 1, where ESP was the outlier, being the only topic for which belief-basis did not correlate with self-predicted belief change. Indeed, it was useful to observe the lack of correlation between belief in ESP and self-predicted belief change, which replicates the finding from Study 1. It seems that this result is therefore not merely due to the use of a specialist interest group sample.

The most important new factor introduced into the present study was, however, the idea of inhibition of intuitive thinking, as measured by the CRT5. It was argued that, based upon the existing evidence, rational thinking needs to be either cued or intuitive thinking inhibited in order for rational thinking to be applied. This was further refined, noting that cueing is unlikely naturalistically with respect to paranormal beliefs, so that a person's own tendency to inhibit intuitive thinking will be the main factor in activation of rational thinking. As already noted, it is not enough simply to possess the ability to think rationally, it must actually be applied in the face of the evolved primacy of intuitive thinking. As a measure of thinking style, it makes sense that inhibition would correlate with belief-basis and this was indeed the case. Moreover, greater inhibition (a more rational thinking style) correlated with lower belief in ESP. Overall, these findings therefore add to the body of evidence showing that belief in the paranormal is associated with intuitive thinking style and belief-basis.

An alternative explanation to inhibition would be to reframe this thinking style as a tendency to *detect* the need for rational thinking – a kind of 'self-cueing' effect, as

suggested by Johnson, Tubau, and De Neys (2016). Using the bat and ball problem from the CRT, they looked at confidence and response times (under cognitive load or not under cognitive load). They found that participants showed reduced confidence ratings and increased response times when they provided incorrect answers. The authors argue that this indicates participants did have some degree of sensitivity to the need for rational thinking. The fact that they were still giving the wrong answers suggests that this detection was occurring, but not reaching the threshold required to actually activate rational thinking. The conclusion the authors made was that people have a 'substitution monitoring process' that is actually part of intuitive cognition, but activates rational cognition. This explanation retains the same properties as required by the path-dependent model and makes the same predictions as inhibition. The difference in interpretation is that instead of CRT being a measure of tendency to inhibit default processing, it would be seen as a measure of sensitivity to the need for rational processing. The present findings support both theoretical positions: inhibition and cueing.

However, neither of the above explanations nor the path-dependent model can explain the lack of association between inhibition and belief change. It ought to be the case that a tendency to inhibit intuitive thinking, or a tendency to detect the need for rational thinking, leads to greater engagement with the rational disconfirming evidence provided in the intervention, and thus produces greater belief change. However, this was not found in the present study. Nor did inhibition interact with belief-basis to predict belief change, as the path-dependent model predicts it should: a more rational belief-basis should be more influenced by rational counterevidence, and a greater inhibition will facilitate rational processing of the rational material, thus leading to overall greater likelihood of belief change. As already noted, however, the lack of a general belief change effect may have reduced the power to detect belief change effects related to individual differences in the present study. The next intervention study addressed that issue, however (see Study 5).

There is one idea that may offer a starting point to explaining the findings, however, and this is the viewpoint that has been referred to in this thesis as inoculationism. As

the name implies the idea is that people can be inoculated against beliefs forming in the first place. So in this case those with greater tendency to inhibit intuitive cognition would be less likely to form paranormal beliefs – they are partially ‘inoculated’ against it, so to speak. Extending the analogy further, if the inoculation fails then the belief takes hold and beyond this point the inoculation is of little use (it has already failed in its job). This might explain why the correlations with belief and belief-basis (as a proxy for mechanism of belief formation) appear to be robust, while the effects at the point of belief change have entirely eluded the present research programme so far – and, in fact, in the present study general belief change was also elusive.

There is a certain amount of support for this idea in the literature. In particular, research by Green and Donahue (2011) demonstrated that finding out that a story was inaccurate, or even deliberately fake, did not change story evaluations made by participants. Once the beliefs were formed they did not change even though in normative terms they should have done. Research by Hadjichristidis et al. (2007) demonstrates this indirectly when they tested the effect of category similarities in ‘if/then’ evaluation scenarios. For example, given the following statement participants were asked if the consequent (the claim about rhinos) was true:

“If squirrels have a left aortic arch, then rhinos will have a left aortic arch.”

As the reader may experience, the antecedent (the claim about squirrels) is held as being true, at least for a while, with the focus of scepticism drawn towards the rhino claim instead. Overall, this approach is very similar to the view of Spinoza (1677/1996) who thought that at first people believe, upon initially comprehending an idea, and only after this can they unbelieve it (Downing, 1992; Gilbert, 1991, 1992; Gilbert, Krull, & Malone, 1990; Gilbert, Tafarodi, & Malone, 1993). In relation to Donahue and Green’s findings, this relates to the ease with which beliefs were formed, but with the added finding from their study that, once formed, beliefs may be hard to change.

Alternatively, the lack of effect of inhibition on belief change could be explained by the various rational actor models of belief discussed at the start of this thesis. Simply put, if it is assumed that rational cognition has primacy, then a tendency to inhibit intuitive

thinking will have little effect on belief change, especially when people are reasoning about abstract problems or counting letter F's. However, the apparent effect of inhibition at the point of belief formation (measured via the proxy of belief-basis) is much harder for rational actor models to account for. Some rational actor accounts, such as Bleile (2014), do predict asymmetry between belief formation and change, but this does not account for the correlation with inhibition specifically, which is a factor that is outside rational actor models, since it is a thinking style and thus part of the thinking process rather than merely feeding 'data' into an underlying rational process.

In terms of the methodology of the present study, the use of the CRT5 made significant contributions to overall understanding of belief formation and change, although not in line with the proposed model. Unfortunately, the present study did fail to provide a direct comparison between self-predicted belief change and actual belief change, however, due to the lack of a general belief change effect, contrary to the other intervention studies in the literature and Study 2 in the present programme. The present study used a single lecture intervention, however, whereas most intervention studies in the literature use course-length interventions. Arguably such interventions provide a higher 'dose' of knowledge than a single lecture can. For this, and other reasons, Study 5 therefore addressed this issue by using a course-length intervention.

In conclusion, the dual-process, path-dependent model of belief formation and change once again received only mixed support within the present research programme, although dual-process conceptions of cognition in general were supported by the robust belief-basis and the new belief style findings (i.e. tendency to inhibit intuitive thinking). The path-dependency model therefore requires further investigation and a stronger intervention was therefore needed to provide the best chance to demonstrate a clear effect.

Study 4 – The CRT5: Extending the 3-Item Cognitive Reflection Test

Background

The background of the previous chapter outlined the rationale for including inhibition of intuitive cognition in the path-dependent model of belief change. This was in recognition of the evolved primacy of intuitive cognition, evidenced in part by the fact that possessing critical thinking skills dissociates from actually applying them. It was also noted that the situations in which paranormal beliefs are likely to form are also less likely to include external cues for rational thinking. The conclusion drawn was that the person's internal tendency to inhibit intuitive thinking would therefore be the differentiating factor at the point of belief formation, in relation to the formation of beliefs for intuitive reasons. The basic path-dependency model predicts that people will be more likely to change their belief in response to counterevidence or argument that appeals to the type of thinking via which the belief was formed (intuitive or rational). Since there will be variation in the reasons for belief in the paranormal, the prediction was that people would be differentially affected by rational disconfirmation, of the kind presented in the interventions. However, in order to engage with this rational material at the point of belief change, the inhibition of intuitive cognition may still be required. If intuitive cognition has primacy, as theorised, then it will need to be inhibited in order for rational disconfirmation to influence rationally held beliefs.

In order to measure inhibition, CRT5 was used, which is an extended version of the Cognitive Reflection Test (Frederick, 2005). The original CRT has a number of shortcomings, chiefly a strong numeracy bias, and a more balanced version was therefore sought. Although a number of alternatives and extensions to the original CRT have recently become available, they were not available at the time of the main study programme and therefore the present sub-programme was convened to extend the original CRT. The present chapter covers the development of the five-item CRT5

from the original 3-item CRT and the associated research sub-programme (4 cohorts plus additional data from other studies in the main research programme). The CRT asks people questions such as:

If it takes five machines, five minutes to make five widgets, how many minutes would it take 100 machines to make 100 widgets?

The correct answer is 5 minutes, but the intuitive answer that usually comes to mind faster is 100. The correct answer is not overly hard to arrive at, but it does require inhibiting the speedy incorrect, intuitive answer. As such the CRT claims to be a measure of inhibition of default response, or intuitive thinking, in favour of rational thinking.

One of the important things to note about the questions on the CRT is that they are not trick questions. Nor are they what is often classed as ‘insight’ problems, such as the nine-dot problem (Kershaw & Ohlsson, 2004), where the problem is hard to solve until the moment of insight is reached; in this case one must literally think outside the box of the 3x3 nine-dot grid in order to draw the least number of lines to join dots. The CRT presents problems that are easy to solve, but that also present an intuitive answer that springs quickly to mind. There is no attempt to trick people and there is no need for special insight. In this sense, the questions are similar to the exclusion problems used in other research, where one route to obtaining an answer must be excluded (e.g. Ferreira et al., 2006).

Notably, in Frederick’s (2005) original study, the sample sizes were extremely large ($n = 3428$) and validation of the measure was conducted against inhibition measures, such as delay of reward; the inhibition of the intuitive desire to have something now instead of something better later. This particular cognitive bias is a common psychological tool used in selling products: ‘fear of losing out’ is all too familiar in the guise of the closing down sale, limited time special offers, and so on (Cialdini, 2007). As noted in the previous chapter, however, there are various types of inhibition and the type relevant to the present research programme is the inhibition of higher order cognition, similar in kind to those referred to by Gilbert (1991). For example, this would include

inhibition of intuitive thinking processes, or delay of a reward, but not the inhibition of automatic processes under speeded conditions, such as exhibited in the Stroop task. Although there may be some relationship between the types of inhibition, the latter is less relevant and using such measures may be misleading (e.g. Lindeman et al., 2011).

Initially then, the CRT would appear to be a suitable measure of inhibition for the present programme. And, indeed, this is supported by a body of literature demonstrating that the CRT associates with thinking styles and errors in the ways that a dual-process account would predict. That is to say, that lower CRT scores (lesser tendency to inhibit intuitive thinking) associate with a more intuitive thinking style and with more thinking errors; the very kinds of errors that critical thinking skills tend to dissociate from. For example, Toplak, West, and Stanovich (2011) found evidence that CRT was a good measure of a cognitive miser processing tendency – i.e. the tendency to go with whatever comes to mind most easily and not waste precious time and energy resources; another way of stating the evolved primacy of intuitive thinking. They argue from their findings that neither intelligence tests, nor executive function tests, are as good at measuring this as the CRT is. They base this claim upon the fact that they found a unique contribution of CRT to predicting results of various heuristics and biases tasks, once executive function and intelligence tests were factored out. For example, they found that CRT correlated with their ‘rational-thinking composite’ score contributing 11.2% to the multiple linear regression with other measures factored out ($p < .001$). Similarly, CRT correlated with a composite heuristics and biases score explaining 8% variance, almost twice the correlations of the other factors combined. In total, across a number of measures Toplak and colleagues found that CRT accounted for 23.7% of the variance if used without factoring out other measures (i.e. as the CRT would be used normally). Meanwhile, the Stroop task explained only 2% of the variance. Similarly, Oechssler et al. (2009) found that higher CRT scores predicted less susceptibility to errors in thinking biases, such as the conjunction fallacy. Such findings are in striking contrast to the failure of intellectual ability and thinking skills to correlate with these sorts of thinking errors, discussed in earlier chapters.

However, while the CRT appears well suited to the needs of the research programme, it does have some potential issues. One thing that is especially noticeable about the CRT is that all of the items are based upon numeracy. While the numeracy requirements are not high, they are nevertheless a factor. It may be the case that CRT is measuring numeracy skills rather than inhibition, which for some reason happens to be correlated with various other factors. For example, the CRT correlated well with the math element of SAT scores (Frederick, 2005). Such correlations with ability do not explain the CRT's correlation with thinking style, which dissociates from ability, so the CRT must be measuring something more than just numeracy skills. However, the concern that prompted the present study was that access to the correct answers on the CRT questions relies entirely upon a certain degree of numeracy, which may be an unnecessary limitation on the measure.

This line of thought has been followed in a number of more recent papers, such as Campitelli and Gerrans (2014). That paper is particularly interesting as they compared mathematical models in an attempt to find out if the CRT is measuring more than just numeracy. Their findings support the other literature, with the model that included inhibition providing the best fit. However, they also found that there was a numeracy component being measured and this confirms the concerns that prompted the present study programme. The numeracy issue is raised by other researchers as well, such as in Erceg and Bubić's (2017) paper on scoring of the CRT, which will be covered in more detail in the discussion of the present study, along with other recent projects to modify or extend the CRT (e.g. Thomson & Oppenheimer, 2016).

The present study therefore aimed to extend the original 3-item CRT (Frederick, 2005) in order to address the numeracy issue. The reason for conducting a study on the new measure was to validate the new CRT items against known CRT correlates from Frederick's study, thus giving validity beyond face validity for the extended measure. The validation items used related to delay of reward and were selected from Frederick's original study series (3428 participants) on the basis of them having the greatest levels of significance in that series and thus most likely to detect an effect with the new items in the present study, and more likely to validate the original items. In

logistical terms, the present study series ran in parallel to the main one in order to collect enough data. Furthermore, it also used the main study series as opportunities for further data collection on CRT5. This meant that it was particularly important to retain the already validated, original CRT so that this was available for analysis regardless of the outcome of the present findings – hence extending rather than replacing the CRT. Finally, the present study also took the opportunity to gather additional data in relation to belief-basis using the revised belief-basis measure, thus making best use of time and resources overall.

Hypotheses

H1 – Scores on the original CRT would correlate positively with the score on the new items, since both sets of items purport to be measuring inhibition.

H2 – higher scoring on the original CRT and the new items would correlate with higher measures of delayed reward.

H3 – pre-intervention belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson’s study.

H4 – Higher CRT5 scores would correlate with greater (i.e. more rational) belief-basis scores.

H5 – Higher CRT5 scores would be correlated with lower levels of belief in ESP.

Method

The CRT element of the study included the scores on two separate sets of CRT items and the overall score for all CRT items. The original CRT contains three items and is scored on a scale of 0 to 3, with one point for each correct answer given. The two new CRT items were scored in the same way, giving a scoring range of 0 to 2. The combined CRT5 score was simply the total of the original and new CRT items. A measure of delayed reward was also included as a validation measure for the original CRT and CRT new items. This was formed from a combination of two delay questions, with one point given for a delay response, giving a range of 0 to 2. A measure of loss-

aversion (Kahneman & Tversky, 1979) was also included as a control. Finally, measures of belief-basis and belief level from the previous studies were also included.

Participants

Participants were 4 cohorts of students (mainly 17 to 19 years of age), visiting Goldsmiths College, University of London. As part of their visit, they spent some time with the Anomalistic Psychology Research Unit and this included taking part in the present study. There was a total of 102 participants, after 4 were removed due to missing responses to one or more items on the questionnaire. There were 20 male participants and 82 female participants, ages ranging from 17 to 25 (mean 18.92, SD = 1.772).

Materials

A questionnaire (Appendix 5) was used that combined the CRT items, validation items, and belief-basis and level measures. The sections of the questionnaire were in the order just given, with CRT items being first so that participants were mentally fresher for that section. The aim was to avoid any potential effects of ego depletion (e.g. Wheeler, Briñol, & Hermann, 2007) in order to allow participants to better demonstrate their tendency to inhibit intuitive thinking – ego depletion is the finding that mental ‘energy’ can be used up. This was also important since the CRT was the main focus of the present study and presenting other sections of the questionnaire first was avoided so as to avoid them having any influence on CRT responses.

The original CRT items were taken directly from Frederick (2005) and are given in full below:

1. A bat and a ball cost £1.10 in total. The bat costs £1 more than the ball. How many pence does the ball cost? (*answer: 5p*)
2. If it takes five machines, five minutes to make five widgets, how many minutes would it take 100 machines to make 100 widgets? (*answer: 5 minutes*)
3. In a lake there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how many days would it take for the patch to cover half the lake? (*answer: 47 days*)

Mixed in with these items were two new items developed to address the numeracy bias of the original CRT. For development of these new items, an initial pool of potential new CRT items and types of items was created. This was based upon three key selection criteria. The first two criteria follow the rationale behind the original CRT items. The final criterion is an additional constraint.

1. There must be an obvious intuitive answer that is, however, clearly wrong upon further reflection.
2. There must be a clear right answer that is easy to arrive at upon reflection (the CRT is measuring inhibition not cognitive ability).
3. It must not rely upon numeracy.

The initial pool of ideas for new items was:

1. The F's test (or similar reading test)
2. Modus pollens/tollens
3. Producing a random sequence of numbers
4. The Wason 4 card selection test or a reframing thereof to make it easier and to make it less recognizable as the classic test
5. Hyperbolic discounting
6. Framing effect – odd one out test

The F's test involves participants reading a sentence and stating how many letter F's it contains. This requires disengaging fluent reading and thus requires sustained cognitive effort of inhibition for the whole sentence. The task is easy enough from an intuitive perspective and requires no numeracy skills. But mistakes are easy to make unless additional effort is applied, yet there is no ambiguity about the correct answer, which is easy to arrive at if inhibition is applied. This item was therefore deemed to be a good match to the selection criteria and a useful item to include in the extended CRT measure.

Modus pollens or modus tollens was also considered, as a form of exclusion problem, presented as misleading syllogisms. However, this option was dismissed for a number of reasons. Firstly, it is the kind of problem that is used in tests of thinking ability and this would confound any correlations between the CRT and such studies, since they would have content that was too similar. Secondly, it is unclear if a single syllogism would be effective enough as a measure (studies on thinking skills always use a battery of syllogisms).

Producing a sequence of random numbers was considered as demonstrating ability to inhibit intuitive thinking, since this requires suppressing the intuitive notion that repetition should be avoided in random sequences. However, there may be issues with it involving numbers even though no numeracy skills per se are required. This option was therefore dismissed.

A variation on the Wason 4 card selection test was also considered (Sperber, Cara, & Girotto, 1995). This test involves four cards with information on each side of each card. Participants can therefore see what is face-up, but not what is face-down on the cards. Participants are given a statement and asked to specify which cards to turn over in order to check if the statement is true (i.e. the minimal set of cards to turn over rather than just turning over all of the cards). This type of question is used in some research on thinking skills and styles, but is typically presented in a guise that is abstract, such as using letters and numbers. There is a tendency for people to turn over cards that confirm their hypothesis (i.e. the statement). But, confirming cards add no new information so that it is actually more informative to turn over cards that could disconfirm the hypothesis. This demonstrates inhibition of higher order cognitive processes, but there is a tendency towards a floor effect due to the difficulty of the task when framed in abstract terms. However, the problem can be framed in a concrete way and this makes it much easier, but not too easy, to complete. The concrete presentation of the Wason 4 card selection task was therefore included as an item in the extended CRT.

Hyperbolic discounting was initially considered, but quickly dismissed as a form of delayed reward – i.e. the tendency to prefer payoffs that are closer in time, but are of

lower value. This was far too similar to the CRT validation items being used already, making it unsuitable without changing the validation items.

Finally, framing was considered as a way to measure inhibition of intuitive thinking. Three simple problems would be presented. Two of them would be identical in structure, but framed differently. The third would be different in structure, but framed to be similar to one of the other two problems. Participants would need to specify which problem was the odd one out. However, this was dismissed as it might not be clear to participants what they were being asked to do. There was also the difficulty of constructing such a problem set to be short enough to fit into the CRT without overwhelming it.

Overall therefore, two items were selected for addition to the original CRT, forming a new five-item measure, the CRT 5. The additional two items are given below (see Appendix 5 for the actual order of presentation of all 5 items in the CRT5). Answers are given further on the next page.

The F's test

How many letter F's are there in the following paragraph?

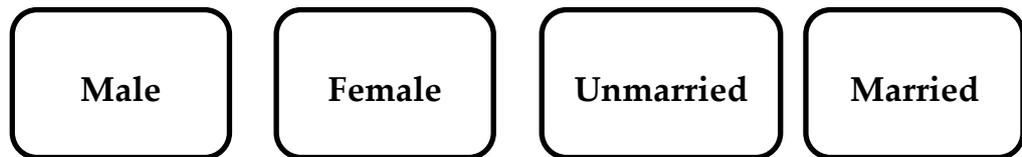
FINISHED FILES ARE
THE RESULT OF YEARS
OF SCIENTIFIC STUDY
COMBINED WITH
MORE THAN A FEW
YEARS OF EXPERIENCE

Wason 4 Card Selection Test

The City Council of Padua has asked for volunteers to take care of visiting English schoolchildren. Volunteers have to fill in a card. Mr Rossi and Mrs Bianchi are about to sort the cards. Mrs Bianchi argues that only women will volunteer. Mr Rossi says

she is wrong, and states that men will volunteer as well. Mrs Bianchi counters that if that is the case, then the men will be married.

Cards filled in by the volunteers show gender on one side and marital status on the other. Given the four cards below, circle the two cards that you must turn over to check whether or not Mrs Bianchi is correct that the male volunteers will be married.



The correct answer for the F's test is 7 and the correct answer for the card selection task is cards 1 and 3 ('male' and 'unmarried', respectively).

The two CRT validation items, relating to delayed financial gain, were taken from Frederick's (2005) original study and in that study series had p-values less than .0001 in a chi-square test involving groups scoring high and low on the CRT. The total sample size was 3428. Oechssler et al. (2009) also replicated the correlation of CRT with these two items. These items were therefore selected as likely to be the most robust validation items for use in the present study. The items were modified slightly to fit the UK audience (the originals were in dollars), and are given in full on the next page.

1) Which would you prefer to receive?

- a) £100 now
- b) £140 this time next year

2) Which would you prefer to receive?

- a) £3000 now
- b) £3800 this time next month

The number of validation items included was kept small so as not make the questionnaire too long, especially as they were also used in some of the main research programme studies in order to gather additional data. However, considering the apparent robustness of the items this was considered to be sufficient. Loss avoidance items were also included, both as filler items so that participants would be less likely to catch on to the delay items, and as a check, since loss avoidance is known to be a robust effect (Silberberg et al., 2008).

Finally, the revised belief-basis measure and belief rating questions were used as per the other studies in the main research programme. The free-text response questions were omitted for brevity of the questionnaire due to time available and self-prediction of belief change was also omitted to avoid introducing any unnecessary bias.

Scoring

Belief in each topic was measured in the same way as in Study 1.

Belief-basis on each topic was measured in the same way as in Study 3.

Original CRT was scored by assigning one point for each correct answer to the three original CRT questions. These points were added together for an overall score between 0 and 3. Where 0 indicates a low tendency to inhibit default responses and 3 indicates a high tendency to inhibit default responses.

New CRT was scored by assigning one point for each correct answer to the two new CRT questions. These points were added together for an overall score between 0 and 2.

Where 0 indicates a low tendency to inhibit default responses and 2 indicates a high tendency to inhibit default responses.

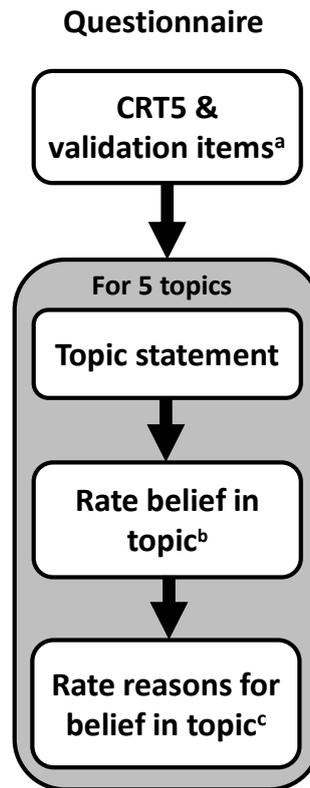
CRT5 was scored as the sum of original CRT and new CRT (i.e. using all five items). This gave a score ranging from 0 to 5, where 0 indicates a low tendency to inhibit default responses and 5 indicates a high tendency to inhibit default responses.

CRT validation measure, delayed reward, was calculated by assigning one point for choosing to delay on each of the two delayed financial gain questions, giving a score between 0 and 2, where 0 indicates a greater preference for smaller financial rewards now and 2 indicates a greater preference for greater financial rewards later. That is to say, a higher score on this measure indicates a greater tendency to accept a delay in return for a greater reward later on.

Procedure

The time sequence of the study is illustrated in Figure 23. Participants from each cohort were given the questionnaire which had a briefing and consent sheet on the front (Appendix 5). The signed consent sheet was detached from the questionnaire after data collection to maintain anonymity of the participants. Participants also had the right to withdraw from the study. After signing the consent form they completed the questionnaire. Once everyone in the room had completed the questionnaire they were briefed on the nature of the study. This included an extended discussion of related topics, as part of the students' visit to Goldsmiths. As usual (BPS, 2018) ethical guidelines were followed. This study was approved by the ethics committee at Goldsmiths College, University of London.

Figure 23 - Time sequence and measures for Study 4



^a **CRT5** – one point for each correct answer, added together for a range of 0-5 (low to high tendency to inhibit default responding). Two **validation items**, on delayed reward, providing a range of 0-2 (low to high preference to accept a delay for a greater reward).

^b **Belief** in topic rated from 1-9 (none to completely).

^c **Belief-basis** – calculated from 6 ratings of reasons for belief (1-9, from not at all to completely). Mean rating for the three intuitive items is subtracted from the mean rating for the three rational items, giving an overall rating from 1-9 (from intuitive belief-basis to rational belief-basis)

Results

As in the previous studies graphs of the belief-basis in each topic for believers and non-believers are presented, compared alongside the results from Griffin and Ohlsson's (2001) original study. Once again, there is a close visual match, although disbelievers show a little more variation from Griffin and Ohlsson's sample than believers do.

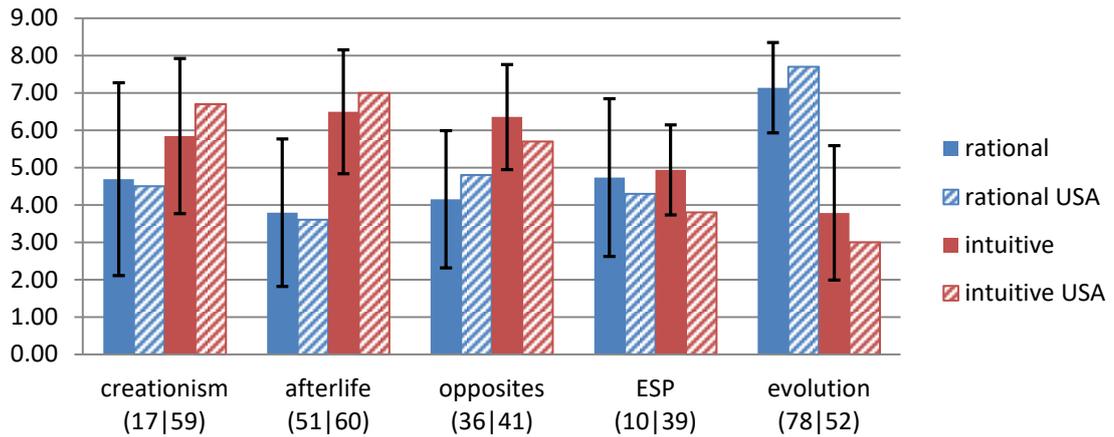


Figure 24 - Comparison between Study 4 and Griffin and Ohlsson's (2001) USA sample for believers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

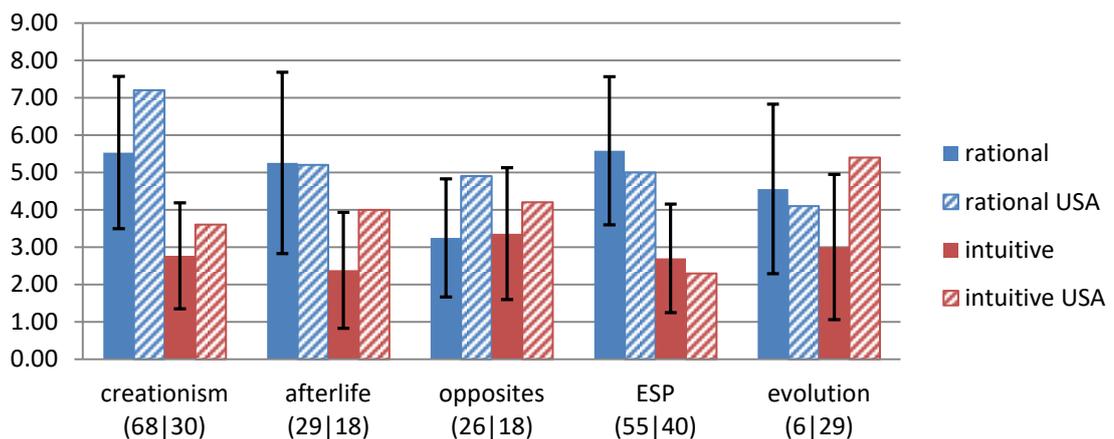


Figure 25 - Comparison between Study 4 and Griffin and Ohlsson's (2001) USA sample for disbelievers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

Prior to statistical analysis of the results, the integrity of the belief-basis measure was checked. The overall Cronbach's alpha was .492. Factor analysis without rotation is relatively clear on the expected split, but with item 4 perhaps a little less clear (not a negative correlation). However, rotation makes it clear that 1, 3, 4 are all on a single factor. After rotation, Cronbach's alpha for intuitive was 0.537 and for rational it was 0.685.

Cronbach's alpha for the CRT5 is given in Table 21, along with the same analysis conducted on the data from the other studies in the wider study program. This value

ranged from .413 to .655 across the four studies. The value of .413 is a little on the low side, even for the original 3-item CRT, but overall the results are not too far off the range found in the literature where researchers have attempted to extend the CRT. Indeed, the Cronbach's alpha is included here chiefly as a standard measure, but for low-item measures Cronbach's alpha is liable to lead to lower alpha values simply due to the low number of items and this factor needs to be taken into account when using it as a measure of internal consistency (Lance et al., 2016; Tavakol & Dennick, 2011). For example, Toplak et al. (2014) goes so far as to state that .72 for their 7-item test indicates "substantial reliability". Meanwhile, Thomson and Oppenheimer (2016) report Cronbach's alpha for the original CRT alpha as .642 and for their four new items as .511, with the combined 7-item scale achieving .705. Primi, Morsanyi, Chiesi, Donati, and Hamilton (2016) reviewed CRT studies and found a range from .57 to .74 for the original CRT, whereas Frederick (2005) does not cite Cronbach's alpha at all in his original paper on the CRT. Similarly, Erceg and Bubić (2017) do not cite the Cronbach's alphas for their scoring of CRT in 'five different ways', even though they studiously present tables of the reliability metrics for six other measures that they correlated with CRT. This included stating the mean, SD, min, and max, in addition to the Cronbach's alpha, for each of the 6 measures. Finally, it must be noted that the items added to the original CRT were not simply added to strengthen the existing scale in terms of measuring exactly the same thing. They were added to mitigate the numeracy bias of the original scale and this means that there will inevitably be some difference in what the new and original items are measuring. However, as will be seen, the items do intercorrelate, indicating that they are related and not measuring completely unrelated constructs.

Table 21 - Cronbach's Alpha for CRT5 in each study from the wider research programme

	Study 3*	Study 4*	Study 5*	Study 6*
Cronbach's Alpha	.548	.413	.596	.655

* significant at $p < .05$

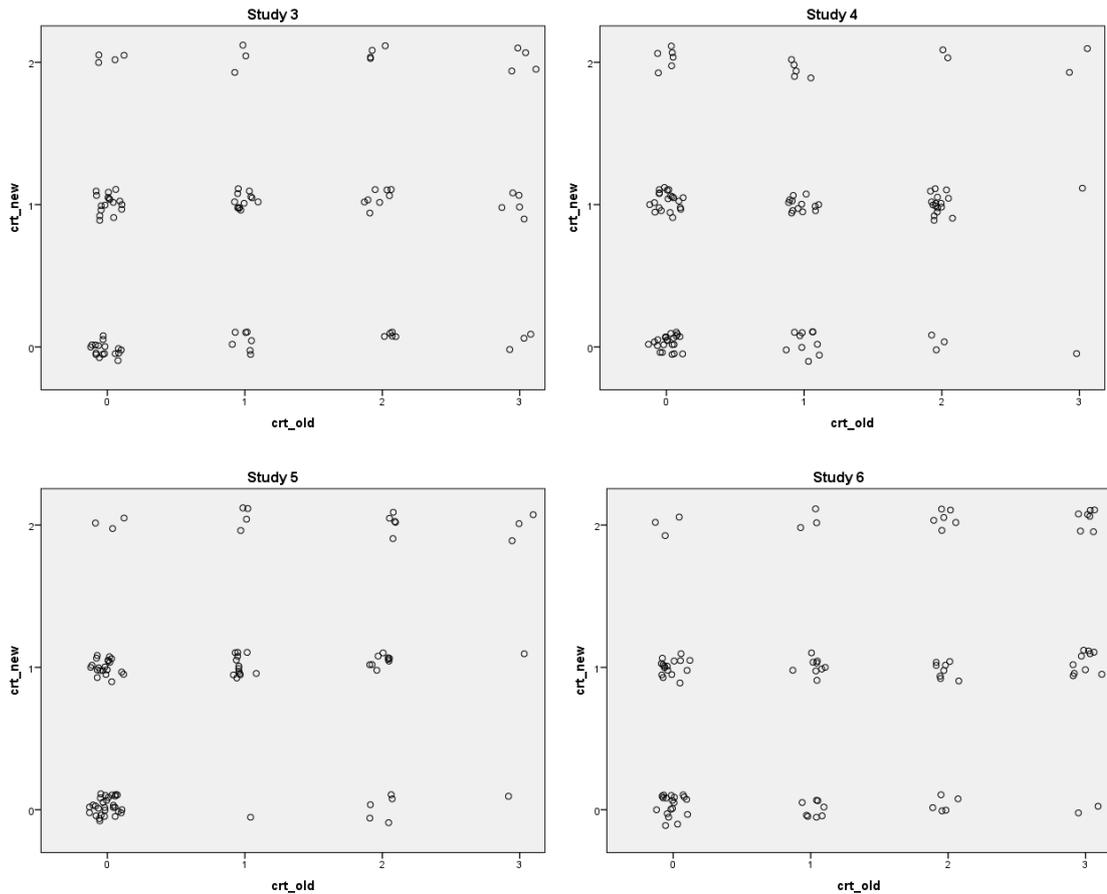
Hypothesis 1 predicted that scores on the original CRT would correlate positively with the score on the new items, since both sets of items purport to be measuring inhibition. A bivariate correlation was conducted on original CRT score and CRT score for new items only (the data from each study in the main research programme was analysed separately -

Table 22). The correlations were significant in all datasets, with rho ranging from .209 to .526, and p-values from < .0005 to .048. It is also worth noting that all five items were individually significantly intercorrelated, ranging between rho = .209 and rho = .526.

Table 22 - Intercorrelations of original and new CRT scores

	Study 3	Study 4	Study 5	Study 6
Spearman's Rho	.211	.209	.526	.364
Significance	.048	.035	.001	<.0005

Figure 26 - Scatterplots of original CRT scores vs new CRT scores



Hypothesis 2 predicted that higher scoring on the original CRT and the new items would correlate with higher measures of delayed reward. Bivariate correlations between each of the CRT scores (original and new items only) were conducted against the validation measure. A positive correlation indicates that a greater tendency to inhibit default responding is associated with a greater tendency to accept a delay for increased financial gain later. The results were mixed, with only 3 of 9 correlations being significant and no discernible pattern within the results – both new CRT items and original CRT scores correlated with the validation measure at different times (see Table 23). Considering the family-wise error rate involved in this number of calculations and no clear pattern to the results, it must be concluded that neither the original CRT nor the modified CRT validated consistently against the selected items in this instance. This was the case across three different studies, drawing upon three different sample populations. Note that Study 5 did not include the CRT validation items.

Table 23 – Original CRT, new CRT, and CRT5 scores correlated with delay of reward

	Study 3	Study 4	Study 5	Study 6
Original CRT	.035 (.742)	-.082 (.414)	n/a	.276 (.007)
New CRT	.211 (.048)	-.086 (.392)	n/a	.139 (.178)
CRT5	.131 (.233)	-.098 (.328)	n/a	.267 (.009)

The table shows Spearman's Rho with p-value in brackets, for each correlation.

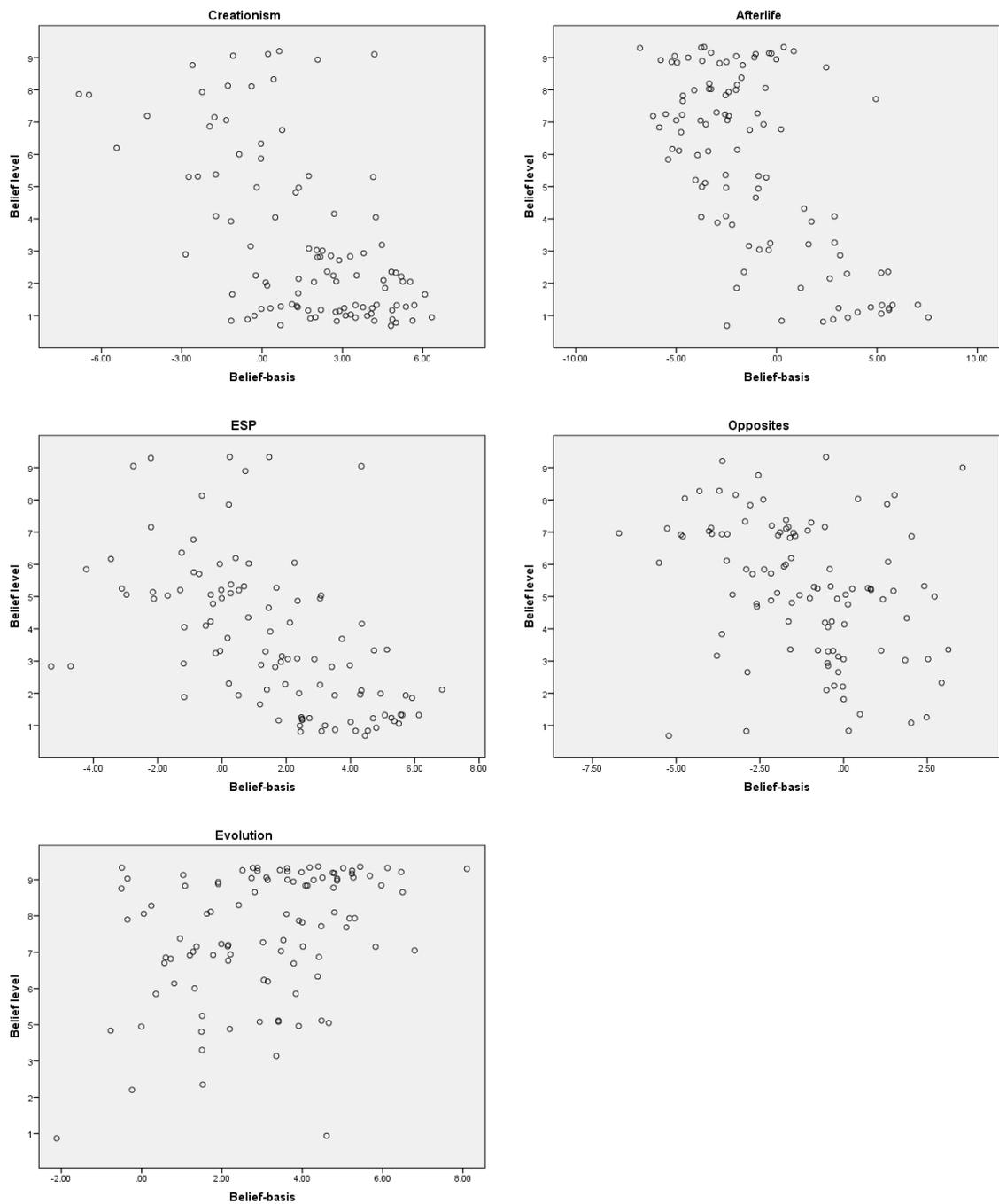
With respect to the loss-aversion check, the items testing for loss-aversion actually showed participants tended to have a strong preference for certainty instead (this was the case across all of the studies). That is, participants answered in a way that demonstrated they preferred not to take chances, even if the odds were that their losses would be reduced.

Hypothesis 3 predicted that pre-intervention belief-basis would correlate with belief in the topics in the same pattern as Griffin and Ohlsson's study. A bivariate correlation was conducted between belief-basis and belief level across all five topics. A positive correlation indicates that belief in a topic has a more rational basis and a negative correlation indicates the belief has a more intuitive basis. As can be seen from Table 24, Griffin and Ohlsson's original pattern of findings were replicated in the present study. All topics apart from evolution correlated negatively with belief-basis, rho ranging from -.402 for opposites to -.656 for ESP. Evolution correlated positively at rho = .358. All correlations were at $p < .0005$.

Table 24 - Correlations between belief-basis and belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.527	-.571	-.656	-.402	.358
Significance	<.0005	<.0005	<.0005	<.0005	<.0005

Figure 27 - Scatterplots of belief-basis vs belief



Hypothesis 4 predicted that higher CRT5 scores would correlate with greater (i.e. more rational) belief-basis scores. This was tested with a bivariate analysis between belief-basis and CRT5 score. A positive correlation indicates that participants who have a greater tendency to inhibit default responding are more likely to have rational reasons for their beliefs. No significant correlations were found on any topic, in contrast to the findings of Study 3. P-values ranged from .106 to .595 (see Table 25).

Table 25 - Correlations between belief-basis and inhibition

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.057	.110	-.161	-.053	-.111
Significance	.570	.270	.106	.595	.268

Hypothesis 5 predicted that higher CRT5 scores would correlate with lower belief in ESP. This was tested with a bivariate correlation between ESP belief and CRT5. A negative correlation indicates that participants were less likely to believe in a topic if they had a greater tendency to inhibit default processing, whereas a positive correlation indicates that participants were more likely to believe in a topic if they had a greater tendency to inhibit default responding. However, the correlation for belief in ESP was not significant, $\rho = .144$, $p = .149$. Bivariate correlations with the other topics are also presented in Table 26 for comparison. Again, these findings are in contrast to the findings from Study 3.

Table 26 - Correlations between inhibition and belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.039	.074	.144	-.040	-.017
Significance	.696	.460	.149	.686	.865

Discussion

As predicted, the original and new CRT items were positively correlated, although not to an especially high degree ($\rho = .209$). However, neither new or original CRT items validated against the selected validation items taken from Frederick's (2005) original study. This remained the case with the full CRT5. Similarly, no loss aversion effect was observed in this study. The robust belief profile effect across the five topics was

replicated again in the present study. But, inhibition was not associated with belief-basis or belief levels, contrary to the findings in Study 3, which demonstrated these associations clearly.

The fact that the belief-basis graphs and the belief-basis correlations replicated Griffin and Ohlsson's (2001) original findings and those of previous studies in the main research programme, suggests that anomalies in the CRT-related results were not simply due to participants being inattentive to the demands of the questionnaire. However, the failure of the original CRT to validate against the carefully selected validation items and the failure to find the usually robust loss aversion effect (Kahneman & Tversky, 1979; Silberberg et al., 2008) does raise questions about whether there is something different about the sample. Indeed, this is underlined by comparison with the results of Study 3, but they did produce the predicted associations between inhibition and belief, and belief-basis. On the other hand, the present study also failed to validate either the original CRT or the CRT5, and did not find a loss aversion effect. This finding was replicated across the other studies in the wider programme where CRT5 validation was included. The implication is that the absence of loss-aversion and lack of validation of the original CRT are potentially due to a methodological issue, although it is unclear in what way the questionnaires presented differ sufficiently from the original studies, such that these robust associations and effects disappear as convincingly as they have done here.

One possibility is the age of the participants in the present study and main study programme, which were often students and thus relatively young. However, Hertzog, Smith, and Ariel (2018) did not find any differences in CRT scores relating to age, in their study comparing young (age 17 to 35) and older adults (age 60-80). On the other hand, gender differences are commonly observed in CRT scoring (Erceg & Bubić, 2017; Ring, Neyse, David-Barett, & Schmidt, 2016; see also: Zhang, Highhouse, & Rada, 2016). Gender differences were not analysed in the present research programme as they are not relevant to the proposed model, but it can be observed that the ratio of men to women in the present study and in Study 3 are very similar, so that it is very

unlikely that gender differences in CRT scoring are playing a part in the anomalies observed.

Thomson and Oppenheimer (2016) also attempted to address the numeracy issue of the CRT with their own extended version. In doing so, they included validation items relating to risk preference (greater preference for risky than certain outcomes) and time preference (referred to in the present study as delaying reward, also known as hyperbolic discounting). The range of items included was much broader than in the present study, with 11 risk preference items and 8 time preference items. They did not fully replicate Frederick's (2005) findings regarding these items, however, with only 1 of the 11 risk items and 3 of the 8 time preference items correlating significantly with original CRT scores. Considering the family-wise error rate in so many analyses, it is not surprising that a few correlations were found. Nevertheless, in general the CRT does tend to be validated and correlate with measures of inhibition, in addition to its correlation with thinking errors, which is a particularly important factor for the present study.

For example, Oechssler et al. (2009) replicated the original risk and time delay associations with CRT on a student sample, thus making it very similar to the present study. Oldrati, Patricelli, Colombo, and Antonietti (2016) built upon previous research demonstrating an association between the dorsolateral prefrontal cortex (DLPFC) and inhibitory control. They found that there was some reduction in correct responding on the CRT when transcranial direct current stimulation was applied to disrupt its function. This sort of finding offers a degree of triangulation regarding the validity of the CRT measuring inhibition, although care must be taken in generalising from this study to inhibition of higher cognitive processes of the type included in the path-dependency model of belief formation and change. Further triangulating evidence comes from Travers et al. (2016), discussed in the general background chapter. They used mouse tracking to explore the directional time-path of participants' responses. Given a number of answers on screen to choose from, participants tended to move the mouse initially towards the incorrect intuitive answer, even if they went on to click on the correct answer; thus demonstrating inhibition of the initial, intuitive response, all of

which does suggest that the CRT remains a valid measure with respect to inhibition. Certainly in relation to the present study, it would seem foolish to cast it out on the basis of a lack of correlation with two validation items.

It was not expected that the original CRT would fail to validate and considering the similar, if not better, face value of the new CRT items the whole CRT5 was used across the rest of the main research programme, since it does not seem at this point to differ appreciably from the original CRT in validity terms, but it does improve on the issue of numeracy bias. Indeed, the present study is not the only one to have addressed issues with the original CRT. Although at the time the present study was proposed and carried out there were no alternative CRT measures, more recently a number of studies that extend or critiqued the original CRT have appeared.

The study by Thomson and Oppenheimer (2016) was motivated by the same numeracy issue as the present study, although ironically the four new items they provide do all include number references or numeracy to varying degrees. Recall that one reason for not including a production of random sequences item on the CRT5 was precisely because it has a connection to numbers. It is therefore not entirely clear that the new items proposed by Thomson and Oppenheimer do properly address the issues they were trying to address. Indeed, they limit their overall claims to the new measure items as not requiring as much numeracy as the original, rather than eliminating the requirement altogether, as was the aim in the present study. Although, of course, it could also be argued that the F's Test from the present study does, strictly speaking, involve numbers; it does appear to be a difficult thing to avoid entirely.

Primi et al. (2016) go even further, however, arguing that it is not merely that numeracy is an issue for the CRT, but that even the limited numeracy it requires is too hard for many participants except those in elite groups. Indeed, Frederick's (2005) samples were from top universities across the United States rather than a more general sample. Such a population would not be expected to have much trouble with the level of numeracy required on the CRT. However, Primi et al. (2016) demonstrated that this might not be the case for other populations. Although they used student samples they also included measures of intellectual ability in combination with an item-response

theory approach to analysing the data. Item-response can be visualised as an S-shaped curve on a graph of probability of correct response against a latent trait (such as intelligence) on the x-axis, with a flattening out at bottom left and top right. Ideally, the S-shaped curve should be centred and symmetrical, indicating that the item in question, such as the bat and ball problem, are optimal for measuring variance (in CRT scoring) within that population. They found that this was not the case for the original CRT items. Their response was to develop the CRT-L, although this measure has debatable application in relation to their claims about its potential for use with developmental samples, since the improvement over the original CRT in samples of young adolescents was marginal. However, their general point and their findings regarding the difficulty of the test items needs taking into account when sampling from less elite populations. The present research programme tended to use student samples, so this is less likely to be an issue in this instance, although it is interesting to note the relationship of the F's test to Primi et al.'s cautionary findings, since that particular test is undemanding of intellectual ability. Indeed, it was observed that some participants even physically highlighted the F's that they found so as to avoid taxing working memory. Interestingly, they still made mistakes, implying that inhibition measured by the F's test is not simply due to working memory, since participants could take their time going over the sentence multiple times if they wanted to, although that in itself requires inhibition.

On the other hand, in contrast to findings linking CRT, at least partially, to inhibition, Erceg and Bubić (2017) come to the much stronger conclusion that CRT does not measure anything more than numeracy. They argue that CRT associations with non-CRT measures are largely down to numeracy and analytical thinking abilities. However, they did not actually look at correlations between CRT and such measures in their study, relying instead upon measures of need for cognition, faith in intuition, superstitious thinking, maximising and post-choice regret. They therefore seem to be overreaching in their conclusion, considering the wider body of literature and the lack of direct testing in their study in relation to their conclusions.

Numeracy bias is a serious charge for the CRT, however, as it could invalidate not just current findings, but previous ones in the literature as well. It is therefore fortunate that the CRT benefits from triangulating evidence on its association with inhibition beyond simply measuring numeracy (e.g. Oldrati et al., 2016; Travers et al., 2016). However, a number of researchers have also raised the potential issue of over-exposure of the CRT, suggesting that the CRT may be a victim of its own popularity, meaning that participants are likely to have seen the questions before and that this will alter the way they respond. This body of research was not available prior to the start of the current study, but it is an issue that bears attention with regards to the results of the study.

The issue of over-exposure was an additional motivating factor in Thomson and Oppenheimer 's (2016) extension of the CRT. They note, for example, that in their study using Amazon's 'Mechanical Turk', an online pool of research participants and associated tools, 72% of participants had encountered at least one of the CRT items before. Although in relation to this, they also note that Mechanical Turk participants may take part in more studies than most undergraduates do, so have a higher likelihood of exposure. Nor did they actually test for whether familiarity altered the utility of the CRT. However, a study by Bialek and Pennycook (2017) did test whether utility was retained. Motivated by the potential problem of over-exposure of the CRT, they examined the effect of multiple exposures. With a sample of approximately 2500 participants, they failed to find any evidence for reduction of the predictive validity of the CRT. That is, although they found that participants scored higher in later exposures to the CRT, this was only a relative difference and the CRT retained its association with other variables, such as susceptibility to thinking errors. This adds an important caveat to the likes of (Haigh, 2016), where it was found that scoring on the CRT increased after prior exposure, raising concerns about the measure's continued usefulness. Perhaps inevitably, such a short and popular measure will become too well known, however, and it is certainly a good thing that alternatives are being devised (see also: Toplak et al., 2014).

In relation to the non-CRT findings of the present study, it was noteworthy that the belief-basis findings were, yet again, robustly demonstrated. However, it is equally noteworthy that the predicted association between inhibition and belief-basis was not found. Nor was the predicted association with belief. This does need to be taken within the context of the wider study series, however, and as a whole the CRT5 scores do tend to correlate with intuitive belief-basis and paranormal belief. Nevertheless, the lack of association in the present study may have implications regarding the nature of the CRT and discussion therefore now turns to whether the CRT is measuring what it claims to measure, rather than whether there are contaminating issues, such as numeracy bias. For example, it may be that beliefs are not influenced by inhibition, or that other factors can override the effect.

This is what Kahan and Stanovich (2016) argue for in their paper. They looked at religiosity, belief in evolution, and CRT scores, and concluded that group membership (as measured by religiosity) influences beliefs more than critical thinking skills (CRT scores). Here the authors make the mistake of taking CRT as a measure of thinking skills rather than as a tendency to apply said skills, but this aside, the finding still requires discussion. Their suggestion has similarities to the backfire effect (e.g. Betsch & Sachse, 2013), which suggests that strongly held beliefs become even more strongly held when 'attacked' by disconfirming evidence. In this case they observed that those higher in religiosity were equally unlikely to believe in evolution regardless of their tendency to inhibit intuitive thinking, and they go further than this arguing that, in fact, it is likely that those with a greater tendency to inhibit intuitive thinking would have even lower belief in evolution. However, against this claim they find an overall correlation between CRT scores and belief in evolution, driven mostly by the low religiosity participants. These findings therefore imply that inhibition does generally correlate with belief in a particular topic, such as evolution or ESP, as found in Study 3, but that, if the sample population has a strongly rooted group identity that is in competition with such a belief, then the effect of inhibition will be minimal if not counter-productive. While plausible as a general explanation, it is unclear whether the sample in the recent study had such a group identity or what it might be, beyond being of similar ages (mainly 17 to 19 years of age). The cohorts were from three different

years, different schools, and of mixed ethnicity and gender. Nevertheless, it remains an interesting possibility in contrast to writing the finding off as a statistical anomaly.

Another alternative is presented by Stupple, Pitchford, Ball, Hunt, and Steel (2017), who argue that the CRT is really measuring mindware gaps rather than inhibition. They conclude this based upon their findings that the time taken to reach correct answers was only minimally longer than when responding with incorrect, intuitive answers. This would mean that CRT scores would not correlate with belief-basis because the latter is due to inhibition (i.e. thinking style), whereas the CRT is really measuring whether people possess the mindware to solve the problems the CRT presents. However, this explanation fails to explain the findings of other studies in the wider programme, which did find a correlation between inhibition and belief-basis. This would require that participants in the present study lacked that particular set of mindware, yet at the same time they still formed beliefs with the expected belief-basis profiles, implying two distinct sets of mindware. An alternative explanation for Stupple et al.'s findings, however, is that taking a longer time to come to a decision does not rule in or out the need for inhibition of intuitive processing to arrive at correct answers; it may simply mean that people detect the need for something more (Johnson et al., 2016), but are unable to inhibit the intuitive response in the end (Denes-Raj & Epstein, 1994). It must therefore be acknowledged that Stupple et al.'s conclusion requires an assumption that is not warranted by the wider body of literature, such as the evidence from speeded task studies (e.g. Kelemen et al., 2013).

Finally, some researchers, notably Erceg and Bubić (2017), have recently turned their attention to how the CRT is scored. Traditionally the CRT has been scored on correct answers, but it is argued that this is not a true measure of inhibition, since people may lack the numeracy skills to get the right answer; even if they do inhibit the intuitive incorrect answer they may arrive at a rational incorrect answer. They therefore recommend alternative scoring, such as only scoring intuitive incorrect answers as intuitive and scoring the rest as rational (i.e. demonstrating inhibition). Campitelli and Gerrans (2014) findings support this assertion. They investigated CRT, syllogistic reasoning, actively open-minded thinking, and numeracy, and concluded that looking

only at the inhibition element of the responses proved to be a better predictor of actively open-minded thinking (AOT). AOT is measured via a questionnaire, similarly to REI (Rational-Experiential Inventory – Epstein et al., 1996) and asks people about their views and preferences on various points relating to thinking style. As such it is not a direct measure of inhibition, but as a measure of thinking style it is useful. Therefore, based upon the sound logic behind the argument and the findings of Campitelli and Gerrans, the analyses for all studies in the main research programme were reanalysed with inhibition-only scoring of the CRT. This did not make any appreciable difference, however, beyond a handful of noisy statistical spikes that are expected when such a large number of exploratory analyses are conducted.

In conclusion, the results of the validation programme are mixed. While the new CRT items did not consistently validate (only 1 in 3 correlations), neither did the original items (again, 1 in 3 correlations). This is clearly in contrast with other findings regarding the correlation of the CRT with the chosen items. It does not mean, however, that the CRT5 is not measuring what it claims to measure in relation to the research being conducted, which is not investigating delayed reward, but rather is investigating inhibition of higher order cognitive processes more generally in relation to belief formation and change. In this respect, the lack of the original CRT validation in the current sub-programme means that the CRT5 cannot be dismissed as useful in the present research context. Indeed, the items used have good face validity. Therefore, since it did not differ appreciably in validity from the original CRT and has the advantage of reducing the numeracy bias, it was decided, on balance of evidence, to use the full CRT5 in the analyses in the present research programme.

Study 5 – An Extended Intervention on Path-Dependent Belief Change

Background

The studies in the research programme so far have consistently supported the idea of belief-profiles varying across topics in terms of intuitive and rational components of belief-basis. At the same time, however, the programme has only been able to provide cautious support for a relationship between thinking style and belief change. In addition to this, there was variation in whether the intervention studies produced general reduction of belief in ESP or not. The interventions so far both used single lectures, however, and the majority of the literature demonstrating belief reduction after interventions relies upon course-length interventions rather than single-dose versions. For a number of reasons, a higher dose intervention was therefore prescribed for the present study.

There are a number of existing intervention studies on belief change, including interventions specific to reduction of paranormal belief. All demonstrate belief reduction, although most do not examine why change is occurring, only that it does happen; a knowledge deficits model typically being assumed or implied. These mainly use course-length interventions (Banziger & College, 1983; Harrington, 2013; Jones & Zusne, 1981; McLean & Miller, 2010; Morier & Keeports, 1994), although one did use a single-dose approach (Happs, 1991). Such studies are liable to be 8 weeks long or more and arguably provide a greater dose of knowledge than a single one-hour lecture can do. In a similar vein, they will also provide a much greater amount of time within which the slower process of rational cognition can be applied. Indeed, multiple doses of knowledge (and thinking skills) also give more chances for inhibition to be applied than in the single-dose setting. It was thought that this might therefore explain inability to detect the predicted path-dependent belief change effect in the previous

intervention studies, and, furthermore, the lack of a general belief reduction effect in the second intervention study (Study 3).

Although the one-hour lecture intervention was arguably highly intellectual and rational in its approach, as well as engaging, it does not necessarily mean that critical thinking skills were applied by the students. Inbar et al. (2010) argue that the problem situation should cue rational thinking and arguably such a lecture should therefore be doing so. However, as discussed previously, it is also known that the ability to think critically dissociates from actually applying it. Indeed, as any lecturer or teacher will report, it is not unusual for students to let a lecture 'wash over them'. They may fail to engage in what Ennis (1991) refers to as critical thinking. A longer intervention, on a course that is graded and contributes to students' overall degree classification, should help to address this and other issues. Such an intervention should provide greater motivation to engage with the course materials. It should allow greater time for rational thinking preferences to be applied and/or more chances for them to be applied (since intuition has primacy according to the model). It should provide a greater dose of knowledge, thus being better at closing the knowledge gap suggested by exceptionalists (i.e. those taking the view of exceptionalism, as discussed in the General Background chapter). And, it should also promote greater engagement with the materials/depth of learning, due to the coursework included in the particular course used in the present study.

Greater engagement with materials in this way is delivered due to greater depth of processing of the material in the course. It is well known that there are degrees of engagement with material from shallow verbatim recall to engagement with underlying principles (Craik & Lockhart, 1972). The course used in the present study includes a coursework component, which should create depth of engagement, since the material must be processed more elaborately in order for a sufficient piece of work to be produced. It is unclear whether other studies included coursework, however, or exactly what the mode of teaching was. Typically a chalk and talk approach would therefore be assumed. There was also an element of teaching others in the students' coursework as they were asked to write a blog for a lay audience rather than write in

their usual academic essay style. This included a workshop on how to write for such an audience, including the need to teach them about the topic (although not all participants would necessarily choose to write about ESP-related phenomena, it is one of the broader topics in the field).

The knowledge deficits model of belief change would suggest that the greater the dose of knowledge in a course-length intervention, the more likely there will be belief change. A longer intervention would provide this, due to the greater breadth and depth of material that can be covered. In contrast, even a single-dose intervention has been shown to lead to long-term belief change (see Study 1 and Happs, 1991). The argument is therefore not that belief change cannot be elicited in a shorter intervention, but that there may be a dose-response curve involved. Indeed Ghose, Hadjinian, Sattar, You, and Goebel (2004) argue that belief change is a stepwise process, not an either/or change. On these lines, a longer course gives time for more steps and more knowledge to produce those steps. There is also an argument that a course on anomalistic psychology is likely to teach thinking skills and mindware. Osborne (2013) argues that this sort of thing needs teaching in schools. Furthermore, Edward, Maggie, and Christopher (2013) argue that mindware gaps may be what the CRT is really measuring – if so, then a longer intervention that introduces ways to think about anomalous phenomena would be likely to have a detectable effect. However, the path-dependent model of belief change goes further than this and suggests it is not enough to have thinking skills if they are not applied. Indeed, the model is premised on the relationship between the way a belief is formed and the way it can therefore be changed, rather than the existence of knowledge gaps per se. But, nevertheless, knowledge must be a part of that change – this cannot be sensibly denied. However, where the path-dependency model differs from the above deficits accounts is that the reduction in belief will not merely be a general one, as occurred in the first intervention study, it will be associated with the way the belief was formed.

In this respect, discussion therefore turns to the newly introduced inhibition factor – new to the model in the previous intervention study (and Study 4). The argument for a longer study in this respect is that the CRT5 only claims to measure a tendency to

inhibit intuitive thinking. It is not claimed that CRT5 measures the actual application of such thinking or that such thinking is applied *routinely* by the person. Rather it is explaining a tendency for such thinking. Framed in probabilistic terms therefore a longer time period allows for more *opportunities* for such thinking to be activated. Indeed, Benassi, Singer, and Reynolds (1980) concluded that errors in reasoning fallacies accounted for participants being resistant to changing their beliefs about the psychic abilities of the performer in a specially commissioned demonstration. Therefore, if such fallacious reasoning can be inhibited then it would be expected to lead to greater reduction in belief in response to the rational counterevidence presented in the intervention. A greater number of chances to inhibit intuitive thinking and a greater amount of time to take the new knowledge on board may better allow for reasoning skills to have their effect at a detectable level in the study.

A course-length intervention should also provide a much greater ability to cue students' rational thinking (e.g. Inbar et al., 2010). Therefore all participants should be getting cued more strongly to use rational thinking, regardless of belief-basis. According to Inbar et al., this will mean a greater general reduction in belief in ESP, since students are more likely to actually apply their critical thinking skills. However, the path-dependency model predicts that despite such skills being engaged, the counterevidence will be less likely to influence intuitively held beliefs, because those beliefs are formed via, and stored in, intuitive cognitive systems in the brain and thus less amenable to influence by rational inputs. Thus greater cueing should actually help to enhance the originally predicted basic effect, over and above the natural tendency of participants to inhibit intuitive thinking, which was introduced in the revised version of the model.

Finally, the present study presents an interesting situation where a direct comparison of single and multi-dose interventions is possible. This was not something that was possible based upon the existing literature, since the single dose and multi-dose studies were all conducted separately. Moreover, setting aside the point that there was only one single-dose study (Happs, 1991), this study used a different kind of counter-evidence to the other studies (Banziger & College, 1983; Harrington, 2013; Jones &

Zusne, 1981; McLean & Miller, 2010; Morier & Keeports, 1994): the use of videos instead of typical taught materials and discussion. It is therefore difficult to compare the effect sizes between the single and multi-dose studies found in the literature as there is only a small sample of them and very few single-dose studies to include. However, it is possible to directly compare the different length intervention studies in the current programme directly as they use almost identical materials. Self-predicted belief change was not measured in the present study, however, so as not to introduce unnecessary risk of demand effects. Unlike in studies 2 and 3, the participants in the present study were encountering the questionnaires within the context of being taught about anomalistic psychology, whereas previously the participants encountered the questionnaires separately from the intervention itself.

In summary then, the course-length intervention should increase the likelihood of detecting a clear path-dependent effect, due to greater motivation, greater depth of engagement with the material, greater amount of knowledge, and a greater chance of inhibiting intuitive processing.

Hypotheses

H1 – pre-intervention belief-basis would correlate with belief in the topics in the same pattern as in Griffin and Ohlsson's (2001) study.

H2 - Belief in ESP would be lower after the lecture course than before.

H3 - The more rational the basis for their belief in ESP before the lecture course, the more likely participants would be to reduce their belief in ESP afterwards.

H4 – it was predicted that greater (i.e. more rational) belief-basis scores would correlate with greater CRT5 scores.

H5 – it was predicted that higher CRT5 scores would correlate with lower ESP belief.

H6 – higher CRT5 scores would correlate with greater belief reduction in ESP.

H7 – CRT5 would interact with belief-basis, leading to greater reduction of ESP belief when belief-basis was rational and CRT5 scores were higher.

Method

This study used the same intervention paradigm as used in Study 3. However, the self-predicted belief change measure was not included. Variables measured were belief-basis and belief-level, both on a 9-point scale. The CRT5 was also included as a measure of tendency to inhibit default responses (i.e. intuitive thinking). Belief change was measured as the difference between pre- and post-intervention belief levels.

Participants

Participants were third year undergraduates enrolled on a course in Anomalistic Psychology. Data was collected across three cohorts, in separate years, in order to provide a greater sample of participants taking part in both parts of the study. Taking part in both parts of the study also gave students a chance to win £50 – this prize applied separately to each cohort. In total, 94 participants participated in the first half of the study, after one participant was removed due to apparently misinterpreting instructions with respect to rating belief/disbelief. There were 26 male participants and 68 female participants, aged 20 to 46 (mean 22.46, SD = 3.582). The sample size for participants completing both halves of the study was 39, consisting of 9 male and 30 female participants, aged 20 to 32 (mean 22.16, SD = 3,063).

Materials

The study relied mainly upon pencil and paper presentation of the questionnaire, as in Study 3, with CRT validation items removed, to reduce the length of the questionnaire, which was at the start of a lecture. However, an online presentation was created to increase the number of students completing the second half of the study. Due to the tendency for non-attendance on most university courses late in the year, it was anticipated that an online option would be needed to maximise participation. As discussed, and demonstrated, in Study 1, these modes of presentation are generally equivalent and it was not expected that the differences in presentation would be an issue. The questionnaire was the same as the one used in Study 3, with the self-prediction question omitted. The online presentation was via Lime Survey version 1.92 (<http://www.limesurvey.org/>) hosted on computer servers at Goldsmiths College, University of London. The intervention itself was one semester long and covered the

material in a textbook co-written by the course's principal lecturer (French, 2014). This included material on ESP. The course contributed to students' overall degree classification and included a piece of written coursework and a written exam.

Scoring

Belief in each topic was measured in the same way as in Study 1.

Belief-basis on each topic was measured in the same way as in Study 3.

Belief change on each topic was measured in the same way as in Study 2.

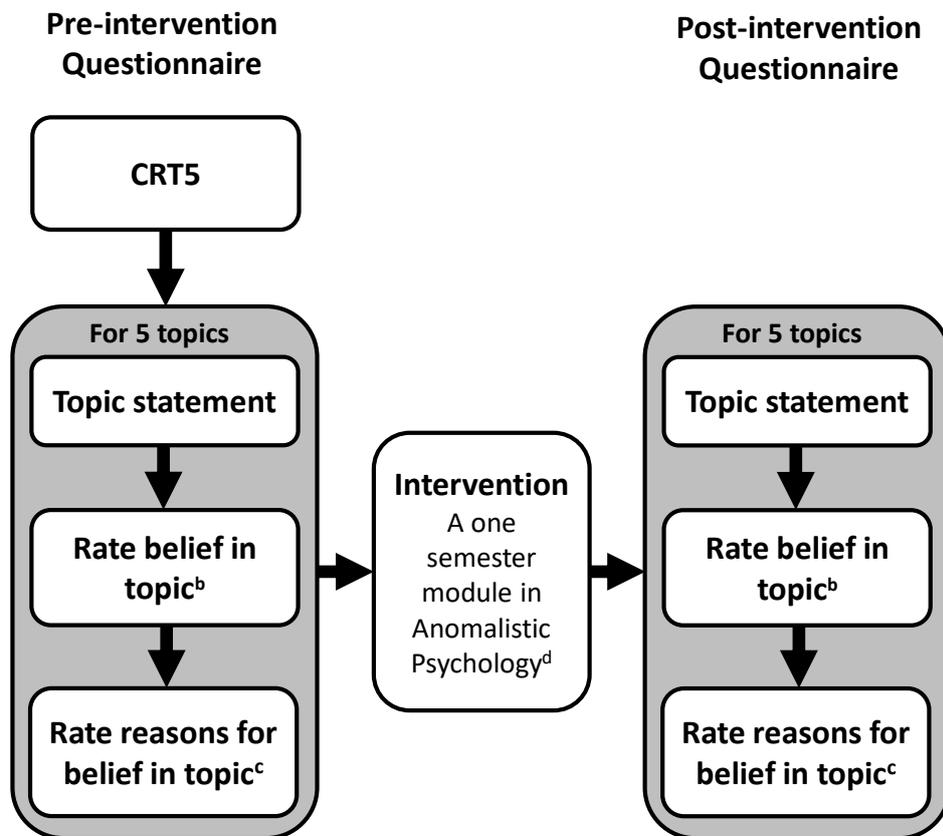
CRT5 was measured as detailed in Study 4.

Procedure

The time sequence of the study is illustrated in

Figure 28. Participants were briefed via a sheet on the front of the pre-intervention questionnaire (Appendix 5). They also signed the consent form, which was removed from the front of the questionnaire after data collection to preserve participant anonymity. BPS ethical guidelines were followed and participants were free to withdraw from the study (BPS, 2017, 2018). Participants completed the first questionnaire in the first lecture of the course. Then, one or two lectures before the end of the course participants completed the second questionnaire – typically this was during the exam revision lecture as this type of lecture tends to produce the highest attendance. Those who did not attend the lecture were emailed and given a link to the questionnaire online. This mailing was repeated once more for those who had still not participated. Within each of the three cohorts, those who took part in both halves of the study were eligible for a £50 cash prize, drawn at random after data collection had finished. Since data collection continued online, participants were debriefed via email once data collection had been completed (Appendix 5). This study was approved by the ethics committee at Goldsmiths College, University of London.

Figure 28 - Time sequence and measures for Study 5



^a **CRT5** – one point for each correct answer, added together for a range of 0-5 (low to high tendency to inhibit default responding).

^b **Belief** in topic rated from 1-9 (none to completely).

^c **Belief-basis** – calculated from 6 ratings of reasons for belief (1-9, from not at all to completely). Mean rating for the three intuitive items is subtracted from the mean rating for the three rational items, giving an overall rating from 1-9 (from intuitive belief-basis to rational belief-basis)

^d The questionnaires were presented at the start and end of the three month module.

Results

As in the previous studies, graphs of the belief-basis in each topic for believers and non-believers are presented, compared alongside the results from Griffin and Ohlsson's (2001) original study, using the full dataset of 94 participants in the present study. Once again, there is the close visual match that was seen in the previous studies in the current research programme.

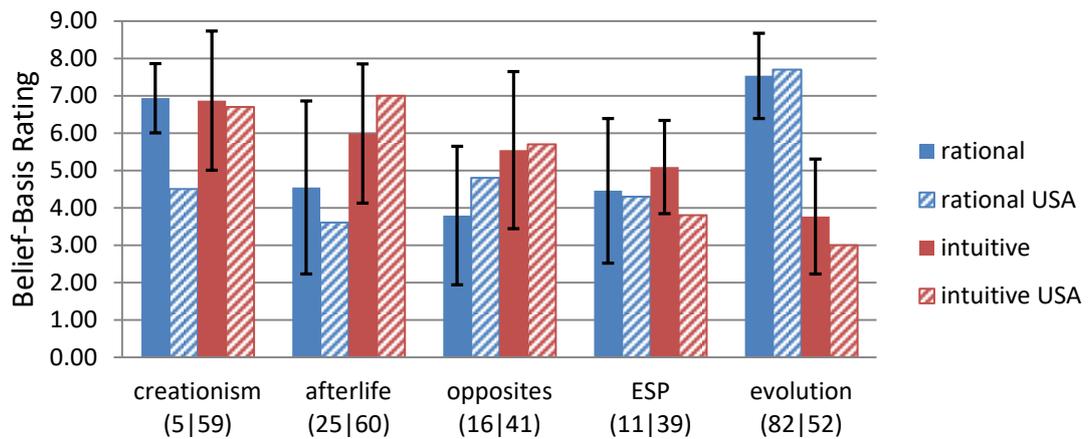


Figure 29 - Comparison between Study 5 and Griffin and Ohlsson's (2001) USA sample for believers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

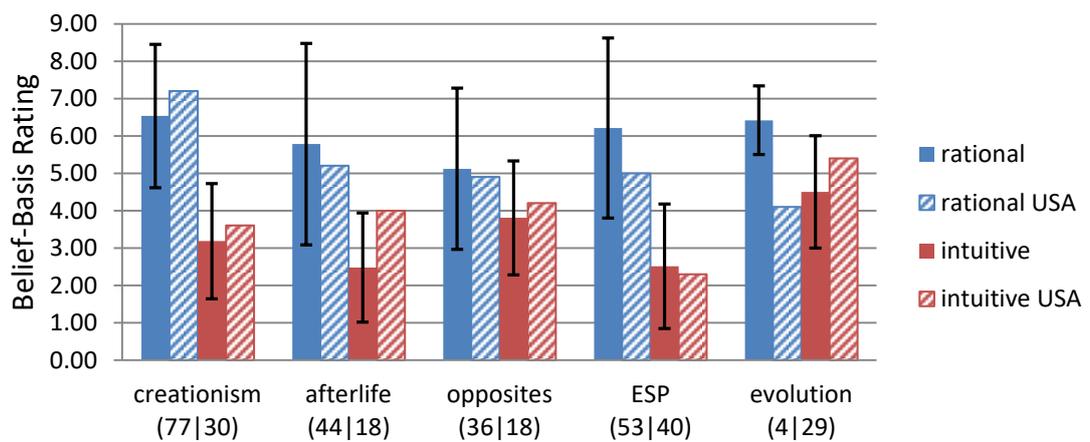


Figure 30 - Comparison between Study 5 and Griffin and Ohlsson's (2001) USA sample for disbelievers' belief-bases (numbers of contributing participants are given for each topic, with USA sample on the right; error bars not available for USA sample)

Prior to statistical analysis of the results the integrity of the belief-basis measure was checked. The overall Cronbach's alpha was .458. Factor analysis without rotation presented a clear loading of the items on intuitive and rational belief-basis. Cronbach's alpha for intuitive items was .755 and for rational items it was .859.

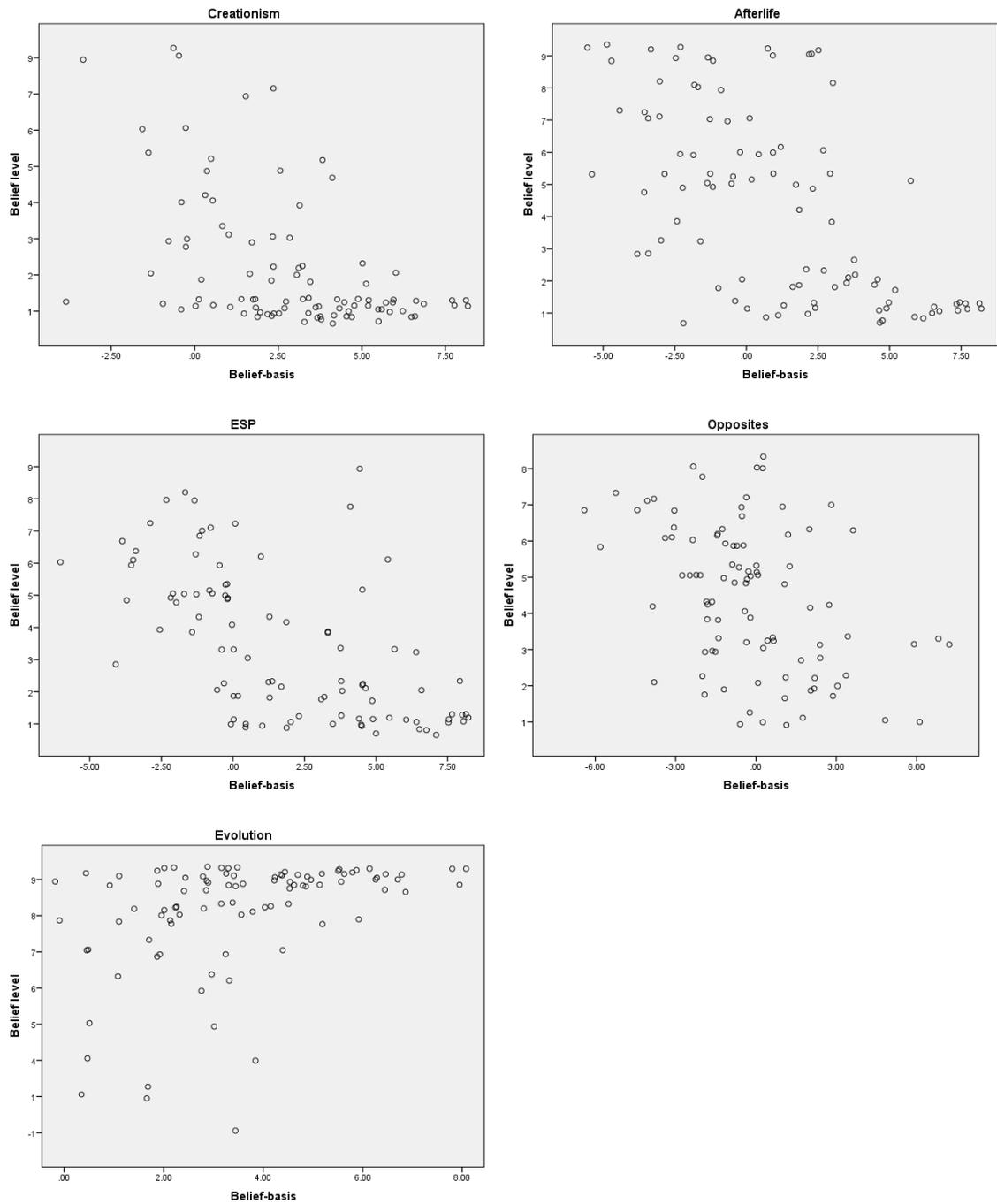
Hypothesis 1 predicted that pre-intervention belief-basis would correlate with belief in the topics in the same pattern as in Griffin and Ohlsson's (2001) study. This was tested

with a bivariate correlation between belief-basis and belief level on each of the five topics, using the full data set of 94 participants. A positive correlation indicates that belief in a topic has a more rational basis and a negative correlation indicates the belief has a more intuitive basis. As can be seen in Table 27, belief-basis correlated as expected, with all topics correlating positively apart from the negative correlation for evolution. Rho ranged in absolute values from .437 to .678, with significance at $p < .0005$ for all topics, thus replicating Griffin and Ohlsson's original findings and those in earlier studies in the present programme.

Table 27 - Correlations between belief-basis and belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.507	-.625	-.678	-.437	.484
Significance	<.0005	<.0005	<.0005	<.0005	<.0005

Figure 31 - Scatterplots of belief-basis vs belief

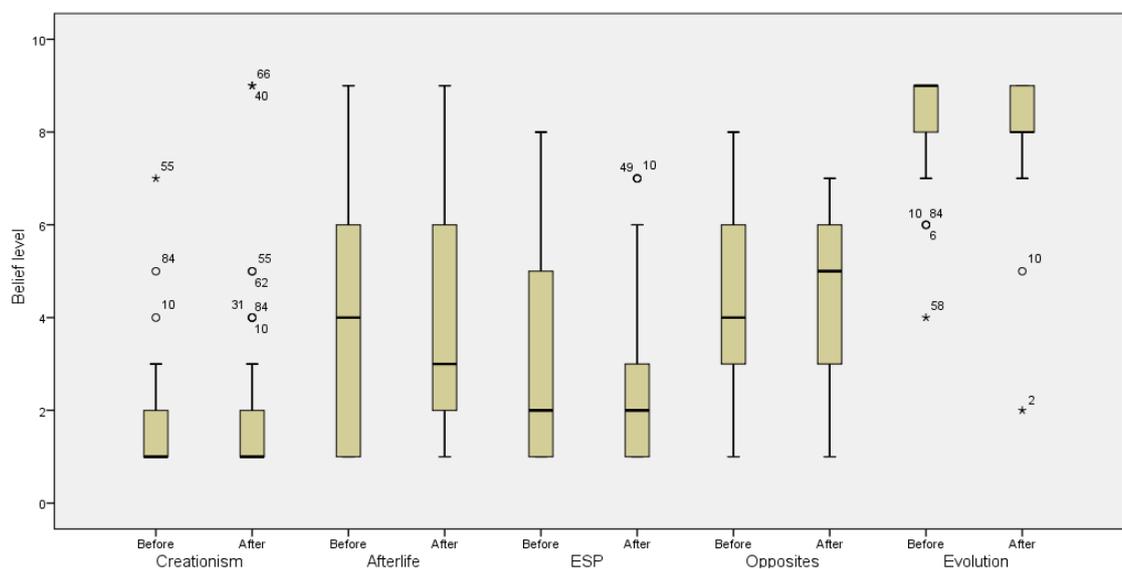


Hypothesis 2 predicted that belief in ESP would be lower after the lecture than before. A Wilcoxon test was conducted on belief before and after the intervention (n = 39). Table 28 shows that the only topic to show belief reduction on the 9-point scale was ESP (reduced by -.67 from 3.15), $z = -2.059$, $p = .037$. All other differences were non-significant. There was therefore no need to compare belief change in ESP with belief change in the other topics.

Table 28 - Belief change after the intervention

	Creationism	Afterlife	ESP	Opposites	Evolution
Mean belief change	.33	-.13	-.67	-.15	-.41
Significance (exact 2-tailed)	.821	.256	.037	.877	.852

Figure 32 - Boxplots of belief for each topic, before and after the intervention



* the difference in belief before and after the intervention was significant, $p < .05$

Since there was significant belief change observed in ESP, additional analysis was conducted to determine if ESP was actually reducing more than belief in the other topics that were not targeted by the intervention. Wilcoxon tests between ESP belief change and belief change in each other topic were conducted. The results are displayed in

Table 29 below. Belief change for ESP did not differ significantly for in comparison to any topic apart from Creationism. However, this latter result would not survive correction for family-wise error rate. Overall, it cannot be concluded with confidence that belief in ESP reduced after the intervention.

Table 29 - Differences in belief change between ESP and the other topics

	Creationism	Afterlife	ESP	Opposites	Evolution
Belief change difference ([topic]-ESP)	1.00	.54	n/a	.52	.26
Significance (exact 2-tailed)	.030	.210	n/a	.312	.643

Hypothesis 3 predicted that the more rational the basis for their belief in ESP before the lecture, the more likely participants would be to reduce their belief in ESP afterwards. A partial correlation, controlling for pre-intervention belief level, was conducted between belief-basis and belief change (calculated as the difference between belief and pre- and post-intervention stages, $n = 39$). A positive correlation indicates that participants who report a greater rational belief-basis are more likely, than those with an intuitive belief-basis, to change their view after the intervention. Whereas as negative correlation indicates the opposite situation. This was not significant for belief in ESP, however ($\rho = .219$, $p = .181$). No correlation for other topics was significant either, with p -values ranging from .159 to .971 (see Table 30).

Table 30 - Correlations between belief-basis and belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Pearson's r	-.066	-.097	.118	-.188	-.079
Significance	.561	.393	.299	.096	.487

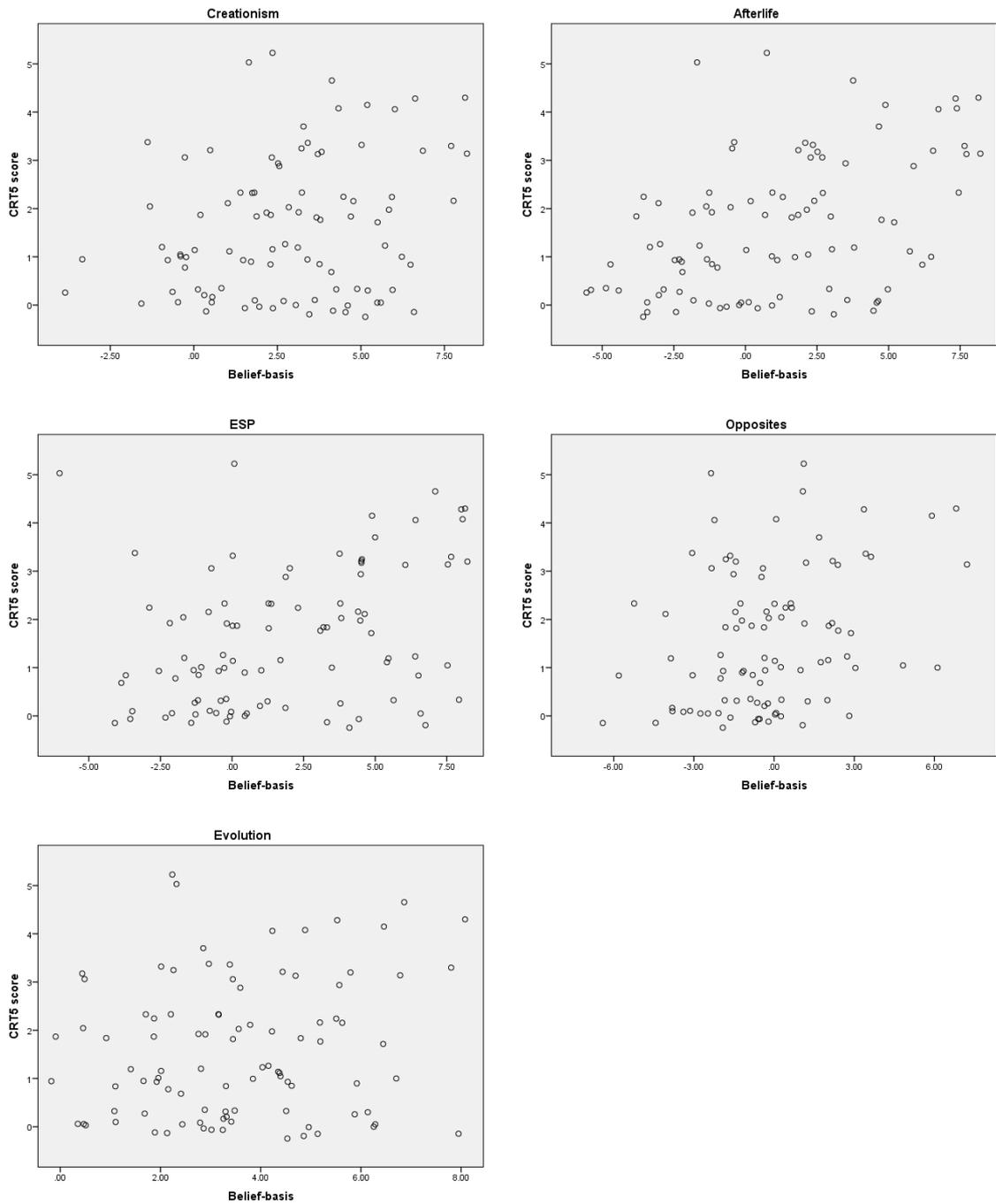
Hypothesis 4 predicted that greater (i.e. more rational) belief-basis scores would correlate with greater CRT5 scores. A bivariate correlation was conducted between CRT5 and belief-basis on each topic ($n = 94$). A positive correlation indicates that

participants who have a greater tendency to inhibit default responding are more likely to have rational reasons for their beliefs. As shown in Table 31, ESP, afterlife, and opposites all showed a positive correlation between CRT5 score and belief-basis score (rho ranging from .265 to .429 and p-values ranging from < .0005 to .010). Creationism also showed a positive correlation that was approaching significance: rho = .200, p = .053. Evolution did not show a significant correlation, however, p = .244. The results of Study 3 were therefore partially replicated.

Table 31 - Correlations between belief-basis and inhibition

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	.200	.429	.319	.265	.121
Significance	.053	<.0005	.002	.010	.244

Figure 33 - Scatterplots of belief-basis vs inhibition



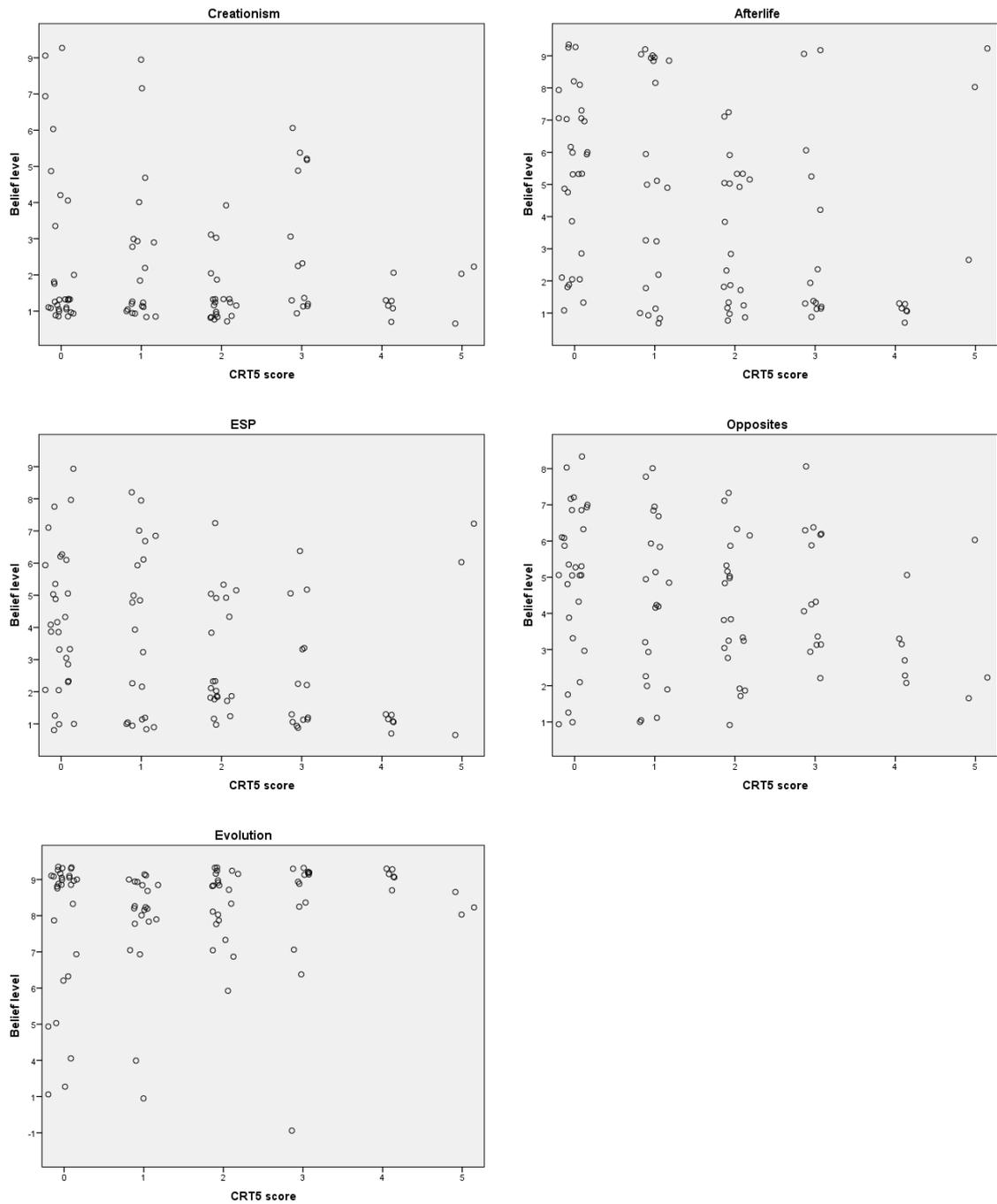
Hypothesis 5 predicted that higher CRT5 scores would correlate with lower ESP belief. A bivariate correlation was carried out between CRT5 and pre-intervention belief levels (n = 94). A negative correlation indicates that participants were less likely to believe in a topic if they had a greater tendency to inhibit default processing, whereas a positive correlation indicates that participants were more likely to believe in a topic if they had a greater tendency to inhibit default responding. Table 32 shows a significant

negative correlation for ESP ($\rho = -.330$, $p = .001$) and afterlife ($\rho = -.355$, $p < .0005$), with opposites approaching significance at $\rho = -.202$, $p = .051$. There was no significant correlation for creationism or evolution.

Table 32 - Correlations between inhibition and pre-intervention belief

	Creationism	Afterlife	ESP	Opposites	Evolution
Spearman's Rho	-.033	-.355	-.330	-.202	.093
Significance	.751	<.0005	.001	.051	.373

Figure 34 - Scatterplot of inhibition vs pre-intervention belief



Hypothesis 6 predicted that higher CRT5 scores would correlate with greater belief reduction in ESP. A partial correlation was conducted between CRT5 and belief change, controlling for pre-intervention belief level. A negative correlation would indicate that belief in a topic reduced more for those participants with a greater tendency to inhibit default responding, whereas a positive correlation would indicate that belief reduction is associated with a lower tendency to inhibit default responding.

Significant correlations were found for Creationism and Afterlife, but no significant correlation was found for the focal topic of ESP: $\rho = .140$, $p = .217$ (see Table 33).

Table 33 - Correlations between inhibition and belief change

	Creationism	Afterlife	ESP	Opposites	Evolution
Pearson's r	.252	.291	.140	.196	.124
Significance	.025	.009	.217	.083	.276

Hypothesis 7 predicted that CRT5 scores would interact with belief-basis, leading to greater reduction of ESP belief when belief-basis was rational and CRT5 scores were higher. The interaction between CRT5 scores and belief-basis was therefore analysed with respect to belief change. The interaction term was calculated after centering of the CRT5 and belief-basis variables, and a partial correlation was conducted between the interaction term and belief change, controlling for pre-intervention belief level. A positive correlation would indicate that when participants report greater rational belief basis in a topic at the same time as having a greater tendency to inhibit default responding, then they would be more likely to reduce their belief after the intervention. However, no significant interaction was found: $\rho = .140$, $p = .217$.

Discussion

As in previous studies in the series, the belief profile findings were once again supported, including an inverse correlation between rational belief-basis and opposites at a high level of significance. Similarly, inhibition was associated with a more rational belief-basis in each topic, apart from evolution, which did not approach significance (note: for creationism $p = .053$). Furthermore, inhibition was associated with lower belief in ESP, afterlife, and opposites (for opposites $p = .051$), although there was no association on the topics of creationism or evolution, thus presenting a partial replication of the findings from Study 3. A general reduction in belief in ESP was also

found, although this reduction was not significantly greater than belief change in other topics, so must be interpreted with caution. However, there was no evidence of the predicted correlation between belief-basis and belief reduction. Furthermore, there was no association between inhibition and belief reduction. Nor did belief-basis and inhibition interact to predict belief reduction.

The present study provided a higher 'dose' intervention and the fruits of this can be seen in the general clarity of the statistical analyses, such as the clear correlations between belief-basis and belief across the topics. There were a few cases where the association was just outside statistical significance (see above), but generally the delineation was clear; even where differences were found between the topics it was a clear difference – e.g. belief-basis vs belief for creationism and evolution had very low significance in contrast to the other topics. This is helpful when it comes to interpreting the results as it is expected that topics might differ on some factors and it helps to ascertain better whether such results are due to noise in the data or real effects (or lack of real effects). For example, the clear difference on evolution and creationism noted above might be explained by group identity, such as religiosity, as proposed by Kahan and Stanovich (2016). In this case, belief-basis would be expected to correlate, but inhibition would not influence the level of belief due to the overriding effect of group identity defences.

The contrast between the consistently robust presence of belief-profiles versus the absence of clear predicted belief change effects was also drawn out clearly in the present study. Belief in ESP showed a clear reduction, with no parallel reduction in belief in any other topic, including afterlife, which is included in measures of general paranormal belief (Tobacyk, 2004). However, ESP did not differ significantly from most other topics, meaning that one cannot be completely confident that the observed reduction in ESP belief is due to the intervention or is not a demand effect, or regression to the mean. Nevertheless, belief-basis correlated to a highly significant degree with belief in each topic, all in the predicted directions. Yet, associations of belief-basis and inhibition with belief reduction were very clearly non-significant. This appears to clarify the mixed findings from earlier studies in the programme, which

could only offer cautious support for the path-dependent belief change hypothesis. The longer intervention has resulted in generally clearer results across the board, but in this instance the findings are not in favour of the proposed hypothesis.

These findings echo the claim of Haidt (2001), from a study on making ethical judgments, that such judgments are rationalised post-hoc. In the present context this can be interpreted as people forming their beliefs in topics such as ESP, and then rationalising their reason for belief. This would explain why belief-basis did not correlate with actual belief change, but at the same time raises the issue of whether self-reported belief-basis can therefore be relied upon. Belief-basis was therefore addressed more directly in the next, and final, study in the series.

Another issue that needed addressing in the next study was the nature of the disconfirming material, which has so far only been of a rational nature. In contrast, Edwards (1990) found that emotionally based beliefs were altered by increasing emotional arousal, but intellectually based beliefs were not. This mirrors the path-dependency model on the idea that belief-basis affects belief change, but the finding only applies to the influence of affect. Strictly speaking it was the effect of emotional arousal that was being investigated, but this can be deemed to come under the umbrella of intuitive thinking. The present study series has not yet presented any kind of intuitively-based disconfirming material, however, and it may be that path-dependency is asymmetrical at the point of belief change, as found by Edwards.

A key rationale behind the longer intervention was the idea of a dose response effect. The higher dose included more knowledge, more time, and more engagement with the materials. As already noted, most of the published intervention studies on belief change, in relation to paranormal belief, presented course-length knowledge-deficit interventions (Banziger & College, 1983; Harrington, 2013; Jones & Zusne, 1981; McLean & Miller, 2010; Morier & Keeports, 1994), although some did use a single-dose approach (Happs, 1991). However, unlike the existing published studies, the present study can be directly compared to other, single-dose interventions. The knowledge deficits hypothesis would predict a dose-response effect, where more knowledge leads to greater reduction in the knowledge gap and thus greater belief change.

However, this was not what was found, even if one sets aside the lack of belief change difference between ESP and the other topics and takes the ESP belief change at face value. The first intervention study (Study 2) actually found a greater reduction in belief (-.88) than the present study (-.67). While the second single-dose intervention study (Study 3) did not produce a general belief reduction effect (-.36, $p = .185$). Averaging between the two single-dose studies gives a reduction of -.44, which does not provide the kind of dose-response effect that might be expected between a single one-hour lecture and a full course of lectures (which resulted in a reduction of -.67). It is worth noting that amount of content specifically on ESP did also increase proportionally with the length of the intervention, so a dose response would be expected. However, it may be that a dose response was hidden by the differences in pre-intervention belief levels. Study 2 and 3 had mean pre-intervention belief levels of 4.81 and 3.82, respectively, on the 9-point scale. Study 3 had a mean pre-intervention belief level of 3.38. Study 2 showed the largest belief change, but the participants also had the most room for belief reduction, whereas Study 3's participants had much less room to reduce their beliefs. However, the present study's participants had least room of all for belief reduction, yet still showed a sizeable belief change effect. This could be interpreted as evidence of the predicted dose-response effect, in line with the knowledge deficits hypothesis and Ghose et al.'s (2004) emphasis on step-wise belief change, although further research would be needed using participants from the same cohort or balanced for initial belief levels, so that a more direct comparison can be made. Indeed, in the analysis of belief-basis and belief change, initial level of belief was controlled for, but no significant association was found, despite some support for this association being found in the earlier studies.

Another type of dose-response proposed was greater time spent studying the material, giving greater time for participants' tendency to inhibit intuitive thinking to have an effect. Similarly, depth of engagement should have been greater, due to extrinsic motivation of course grades and the intrinsic process of engagement with the material for producing the coursework component. Furthermore, there should be more time for external, situational cueing of rational thinking processes, which would help to highlight any belief-basis association with belief reduction. These factors were

therefore thought likely to facilitate the influence of variables involved in path-dependent belief change – inhibition of intuitive thinking and processing of rational disconfirming material. However, this differential type of belief reduction was not demonstrated in the present study, suggesting that while belief formation might be associated with thinking style and situational cueing, belief change might work in a different way.

Perhaps, contrary to assumptions made in the rationale for this study, a greater amount of thinking time does not lead to a greater likelihood of avoiding thinking errors. The assumption was based upon a broad body of literature demonstrating that having thinking skills dissociates from applying those skills to avoid thinking errors (e.g. Benassi et al., 1980; Dagnall et al., 2007; Hergovich & Arendasy, 2005; Irwin & Young, 2002; Kelemen et al., 2013; Royalty, 1995; Schwitzgebel & Cushman, 2015; Stanovich & West, 2007, 2008a, 2008b). However, this body of evidence does not include studying over an extended period of time where there is a greater likelihood of applying critical thinking and avoiding thinking errors. Therefore the assumption made for the present study may be incorrect and a greater amount of thinking time makes no difference to the likelihood of inhibiting intuitive thinking or otherwise engaging critical thinking skills to avoid thinking errors. An alternative to this is that there is greater likelihood of avoiding thinking errors, but that path-dependency of belief change does not occur and therefore this greater avoidance of thinking errors applies regardless of belief-basis. Indeed, Sperber (1997) argued that initially people evaluate things intuitively and only then, with further engagement, do they reflect upon their belief and form a reflective belief. This suggests that, regardless of belief-basis, people are on an equal footing when it comes to belief change via rational reflection. This is in line with the knowledge deficits hypothesis and would require similar research to establish the existence of a dose-response effect.

With respect to belief change the results are also in line with rational actor models, however, where it would be assumed that people are processing the disconfirming information rationally anyway (e.g. Anderson & Rausch, 2009; Bucher et al., 2014; Hample, 1979; Lange & Fishbein, 1983; McFarland & Thistlethwaite, 1970; Morris, 1996;

Schulte, 2002; see the General Background chapter for further examples). However, this type of explanation has problems explaining the belief-basis differences, which implies a difference in belief formation that differentiates between rational and intuitive thinking. Meanwhile, rational actor models that take prior experiences into account (e.g. Bleile, 2014) do not help to explain the lack of a path-dependency effect. Rational actor accounts are therefore not capable of explaining the findings, despite the failure of the proposed dual-process account to do so. Further research is clearly needed.

As already noted, the next study would need to look at belief-basis in more detail in case self-reports of this are inaccurate and thus hiding path-dependency, which would rely upon actual belief-basis. This concern echoes the one about self-predicted belief change, which studies in the series have demonstrated was a legitimate concern. Furthermore, although the path-dependency model predicts variation depending upon the type of disconfirming material, so far only rationally based material has been presented and this means that the model is not being fully tested. Indeed, Edwards (1990) found something similar to the path-dependency model of belief change, but with asymmetry at belief change, such that affect-based beliefs were better influenced by affect-based disconfirmation, whereas rationally based beliefs showed no differential effect of the type of disconfirming material. A follow-up study to the present one should therefore seek to test this aspect of the model.

In conclusion, while the present study adds yet more support for belief-basis findings (as a proxy for belief formation), it also finally clarifies a lack of support for path-dependent belief change. A longer intervention may have produced a dose-response effect for knowledge and the reduction of associated knowledge gaps, although this needs further research. Arguably, however, it did not produce a dose-response effect that had any kind of impact upon individual differences in belief change. One explanation for this is that the model itself is simply incorrect. However, in line with Kluger and Tikochinsky's (2001) argument, it is hasty to overgeneralise from specific null findings and the model should be more fully investigated before that line of inquiry can be closed with confidence. Bearing in mind that even a lengthy

intervention did not appear to demonstrate any influence of material type or cognitive processing style, it seems that a different approach is needed. Indeed, this is the case regarding belief-basis as well, and therefore it was proposed that the next study should change tack and bring the study of the model back into the laboratory where such variables can be controlled.

Study 6 – Belief Formation and Change in the Lab

Background

Up to this point the research programme has consistently demonstrated the existence of belief-profiles for various topics. However, it has been clarified that there was no relationship between belief-basis and belief change, despite some promising early results. Nor has it demonstrated this effect for associated factors, such as inhibition of intuitive thinking. However, previous studies have two major omissions in their testing of the model. Firstly, the type of disconfirming material has been limited to rational material, of the type presented in university lectures and textbooks. This limits the conclusions that can be drawn about belief change in relation to the general dual-process account and the proposed model specifically. Secondly, all of the studies have relied entirely upon self-reported belief-basis as a proxy for the cognitive processes involved in belief formation. However, while this was a necessary assumption within an ecologically valid intervention paradigm, the concern is that self-reports cannot always be relied upon to be accurate, as indeed was found within the present study series. The path-dependent model makes its predictions based upon true belief-basis (i.e. the way the beliefs were formed) and thus self-report might be confounding proper testing of the model. The present study therefore aimed to investigate both points in the belief process – formation and change – in greater detail, under more controlled conditions than previously used in the research programme.

Haidt (2001) argues, with respect to moral reasoning, that the reasons given for ethical decisions are rationalised post-hoc. In the context of belief this would mean people forming a belief and then coming up with a reason for the belief. This latter reason would be the reason that people are expected to be able to report upon, but this reason may be completely unrelated to the true reason. Indeed, the issue of accurate self-access to higher cognitive processes was raised by Nisbett and Wilson (1977). Nisbett

and Wilson argued that it was merely an assumption that people can accurately report on their own higher cognitive processes, since they can verbalise something that appears related to them. In contrast, it would be thought absurd to assume that someone can accurately report on a low-level cognitive process, such as their use of ocular convergence when judging distances.

Nisbett and Borgida (1975) demonstrated this point in a study where participants failed to make accurate predictions (i.e. in line with statistical information they were given) about the likelihood of their behaviour in a research study (bystander apathy or Milgram-style shock studies). Even stronger evidence of this was provided by Balcells and Dunning (2013) who found that students' predictions of their peers' behaviours differed from prediction of their own behaviours. Their peers actually took part in the studies (on bystander helping and making charity donations) and students were reasonably good at predicting their peers' actual behaviours based upon knowledge of the base-rate statistics. However, students predicted their own behaviour would be different; specifically, that they would behave better, with more likelihood of helping or donating. This kind of self-prediction can be thought of in terms of an a priori rationalisation rather than post-hoc.

However, other studies discussed previously also included research on a phenomenon called choice-blindness (Hall et al., 2012; Johansson et al., 2006). In this case participants appear to be blind to a choice that they made just seconds ago and they proceed to construct a reason for the choice post-hoc. This includes choices that are completely contradictory to their original choice and echoes findings from split-brain studies (e.g. Joseph, 1988; Puccetti, 2010). In the split-brain situation the participant is a person who has undergone an extreme form of surgery for epilepsy, involving largely separating the two hemispheres of the brain. Studies reveal that the left side of the brain will confabulate (i.e. rationalise post-hoc) the behaviours instigated by the right side of the brain, such as laughing at a picture or holding a glass of water. This happens because the two halves of the brain have limited communication after the disconnection, but the left side goes right ahead and tries to explain what is going on; regardless of the facts, a story is constructed. This is an extreme case, but it

demonstrates the potential for post-hoc rationalisation, and choice blindness offers evidence of the same process in normal healthy individuals.

If Haidt (2001) is right, then self-reports of belief-basis might also be unreliable. It may be that people do not really have access to their reasons for belief and they are constructing those reasons post-hoc. Although the literature is generally consistent on the relationship between belief-basis, thinking styles, and belief in the paranormal the research is nevertheless typically correlational and the connection between belief-basis and belief formation can only be assumed. Indeed, for practical reasons, real world intervention studies and most studies on paranormal beliefs in general must focus on correlations with existing beliefs and on the belief change point in the belief process. Given the reasons to be cautious about self-reports, the present study therefore aimed to manipulate belief formation directly so that self-reports of belief-basis were not required.

The path-dependent model of belief change predicts that whether beliefs are formed for rational or intuitive reasons influences the likelihood of those beliefs changing later in response to disconfirming material. Specifically, the prediction is that rationally formed beliefs will be most influenced by rational disconfirmation and intuitively formed beliefs will be most influenced by intuitive disconfirmation. The aim of the present study was therefore to induce beliefs of each type and present disconfirming material of each type to induce belief reduction, giving a 2x2 design, forming four conditions, the prediction being that belief reduction would be greatest in the congruent conditions. Induction of belief in the lab is unlikely to be as strong as beliefs in the real world, such as beliefs that the previous studies in the research programme have focused upon. It was therefore not expected that there would be extreme swings in belief, but the aim was to produce and reduce belief at detectable levels.

It was therefore proposed to present participants with different types of material to induce and reduce belief, the types either appealing to intuitive or rational cognition. It is, of course, impossible to directly know what thinking processes a person is actually using, but by presenting different types of materials the aim was to induce the use of the different processing styles. Thus, given material devoid of rational evidence

or argument, it is unlikely that a person can form a rational belief in the phenomenon being advocated. Similarly, if rational material is present then it allows for a rational belief-basis. This means of induction is clearly not perfect, but the aim of the study was to detect relative differences, so to this end the means of induction is sufficient if it provides relative difference, which as described above, it should be capable of doing.

Indeed, there is precedent for the use of differing types of material to influence thought processes. For example, Raab and MacMahon (2015) looked at the hot hand belief in basketball, the belief that players who have made a run of shots are more likely to continue that run. They found that depending upon how things were framed people made different decisions. In fact, they were able to change people's decisions from being hot-hand/cold-hand related simply by changing the camera angle from which people were viewing the basketball plays. Similarly, Reber and Greifeneder (2016) found that the way people feel about the material they encounter influences whether they evaluate it positively or not. Specifically, they found that when fluency was reduced, such as the material being printed in a harder to read font, people evaluated the material less positively. On a related note, Inbar et al. (2010), discussed earlier, argue that both intuitive and rational processing require cueing. That is to say, that the situational context cues which type of thinking to use and in the present context the type of material could be seen as forming part of the situational context.

In order to induce belief formation and change it was proposed that a made-up phenomenon should be used. This was to ensure, as far as possible, that the study was not measuring prior beliefs which, as observed by Benassi et al. (1980), can have a significant influence on interpretation of new information. Precedent for the use of faked materials can be found in the literature, including literature specifically related to paranormal belief. In Benassi et al.'s (1980) study, for example, they used a specially commissioned psychic demonstration (i.e. a trick) in their study. In that case, the demonstration was presented as either a trick or not a trick. The demonstration consisted of a mentalist trick, but this can also seem like the performer has psychic abilities. Much as a magician materialising a deck of cards out of thin air is really just a sleight-of-hand, mentalists could be said to use 'sleight-of-mind' to achieve their

illusions (e.g. D. Brown, 2007; Rowland, 2002). In the condition where the demonstration is not presented as being a trick the material is therefore a fake demonstration of psychic abilities.

In a vein more similar to the present study, however, Nyhan and Reifler (2010) used mock news articles to test how likely people were to change their mind about an issue when a correction was given regarding a misleading claim. The material successfully induced belief in the misleading claim, although unfortunately for knowledge deficit advocates, they found that correction of the misleading claim did not alter belief in the original misleading statement if the correction was contrary to the political ideology of the participant (see also: Tappin, van der Leer, & McKay, 2017). Another study, discussed earlier, by Green and Donahue (2011), also used fake material; in this case fabricated stories that were either initially stated to be truth or fiction. Participants made judgments about the elements of the stories, such as the characters in them, and then were later told that there were inaccuracies in the story they had read (similarly to the corrective information in Nyhan and Reifler's study). They were also told either that the author had introduced the inaccuracy deliberately or by mistake. Regardless of the condition the participants were in, they did not change their original judgements made about the fake material, however.

It was therefore decided that an online laboratory-controlled intervention study using faked news report excerpts would be used. This would be presented online to gather a larger sample and bringing the added advantage of not being over-reliant upon student samples (McNemar, 1946; Smart, 1966). Taking this study into laboratory conditions (albeit online ones) was necessary in order to control the variables being studied. In doing so one must be mindful of the issue of over-generalisation that Mitchell (2012) raised about generalising from the laboratory to the real world. However, in this instance the move is a considered decision to move from the real world into the laboratory (the reverse direction to Mitchell's concern), specifically in order to increase control.

The present study therefore aimed to induce and reduce belief in a fabricated, anomalous (i.e. paranormal-like) phenomenon via manipulation of the types of

materials presented to participants at the points of belief formation and change. The aim was to avoid the potential unreliability of self-reports with respect to belief-basis and to fully test the predictions of the path-dependency model regarding the congruence of disconfirming material at the point of belief change. CRT5 as a measure of inhibition was also included as one of the factors feeding into the predictions of the model. Due to the need to control key variables the study was to be conducted as an online laboratory experiment.

Hypotheses

H1 – Participants' belief in the phenomenon will increase after the pro-phenomenon material is presented.

H2 – Intuitive pro-phenomenon material will increase belief in the phenomenon more than rational pro-phenomenon material – this was predicted based upon the association between intuitive thinking and belief in anomalous types of phenomenon, such as ESP.

H3 – Participants' belief in the phenomenon should reduce after exposure to sceptical material.

H4 – Participants' belief will reduce more when the pro-phenomenon material and the sceptical material are of the same type (intuitive/intuitive, rational/rational) than when they are of different types (intuitive/rational, rational/intuitive).

H5 – CRT5 scores will correlate negatively with increased belief after encountering intuitive pro-phenomenon material, but this will be less pronounced after encountering rational pro-phenomenon material – this is predicted via inhibition of intuitive thinking reducing the influence of intuitive material, but having less effect regarding rational material, since the latter scenario should already be inducing lower levels of intuitive thinking.

H6 – It was predicted that higher CRT5 scores would correlate with belief reduction, but that this effect would be greater for rational sceptical material than intuitive sceptical material, due to increased application of rational thinking processes when intuitive thinking processes are inhibited.

H7 – It was predicted that higher CRT5 scores would correlate with belief reduction most for those participants where rational disconfirming material followed rational pro-phenomenon material.

Method

The experiment used a 2x2 mixed design. IVs were material type (two levels: intuitive and rational) and timing (two levels: before and after disconfirming material). Participants varied in whether they encountered intuitive or rational material at each time point, but all participants experienced both time points. DV was level of belief, measured via a 0-100 sliding self-report scale, from disbelief to belief. This was measured at three points in the timeline: before pro-phenomenon material, after pro-phenomenon material, and after sceptical material. CRT5 was also included as a variable in the experiment and all participants encountered this measure after rating their belief the second time, but before encountering the sceptical material. The CRT5 validation items were also included (see previous studies) along with the loss aversion check. A yes/no control question on knowledge of EVP (electronic voice phenomenon) was also included.

Participants

The sample consisted of a single cohort of participants recruited opportunistically via research participation groups on Facebook, via Facebook referrals to the study, and via bulk email invitations. After removal of 22 participants due to missing data, a total of 96 participants took part in the study: 19 male, 76 female and 1 declining to say, aged 20 to 70 (mean 30.73, SD = 12.333).

Materials

The experiment was presented online using Qualtrix (<https://www.qualtrics.com>), hosted on their secure servers. As in previous studies it was not expected that the mode of online presentation would cause a problem for the experiment (see the discussion in Study 2 regarding equivalence of online and offline modes).

A non-existent phenomenon was created for the study. This had to meet the criteria of being potentially explainable in both paranormal and non-paranormal terms, and open to both rational and intuitive disconfirmation. It also had to be sufficiently different from any existing phenomena so that pre-existing beliefs would not influence belief ratings. The phenomenon proposed that was eventually fabricated was named DVP (delayed voice projection – see below for description). Five news report excerpts were constructed relating to this phenomenon, the first of which was a general introduction to its possible existence, which all participants saw. Care needed to be taken in language use in each of the excerpts in order to convey the right information and tone. In the introductory excerpt, it was important to keep things neutral, not biasing people towards belief or disbelief in the phenomenon. It is included below in full, along with the lead-in provided to participants:

The following is taken from the introduction to a news piece looking into claims about a new phenomenon known as DVP (Delayed Voice Projection). Names have been changed to preserve anonymity – any similarity to real persons is unintended.

*“In a new phenomenon that’s being dubbed Delayed Voice Projection, or DVP, it’s being claimed that when an audio recording device, such as a digital voice recorder, or even a mobile phone, is left to record in a quiet room, it can record extremely faint traces of things people said the day before, and perhaps even further back than that. If these claims about DVP are true then the applications for law-enforcement could be far-reaching. While it wouldn’t allow police officers to see into the future, like in films such as *Minority Report*, it could perhaps help them solve crimes by hearing into the past. Could DVP be the next big break-through in policing? We sent our reporter, Dean Michaels, to do some investigating of his own.”*

An important part of the content in this introductory excerpt was to ensure that on the one hand the phenomenon has real potential to be taken seriously, but on the other hand, that more investigation is needed. The balance in constructing such an excerpt is always going to be a difficult one, but the aim was to at least attain some degree of

neutrality in contrast to the other excerpts. As can be seen in the intuitive pro-phenomenon excerpt given below, the other excerpts were very much less neutral in contrast to the introduction, in order to induce or reduce belief as required in the study:

The following is taken from the same news piece on DVP.

“Reporter: I spoke to some people who’ve had a go at DVP themselves, to see what they think of it.

Interviewee: We did like they said and we put my friend’s mobile phone in the living room to record. And then we went out to the kitchen for half an hour while we cooked dinner. We weren’t really expecting much to be honest, it was just a laugh. But, when we went back and listened to it we could hear this really faint recording of some of the things we remembered saying the day before. It was really spooky.”

Similar excerpts were created for the other three conditions: rational pro-phenomenon, intuitive sceptical, and rational sceptical. These involved advocating or disconfirming the phenomenon in terms of physics in the rational conditions, and in terms of the experiences of real people in the intuitive conditions, such as the one quoted above. A question on knowledge of EVP was also included at the end of the experiment as this is the paranormal phenomenon closest to the fabricated one used in the study. In EVP it is believed that the voices of deceased people can be heard when a recording device is left switched on in an unoccupied room. It is therefore possible that some people would be aware of this phenomenon and it might influence their evaluation of DVP.

The CRT5 and associated validation questions, used in other studies in this series, were used as filler tasks before participants encountered the sceptical material. This was to try to ensure that immediate memory of the preceding material was not a factor. But it also acted as a way to include a measure of inhibition in the study and additional data points for validation relating to the CRT5. Finally, belief was measured on a 100-point sliding scale to increase sensitivity to changes, since the study was not expected to generate large changes in belief (for all items in the experiment see Appendix 6).

Scoring

Belief in DVP at each time point was taken as the raw rating reported by participants. This ranged from 0 to 100, with 0 being no belief in DVP and 100 being complete belief in DVP.

CRT5 was measured as detailed in Study 4.

CRT validation measure was not analysed in the present chapter. Analysis and scoring of this measure are covered in Study 4.

Procedure

Pilot

The study was piloted online by five people (three women and two men). All were personal acquaintances of the researcher. Only minor spelling or word changes were suggested after the pilot.

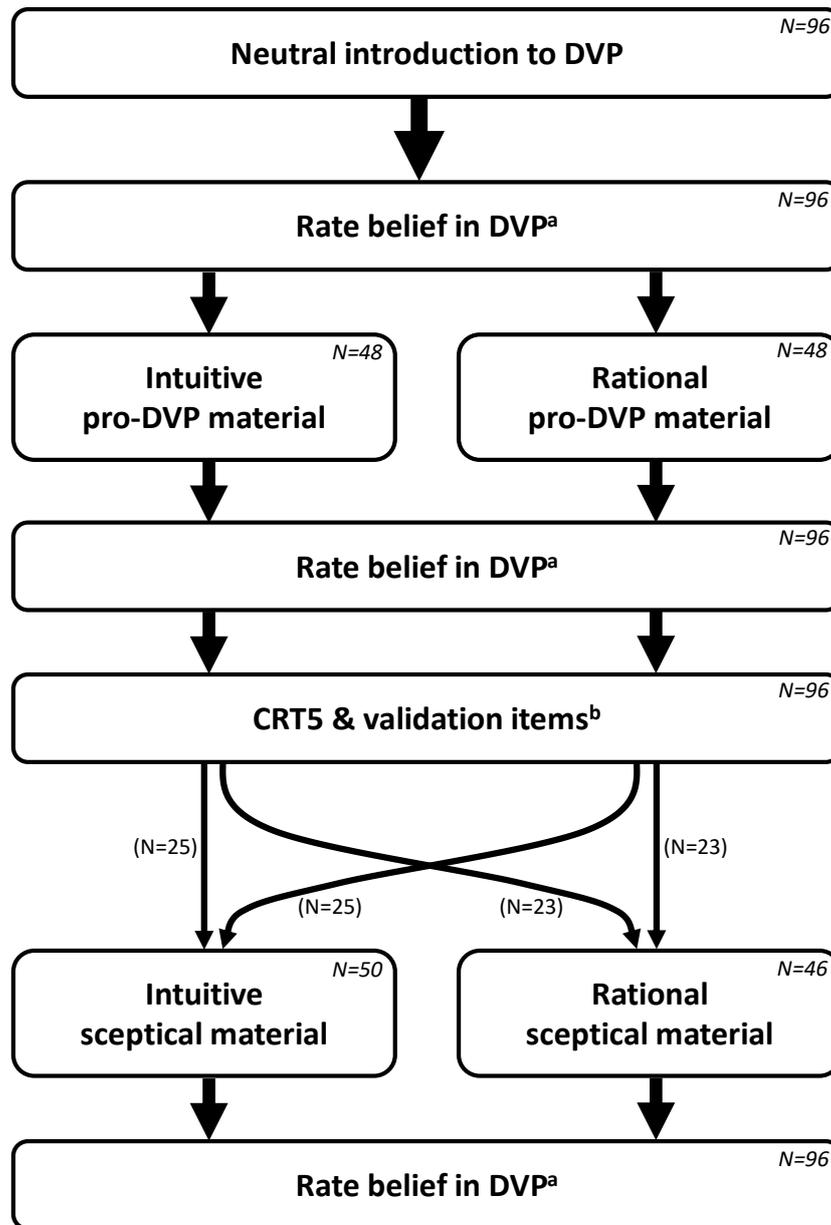
Main Study

The time sequence of the study is illustrated in Figure 35. Participants took part in their own time at a location of their choice. BPS ethical guidelines were followed (BPS, 2018) and the study was approved by the ethics committee at Goldsmiths College, University of London. Participants were presented with a briefing and consent form before being able to take part in the study, and in accordance with BPS internet research guidelines they were required to confirm that they were 16 years of age or older – if they said no to this then they were not given the chance to participate (BPS, 2017). Participation in the study was anonymous and participants could quit the study at any time up until the final confirmation of consent was given. This latter consent was given right at the end of the study to confirm that they were happy for their data to be used. This was necessary since it is possible to quit an online study at any point, even after all data has been entered, so participants needed a way to communicate that they did intend their data to be used. Participants were given the debrief page regardless of whether they answered yes or no to their data being used. The study was available online for a period of approximately 2 months. Participants were made

aware of the study as described in the Participants section above and followed a link to the online experiment.

During the experiment itself, participants first filled in demographic information on gender and age. Gender included an option not to specify and age was banded so as to make participants feel more comfortable giving this information. They were then presented with the introductory news excerpt on DVP. This was followed by an initial belief rating recorded on 0-100 sliding scale. They were then presented with pro-phenomenon material. Participants were randomly assigned by the software to see either intuitive or rational material. They then once again rated their belief/disbelief in DVP on the 0-100 sliding scale. CRT5 and associated validation tasks were then presented, acting as both filler and data collection activities. After this, participants saw sceptical material on DVP. They were randomly assigned by the software to see intuitive or rational material. They were then asked to rate their belief in DVP again. Finally, they were asked control questions relating to potential knowledge of related topics. This included asking if they knew of the EVP phenomenon.

Figure 35 - Time sequence and measures for Study 6



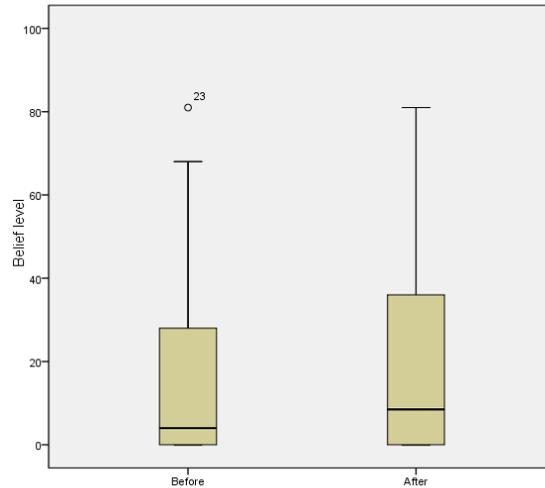
^a **Belief in DVP** at each time point was rated on a 0-100 sliding scale, from no belief in DVP to complete belief in DVP.

^b **CRT5** – one point for each correct answer, added together for a range of 0-5 (low to high tendency to inhibit default responding). Two **validation items**, on delayed reward, providing a range of 0-2 (low to high preference to accept a delay for a greater reward).

Results

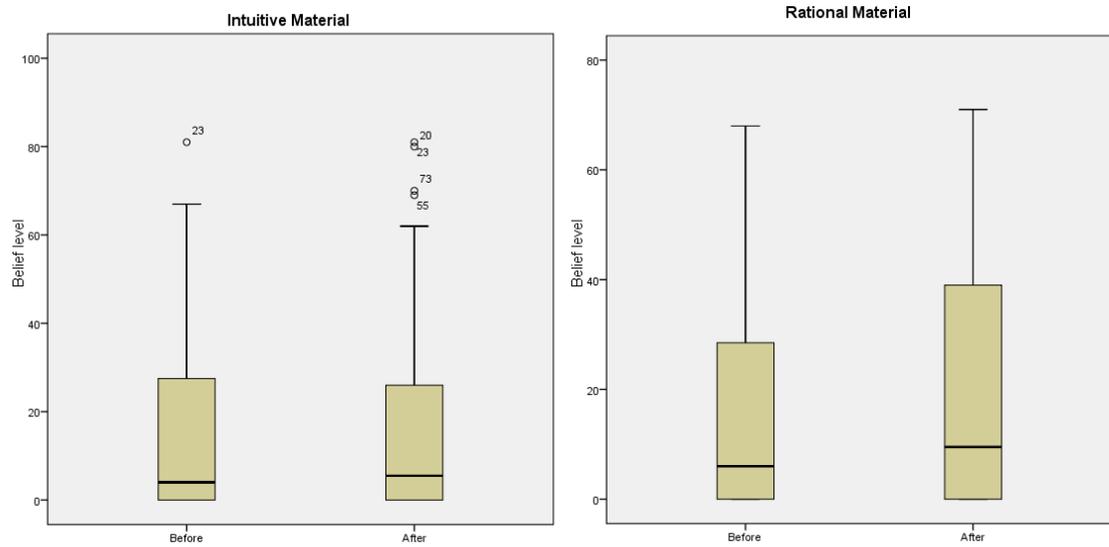
Hypothesis 1 predicted that pro-phenomenon material would induce belief formation relative to baseline. A Wilcoxon test was conducted on belief level before and after the pro-phenomenon material was encountered. There was a significant increase (+3.00) in belief in DVP: $Z = -.374$, $p = .001$, a small but clearly detectable effect.

Figure 36 - Boxplots of belief in DVP before and after pro-phenomenon material



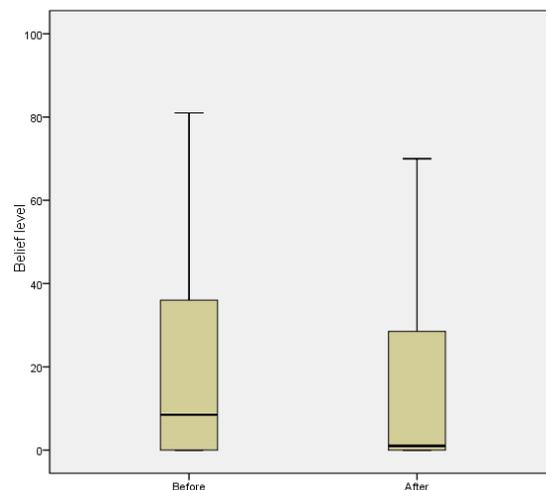
Hypothesis 2 predicted that there would be a difference in belief formation due to type of material (intuitive/rational). This was tested with a Mann-Whitney U test (an independent-measures equivalent to the Wilcoxon test) on belief change, comparing belief change for participants who encountered intuitive material and those who encountered rational material. The difference (2.63) between the two conditions was significant: $Z = -2.628$, $p = .008$. However, it was not in the predicted direction. Encountering rational pro-phenomenon material was more likely to increase belief in DVP than encountering intuitive pro-phenomenon material.

Figure 37 - Boxplots of belief in DVP before and after intuitive or rational pro-phenomenon material



Hypothesis 3 predicted that belief would reduce after encountering disconfirming material. A Wilcoxon test was conducted on belief before and after sceptical material was presented. The difference (-4.87) was significant: $Z = -4.319$, $p < .0005$, in the predicted direction.

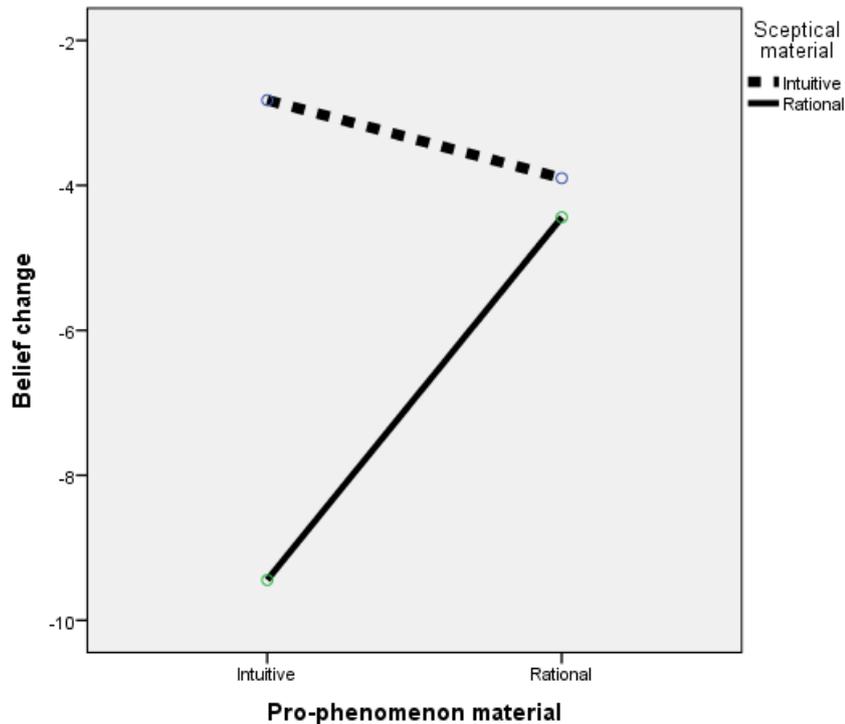
Figure 38 - Boxplots of belief in DVP before and after pro-phenomenon material



Hypothesis 4 was tested with a 2x2 independent-samples ANCOVA on belief level after the presentation of sceptical material. The two factors were the material type (intuitive/rational) and the time point of the rating (after pro-phenomenon

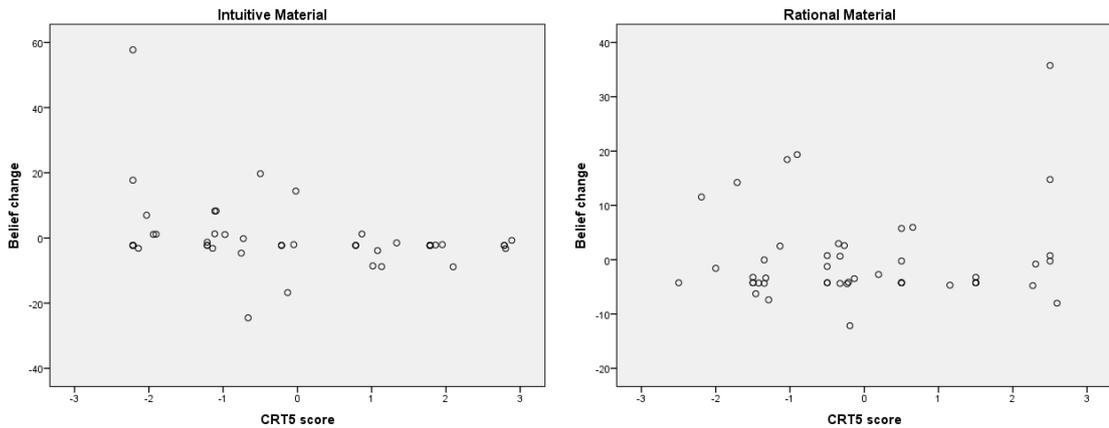
material/after sceptical material). The covariate was belief level before presentation of sceptical material. There were no significant main effects or interactions.

Figure 39 - Belief change after sceptical material



Hypothesis 5 predicted that CRT5 scores would correlate negatively with belief formation after encountering intuitive pro-phenomenon material, but that this effect would be reduced for rational pro-phenomenon material. Partial correlations were therefore conducted between belief change and CRT5 scores on each of the two types of pro-phenomenon material, controlling for belief level before presentation of the pro-phenomenon material. A negative correlation indicates that a greater tendency to inhibit default responding reduces the effectiveness of material to induce belief. As predicted there was a significant negative correlation for intuitive material ($r = -.301$, $p = .039$) while there was no correlation with rational material ($r = .086$, $p = .566$).

Figure 40 - Scatterplots of belief change vs inhibition after exposure to intuitive or rational pro-phenomenon material (prior belief level has been partialled out)



Hypothesis 6 predicted similarly to hypothesis 5, but at the point of belief reduction rather than belief formation. Partial correlations were therefore conducted between belief change and CRT5 scores on each of the two types of sceptical material, controlling for belief level before presentation of the sceptical material. In this case, a negative correlation would indicate that a greater tendency to inhibit default responding limits the effectiveness of material to reduce belief in DVP. Contrary to the prediction, there were no significant correlations. For intuitive material: $r = -.133$, $p = .362$. And for rational material: $r = -.088$, $p = .564$.

Hypothesis 7 also predicted similarly to hypothesis 5, but that the effect would be enhanced for those participants who encountered rational disconfirming material after rational pro-phenomenon material. Partial correlation analysis was conducted between CRT5 scores and belief change on each of the four conditions (intuitive/intuitive, intuitive/rational, rational/intuitive, rational/rational), controlling for belief level before presentation of sceptical material. A positive correlation in one of the four conditions would indicate that belief reduction is facilitated by the particular combination of material types presented at the belief formation and belief change time points. The focal condition for hypothesis testing was rational/rational, where a positive correlation would indicate that participants were more likely to reduce their belief in response to rational material if they had formed their belief based upon rational material. However, there were no significant correlations. For the hypothesis' focal condition – rational/rational – $r = -.287$, $p = .195$.

Exploratory (EVP knowers removed) – Exploratory analyses were conducted with EVP-knowers removed (reducing the sample to 62). That is, participants who responded ‘yes’ to the EVP knowledge question were removed and the full set of analyses were rerun. No differences were found in this reanalysis and it was therefore concluded that having knowledge of EVP did not influence evaluations of DVP. These analyses, with EVP-knowers removed, were also conducted with the alternative, inhibition-only scoring of the CRT5. This did not appreciably change the results, however, beyond the type of noisy variations expected in multiple exploratory analyses.

Discussion

The study succeeded in its aims to induce and reduce belief change in an experimental laboratory situation. Detectable levels of belief increase and reduction were found after exposure to pro-phenomenon and sceptical material, respectively. However, initial belief increase (belief ‘formation’) occurred to a greater degree in participants who encountered rational pro-phenomenon material, contrary to the prediction that this effect would be demonstrated with intuitive material. Similarly, the hypothesis that belief would reduce more in congruent conditions was also not supported. However, hypothesis 5 was supported, finding that inhibition correlated inversely with initial belief formation, but only for intuitive material. Rational material showed no association with inhibition at all. Finally, the association between inhibition and belief change was not found at the point of belief reduction.

The present study took the research programme from the real world into the (online) laboratory to conduct an experiment, with the variables of interest under greater control. The hope was that this might allow detection of a path-dependency in belief formation and change. However, this was not the case. The present study supported the failure of the previous study in the series to detect path-dependency at the point of belief change. In itself this is no bad thing, since it makes the conclusions regarding the model very clear at this point in the research programme. Indeed, a number of

potential criticisms of the naturalistic studies are addressed in the present one. One such criticism, already raised in the background section to this chapter, is that the naturalistic studies relied upon a self-report measure of belief-basis, which has the potential to suffer from reporting biases or inaccuracies. However, in the present study the materials presented at each point were controlled and thus no self-reports of belief-basis were required. Another criticism that could be levelled at previous studies is that there was no balancing within the samples to account for the natural tendency for greater intuitive thinking to be associated with greater paranormal belief. This means that the split between belief-basis is never even, potentially skewing statistical analyses if the difference is too great. However, in the present study participants were randomly assigned to the intuitive and rational conditions, yet the predicted path-dependency effect was still absent in the data. Therefore, while the findings of the present study may be disappointing in terms of the success of the model being tested, they do offer greater confidence in the absence of the predicted effects.

Unlike previous studies in the series, however, the association between belief in anomalistic phenomena and a more intuitive belief-basis was not found – it was actually rational material that induced the greatest initial belief in DVP. This is a striking observation considering how robust this effect has been in the present research programme and across the wider literature. It is unclear whether this was due to situational cueing effects (Inbar et al., 2010), since such cueing would likely be absent in real paranormal belief formation scenarios, or whether it is due to something else. For example, was it the case that the intuitive material was simply wholly unconvincing? Certainly it can be argued that reading a text-based transcript of a news item is not as viscerally engaging as a psychic demonstration (Benassi et al., 1980) or videos of failed paranormal claims (Happs, 1991).

However, although the material itself may not have been ideal or factors such as situational cueing may have been in play, the study did support the robust finding from the literature that thinking style is associated with greater belief in anomalous phenomena – a finding that also has support from the present study programme with respect to ESP (although not from Study 4, which did not find this association).

Thinking style, in this case, was proxied by the CRT5 measure of tendency to inhibit intuitive thinking and the results were exactly as predicted at belief formation. A greater tendency to inhibit intuitive thinking was associated with a reduced tendency to believe in DVP, but only for those participants exposed to the intuitive pro-phenomena material. The present study therefore provides strong evidence to add to the existing body of literature associating thinking style with belief in anomalous phenomena, such as the paranormal.

This may also help to explain the reduced effect of belief formation for those exposed to intuitive material. It would make sense if inhibition was reducing the effect of intuitive material, but having no mitigating role in the processing of rational material. The original rationale for the inhibition association at belief formation was based upon the assumption that intuitive material would cause a greater general increase in belief formation. But, if the two types of material are more equal in their belief formation effects then it would make sense that intuitive material would have a smaller effect if inhibition can be brought into play, but that this would not affect the influence of rational material. It may be as Inbar et al. (2010) suggest, that thinking style is cued by the situation (the material in this instance) and it is simply the case that in the real world paranormal beliefs are generally formed by encountering intuitive types of material, as opposed to the formation of belief in evolution, for example, which is likely to form via encountering rational types of material. However, a tendency to inhibit intuitive thinking could still have an influence, to some extent countering the situational cueing in a paranormal belief formation scenario, thereby producing the associations observed in the literature, and the present study series, between paranormal belief and thinking style, and between paranormal belief and belief-basis. In this sense, the present study could be considered too artificial in relation to paranormal belief and thus falling foul of laboratory to real world cross-over difficulties that often affect psychological research (Mitchell, 2012). Care needs to be taken when generalising from the present findings.

Indeed, while the association between inhibition and intuitive material at the point of belief formation is an interesting one, it must not be ignored that the study failed to

find such an association at the point of belief change (i.e. belief reduction). The association at this point in the belief process remained stubbornly absent as it has done throughout the study programme. This is particularly intriguing given the low levels of belief change in the present study; this was not a study that was investigating changes in long held real world beliefs, it was a study inducing small, but detectable changes in belief. Yet, inhibition was not equally influential at the points of belief formation and change. This strongly suggests that initial exposure to material and later exposure to other material are not independent of one another in relation to intuitive and rational thinking.

One possible explanation for this is that, prior to the sceptical material, rational thinking was cued by the CRT5 filler task, and that the intuitive sceptical material was insufficient to reverse this effect. For example, Alter et al. (2007) found that disfluent fonts cue greater application of rational thinking. They found that people made fewer incorrect answers when reading material in the disfluent font (only 35% errors compared to 90% in the fluent font condition). It may be that the use of the CRT5 as a filler task confounded the second half of the experiment, by cueing rational thinking. This would, of course, have to be a strong enough effect to override the more immediate situational cueing of the material that Inbar et al. (2010) argue for. Indeed, while this kind of explanation may be plausible when considered in light of the present study alone, it is harder for it to explain why other studies in the series did not find an association between inhibition and belief change, unless anomalistic psychology lectures and courses have an especial propensity for cueing long-term rational thinking that can override later situational cueing. While this latter point may be an appealing conclusion for sceptics of the paranormal it does seem an unlikely one, given that this would require rational thinking to then remain continuously active, contrary to the evidence from numerous studies indicating that the application of rational thinking is easily subverted, and the argument from evolution, and most people's personal experience, that it would be too draining on resources to be sustained. That such interventions may 'install' mindware, however, is plausible, but is a different suggestion than one regarding cueing due to CRT5 questions. The mindware option will be discussed in more detail in the general discussion.

This combination of a lack of an association between thinking style or belief-basis and belief change, and a clear association at belief formation, is challenging for many accounts of belief, not least the rational actor account. Rational actor theorists would, of course, be entirely unsurprised to see the findings of the present study at the point of belief formation. Naturally, the rational material would have a greater effect, because people are, after all, rational actors at heart. However, it is hard to write off the association between belief and thinking style at belief formation as merely due to trick questions misleading people (McFadden, 1999), when the same effect is absent at the point of belief reduction.

On the other hand, the present findings might be welcomed by exceptionalists, who argue that belief reduction is due to a knowledge deficit. In this case the study not only found that rational material influenced belief formation the most, but that rational material also influenced belief reduction the most, albeit only for those basing their original belief on the intuitive material. While not entirely in-line with a purist knowledge deficit approach, it would nevertheless be seen as encouraging, particularly in paranormal sceptic circles (e.g. Alcock, 2018; Losh, Tavani, Njoroge, Wilke, & McAuley, 2003; Sagan, 1997), where a lack of rational thinking is often seen to be the root problem; if rational disconfirmation changes intuitively based beliefs more readily than any other kind, then that is unlikely to be viewed as a bad thing. Naturally, however, given the exploratory nature of the finding, replication would be warranted before celebration.

Indeed, inoculationists would argue that knowledge on its own is not enough and that the aim must be to prevent belief formation in the first place (e.g. Alcock, 2018; Lilienfeld et al., 2012; Lilienfeld et al., 2009). The asymmetry of the inhibition findings in the present study provide some direct support for this idea. Tendency to inhibit intuitive thinking did appear to ‘inoculate’ participants against forming a belief based only upon intuitive information. However, once beliefs were formed inhibition was no longer useful, its inoculating power having been used it was ineffective against intuitive material at a later date. Instead of limiting the influence of intuitive disconfirming material it had no association at all. Conceptually this is a good fit with

the idea of inoculation; if the inoculation is bypassed or ineffective at the time of infection then it will not have any effect later on either.

With regard to the methodology employed in the present study there were a number of successes. The approach of using a fake phenomenon has proven to be a useful one and the results were not affected by participant's knowledge of a potentially closely related phenomenon (EVP). Moreover, the study demonstrated that detectable belief formation and change is possible with a highly artificial setting with materials that were relatively unconvincing in terms of their presentation: simply text on a screen. The present paradigm can therefore be recommended for future belief change studies as an alternative to relying upon self-reported predictions of belief change, in addition to avoiding any potential issues of self-reports of belief-basis or thinking style. As Mitchell (2012) warns, however, one must be careful when generalising from this study back to the real world. Future research could focus on trying to implement a similar paradigm more naturalistically, perhaps with the use of video materials or live demonstrations (Benassi et al., 1980; Happs, 1991), which are both likely to be more ecologically valid than written vignettes.

In conclusion then, the study was successful in its aims to induce and reduce belief. It also demonstrated the successful use of fake material in relation to belief formation and change. However, the unexpected effect of the material at the belief formation stage in combination with the lack of an effect at belief change and the generally asymmetric inhibition findings, poses challenges for explaining the findings with existing theories. The next chapter will therefore present a more detailed general discussion, taking account of the findings across the research programme.

General Discussion

Path-Dependency and Dual-Process Theories

The current research programme was motivated by the need to explain belief formation and change in relation to emerging research indicating that a dual-process account was required. This included taking into account the apparent evolved primacy of intuitive thinking processes, as evidenced by observations such as the dissociation of thinking skills from the application of those skills. Additionally, the motivation took into account the variations in reasons for belief found in the literature and it was theorized this variation would be associated with differences in belief change. To this end a path-dependent model of belief formation and change was proposed. The core assumption of this model was that beliefs would be formed differently via the two processes that dual-process theories propose: intuitive and rational. And that this underlying difference in the beliefs would be encoded in some way, such as associations with specific types of processing system and/or knowledge, memories, and so on, in the brain. Thus, intuitive beliefs would be encoded with associations to intuitive experience and knowledge, and rational beliefs would be encoded with associations to rational types of knowledge, for example.

In this simple form the model resembled a similar model proposed by Griffin and Ohlsson (2001) whose research showed some support for the idea. However, the path-dependency model was further enhanced with the addition of people's tendency to inhibit their intuitive thinking processes. This addition to the model acknowledged the evolved primacy of intuitive thinking and thus the need to inhibit it in order for rational thinking to be applied. The basic prediction of the model was therefore that beliefs formed via one mode of thinking would be more likely to change in response to disconfirming material of similar kind (intuitive or rational). But, the model also proposed that to engage with rational disconfirming material at the point of belief change required inhibiting intuitive thinking processes.

Taken as a whole the results of the current research programme do not support the proposed model however. In fact, the clearest interpretation of the finding across the whole series was a lack of any path-dependent effect. This was the case in both naturalistic and laboratory settings. The only exception to this was in the online replication of Griffin and Ohlsson's original study, which replicated the original effect – greater rational belief-basis was associated with a greater self-predicted likelihood of belief change. Mitchell (2012) warned that psychology often faces difficulties replicating outside of the laboratory and this is indeed what was found in this instance. Once self-prediction of belief change was swapped for actual belief change in the real world, the purported path-dependency of belief formation and change became more tenuous, and in later studies it disappeared altogether. As found by Nisbett and Borgida (1975), people's ability to predict their own future behaviours or to access the factors involved in their higher order cognitive processes cannot always be relied upon to be accurate.

Griffin and Ohlsson (2001) based their own model upon an earlier three-stage model of belief change, which took a rational actor approach, but they modified it to include acknowledgment of beliefs being held for intuitive as well as rational reasons. The original three-stage model holds that people must detect conflicting information, understand the information, and then assimilate it (replacing existing information if the new information is better). Griffin and Ohlsson proposed that if the new information is rational and the original information is intuitive then the new information cannot be easily assimilated even if it is detected as conflicting and understood. The results from the present programme therefore support the earlier three-stage model in so far as belief reduction was indeed produced, both inside and outside of the laboratory. However, as was the case with the path-dependent model, the results do not support Griffin and Ohlsson's modification of that model. It must therefore be concluded on the basis of the current findings, that if path-dependence in belief formation and change does exist, then it does not follow a 'like-cures-like' path.

However, some elements of the model were supported in the present programme. Strong support was provided throughout the series of studies regarding the association

of thinking style and belief-basis with particular topics. For example, belief in the theory of evolution correlated with greater rational belief-basis and a greater rational thinking style, as measured by greater tendency to inhibit intuitive thinking, whereas topics, such as ESP and creationism, consistently correlated with intuitive belief-basis and thinking style. These findings were consistent inside and outside of the laboratory, and are consistent with similar associations between these types of topics and belief-basis and thinking style that are found in the wider literature (e.g. Aarnio & Lindeman, 2005; Clarke, 1995; Epstein et al., 1996; Irwin & Young, 2002; King et al., 2007; Wolfradt et al., 1999). The findings therefore support the model's premise that beliefs are formed via different processes resulting in different belief-basis, the first step in the path-dependent model.

However, combined with the lack of an effect at the point of belief change, the findings of the present research programme collectively present strong support for the existence of an asymmetry in the process of belief formation and change. This presents a clear refutation of the proposed path-dependency model and that of Griffin and Ohlsson (2001), but it also poses a substantial explanatory challenge to other theories, as will be seen throughout the rest of this chapter. For example, Sperber (1997) proposed a sequential dual-process theory. As a sequential process, belief formation and change maps approximately onto Sperber's process: beliefs are first formed and then reflected upon and potentially changed. Sperber specifically saw this as a relatively low-level process, with beliefs always initially formed for intuitive reasons and then later reflected upon and rational belief formed (or the intuitive belief discarded). However, there is no specific deadline on when the rational reflection must occur and the interaction found in Study 6 indicated that this reflection might occur sometime later – specifically beliefs formed from intuitive material and then disconfirmed by rational material showed the largest reduction in belief. On the other hand, this particular interaction was an exploratory finding with a number of caveats. For example, it is unclear why this effect was not detected in the intervention studies, which presented rational disconfirming material on ESP to participants who had a general tendency to believe in ESP for intuitive reasons. This should have shown a detectable effect if rational information is indeed the best way to reduce intuitively formed beliefs.

Therefore applying Sperber's account to a longer-term, higher-level process of belief formation and change, may be overstretching its domain of usefulness within the dual-process sphere.

However, a dual-process account that has been successfully used in relation to thinking styles and belief, such as belief in the paranormal, is CEST (Cognitive Experiential-Self Theory - Epstein, 1994; Epstein, Denes-Raj, & Pacini, 2016; Epstein et al., 1996; Pacini & Epstein, 1999). CEST provides the Rational Experiential Inventory as a measure of rational and intuitive thinking styles. This is a questionnaire measure relying upon self-reports about thinking style preferences. Nevertheless, it does seem to do well in predicting susceptibility to thinking errors, which dissociate from actual thinking ability, and therefore appears to present a valid measure of thinking style. Interestingly, however, the findings from the measure are that the two styles are independent; a person can be high or low in both. Belief in paranormal phenomena specifically correlates with higher scoring on intuitive thinking style and not with lower scoring on rational thinking style. This is a different approach than many theories, which tend to assume a continuum from intuitive to rational. In terms of the present research programme CEST has no problem explaining the findings at the point of belief formation. From the perspective of CEST, greater belief in ESP would be associated with both intuitive belief-basis and thinking style, as demonstrated in previous research with the REI in relation to paranormal belief. However, the lack of a similar differential effect of material at the point of belief change (Study 6) is more difficult for CEST to explain.

With respect to CEST, and more generally, thinking styles are generally considered to be traits that would be stable upon retest, certainly over a relatively short period such as a few weeks or months, let alone the few minutes that can be assumed to have elapsed in Study 6. Due to the independence of the two types of thinking style that CEST proposes (people can be high or low in either), there is the potential for shoehorning many different explanations for any given set of findings. However, since CEST focuses on consistent thinking style preferences the prediction it makes is that processing at the point of belief change will follow the same thinking style preferences

as at the point of belief formation. For example, even if existing belief is taken into account, it would be processed via the same thinking styles; a person who believes in ESP for intuitive reasons is likely to have formed that belief due to a preference for intuitive thinking style. Therefore when encountering rational disconfirmation they would be evaluating their present belief information (intuitive basis) against the disconfirming information (rational basis), which would give preference to the existing, intuitive information. Indeed, a study by Denes-Raj and Epstein (1994) demonstrated the power of intuitive thinking processes over rational information when people failed to make the optimal choice in a jellybean selection task. Despite fully understanding that the odds were against them, they still *felt* that they had more chance with the suboptimal (larger jar of jellybeans), and went ahead and followed their intuition rather than the rational base-rate information, that the smaller jar of beans had a higher percentage of 'winning' beans. If people are liable to such biases in the extremely tame task of picking jellybeans from a jar, then it would be surprising if the effect were not present when they evaluate more deeply rooted intuitive beliefs against rational disconfirming material, if beliefs are indeed reevaluated in the way suggested above for the CEST account.

A different approach is provided by Lieberman's X/C Systems (Lieberman, 2007; Lieberman et al., 2004; Satpute & Lieberman, 2006). Neuroscientific evidence suggests that intuitive and rational processing may actually take place in different parts of the brain, with some evidence that rational processing is generally only present in evolutionarily more recent parts of the brain (see the General Background chapter on this point). This particular account therefore aligns with the path-dependent model of belief change, since the implication is that beliefs processed by different thinking processes are physically processed by different parts of the brain. Therefore such beliefs are highly likely to have greater likelihood of being encoded in those parts of the brain or have stronger associations to them. This is very similar to the assumption of the path-dependent model, but in a more concrete physical form. However, as already noted, the present study programme did not support the path-dependent model, which fared well at explaining the findings at belief formation, but failed entirely to explain the findings at belief change. Unfortunately, being a further

restricted specialisation of the assumptions of the path-dependent model, the X/C Systems model is also unable to explain the asymmetry between belief formation and change that was found in the current research programme.

Kahneman (Kahneman, 2003; Tversky & Kahneman, 1971, 1974, 2002) also presents a systems-based theory. Although the theory does not specify a particular underlying physical incarnation, it still suffers from the same explanatory challenge as Lieberman's X/C Systems, however. In contrast, Stanovich and West (2008b) present a systems-agnostic, types-based approach, based upon the observation that the brain may not be as clearly demarcated into 'systems' as might be supposed from neuroscience studies. This aside, however, the theory is largely similar to other dual-process theories, apart from the key concept of 'mindware'. Stanovich argues that when people form beliefs in things like paranormal phenomena, they do so because of mindware gaps. This is especially so if the belief is formed for intuitive reasons. The rationale being that if people have the appropriate mindware then their beliefs will be more normatively aligned. Stanovich's mindware concept includes thinking skills, but it is less clear whether it is possible to acquire mindware that works to activate those skills. Certainly based upon the present findings this would need to be the case, since tendency to inhibit intuitive processing was associated with lower belief in ESP, creationism, and afterlife, but with higher belief in the theory of evolution. Since thinking skills per se are known to dissociate from their application then part of the missing mindware must include one or more Type-2 activation 'apps' (i.e. activation of rational thinking; whereas Type-1 equates to intuitive thinking).

One explanation for the overall lack of a path-dependent effect then, is that participants in the current study programme lacked the Type-2 activation mindware to activate critical thinking to prevent forming intuitive beliefs in ESP. However, when presented with rational disconfirming material they did not need the Type-2 activation mindware and therefore there was no difference in belief change regardless of belief-basis. In other words, a greater tendency to inhibit intuitive thinking (thanks to Type-2 activation mindware) leads to lower levels of intuitive beliefs, but has no impact upon processing of rational disconfirming material as the Type-2 activation mindware is not

required in that scenario. However, this explanation falls short of explaining why Study 6 found no differential effect of material type at belief change. The theory of mindware gaps predicts that possessing mindware that avoids intuitive thinking pitfalls should lead to less influence from intuitive material regardless of whether it is presented at the belief formation or change stages of the belief process. However, while Study 6 demonstrated a mindware effect at belief formation, no such effect was found at belief change.

An important factor included in the present study programme was inhibition and in the above discussion this was incarnated the guise of one of Stanovich's mindware apps, the Type-2 activation app. However, this is not the only kind of cueing proposed in dual-process accounts. Another type is external cueing of the type of processing to use. In this case, the cueing can be said to be embedded within the environment or situation. Indeed, Järvillehto (2015) goes as far as to suggest referring to the environment as System-3 in an extension of Kahneman's systems theory. Direct evidence for the task cueing hypothesis was provided in a study by Inbar et al. (2010), which found that situational factors, in this case features of the task, cued either rational or intuitive processing in choice tasks. They found that when the task was presented with precision or as part of a sequence (as described below), that this triggered rational thinking on tasks that normally yield thinking errors due to reliance upon intuitive thinking. These tasks were based upon the ratio-bias phenomenon, already mentioned in relation to jellybean selection, but also in relation to ambiguity-avoidance. The latter is similar to the jellybean selection task, but where one of the bowls is covered. Although the hidden bowl is described such that participants can always tell it has higher odds of winning, participants tend to choose the visible bowl because of an intuitive preference to avoid the ambiguity of the covered bowl. However, describing the contents of the bowls using precise language, instead of less precise language, reversed the effect and participants tended to pick from the hidden bowl. Similarly, the normal effect was reversed when the ratio-bias task was presented as the first in a sequence of tasks towards winning a prize, rather than as the one and only step. Findings such as these suggest that people may be externally cued to use rational or intuitive thinking.

External cueing would therefore be expected to work in combination with the internal cueing demonstrated in the present study programme. External task cueing from the rational material presented in the interventions would put all participants in the intervention studies on an even footing in terms of applying critical thinking skills. Additional internal tendency to inhibit intuitive thinking would be unlikely to have much additional effect in this scenario, thus explaining the robust absence of a differential effect at belief change in the intervention studies in the research programme: participants would be processing the rational material in the same way regardless of the basis for their belief in ESP or their thinking style.

This raises the possibility that Griffin and Ohlsson's (2001) original findings of a correlation between self-predicted belief change and belief-basis were in fact valid. This would be the case if self-reports of belief change were accessing self-knowledge of thinking style preferences (as are self-reported in the REI, for example - Epstein, 1994; Epstein et al., 1996), but were understandably not taking situational cueing into account – without the situational cueing then perhaps participants would have behaved in line with Griffin and Ohlsson's original findings. This idea has face validity and would mean a complete turnaround of the previous advice given in this thesis on the use of self-predicted belief change in research studies. Therefore an exploratory analysis was conducted on the data from Study 2, which included both the CRT5 and the self-prediction question. However, results of a bivariate correlation analysis did not provide a convincing correlation between inhibition and self-predicted of belief-change. The correlations varied widely from $\rho = -.074$ for ESP to $.221$ for evolution. P-values ranged from $.489$ for ESP to $.038$ for evolution (for opposites $p = .049$). Considering the exploratory nature of the analyses, the associated family-wise error-rate (not taken into account in the above), and the sheer inconsistency of the results across the topics, the results do not present a case for self-predicted belief change tapping into self-knowledge of thinking style preferences.

Returning to the task cueing hypothesis then, it has been demonstrated, in Study 6 of the present research programme, that belief formation can occur due to different types of materials. Logically then, in the real world if a particular type of material tends to

be present at the formation of belief in particular topics, such as ESP or evolutionary theory, then that material acts as a cue for people to use a particular type of thinking, which will in turn lead to the observed correlations with belief-basis in the literature. For example, evolutionary theory is most likely encountered via rational material, such as textbooks or educational classes, and is therefore likely to be associated with a rational belief-basis, whereas belief in ESP is more likely to form due to personal experience or hearing a story of someone else's experience (Clarke, 1995). However, in the case of ESP belief, when task cueing fails to cue rational thinking people will still have access to an internal tendency to inhibit intuitive thinking, which varies from person to person. In this situation, thinking style will be observed to correlate with beliefs that tend to be formed intuitively, such as belief in ESP, or paranormal phenomena more generally. This is indeed what is found in the literature and in the present research programme. It also explains the finding in Study 6 that at belief formation rational material had a greater effect than intuitive material, contrary to predictions. Combining internal inhibition tendencies and external cueing, the rational material would be processed equally rationally by everyone, but the intuitive material would only be processed rationally by those with a greater internal tendency to inhibit intuitive thinking, thus reducing the effect of the intuitive material, but having no impact upon the rational material.

However, while this combination of inhibition and cueing provides an elegant explanation for many of the findings, it leaves open the question of why there was no differential influence of material type at the point of belief change. Indeed, regardless of the theories examined, so far this is a finding that has been challenging to explain. The idea that material is processed differently or has different degrees of effect is not a difficult one to support from the present study or wider literature. However, the inhibition and cueing accounts do not predict the observed asymmetry in belief formation and change that was found in Study 6. If internal tendency to inhibit intuitive thinking reduces the persuasiveness of intuitive material then this effect should be seen wherever such material is encountered, including at the point of belief change. Therefore the account predicts that when exposed to intuitive disconfirming material participants should have shown a lesser belief reduction effect in comparison

to exposure to rational disconfirming material. However, there was no difference observed between the two types of material at belief change and nor was there any correlation of belief change with inhibition for either type of material. Once again, the findings resolutely decline to provide any individual differences relating to belief change, while simultaneously providing robust differences in relation to belief formation. These findings bear replication, of course, as this particular asymmetry comes from a single study. But, assuming that it is valid, this finding from Study 6 presents a critical implication for explaining belief formation and change. The implication is that it is not possible to explain belief formation and change by only looking at the factors external to the belief itself. That is to say, in order to explain the asymmetry the internal nature of the belief itself, its encoding within the brain, needs to be taken into account.

In essence the results present an order effect. Before belief or disbelief in a topic is formed, the persuasiveness of intuitive material will be reduced by an internal tendency to inhibit intuitive thinking. Yet, after this initial exposure, a later exposure to similar material will not have its persuasiveness reduced by a tendency to inhibit intuitive thinking. This cannot be explained unless the initial exposure to pro-phenomenon material has an influence on the processing of the disconfirming material encountered later on. In real world scenarios the only plausible mechanism for this is via encoding of the belief itself, which influences how later information can affect it.

However, for Study 6, which was lab-based there is an alternative possibility, which is that the order effect is memory-based. It may be that the filler task was not sufficiently distracting or long enough to prevent in-memory comparisons of the previous material. Indeed, although filler tasks are a common feature in many psychology studies, in order to disrupt recall, sometimes the timescales need to be much longer, such as the days or weeks used in eyewitness memory research (e.g. Wells et al., 2000). Clearly this particular issue would require further study in order to determine if this explains the present findings.

However, invalidation of the filler time-gap in Study 6, would not completely nullify the programme-wide conclusion that taking account of internal encoding of beliefs is

required to explain belief formation and change. The wider literature also supports this idea. For example, Edwards (1990) found that affect-based beliefs were more readily changed by affect-based disconfirmation. This requires that there is something encoded or associated with the belief itself that led to the beliefs being more changeable when exposed to affect-based disconfirmation later on. Of course, the encoding itself may differ in affect-based beliefs from those in the present study and the interaction between encoding and material may differ, but the core point remains. While the specific incarnation of the path-dependent model tested in this thesis may not be valid, the basic motivating premise of the path-dependency model appears to hold true: beliefs are stored differently depending upon how they are formed and this affects later belief change.

Considering Other Accounts of Belief Formation and Change

The main alternatives to dual-process accounts of belief formation come from the rational actor perspective. There is a large body of such literature demonstrating that, to all intents and purposes, people are essentially rational actors, making normative judgments in so far as ability and information quality allow. Indeed, Study 6 in the present programme found a general effect of rational pro-phenomenon material having a greater influence on belief than intuitive material did, thus indicating that people have a general tendency to thinking rationally, the lesser influence of intuitive material being explainable, in purely rational actor terms, as due to it not providing as much rational information that could be processed and thus not being as informative for making a judgment. Similarly, the rational actor account can explain why there were no individual differences at belief change in the intervention studies: everyone was processing rational material equally. In fact, this is also the conclusion that the combined inhibition and cueing account provided earlier in this chapter, except that under that account rational thinking is not always active and requires cueing. This is an important difference between the two accounts, which greatly limits the application of the rational actor explanation to the findings of the research programme. Research on beliefs from the rational actor perspective typically presents participants with

rational material on the basis of which to form and modify beliefs and then finds that participants tend to think rationally.

According to the inhibition and cueing account this is a case of finding what one is looking for by being careful to look in the place where it can most certainly be found. The inhibition and cueing account predicts that if people encounter only rational material then they will always apply rational thinking processes due to situational cueing, as was seen in Study 6 at belief formation, and in the intervention studies at belief change. However, when one looks in other places, where other types of information can be found, people become less rational. Therefore, at the point of belief formation the rational actor account can explain why different types of material would result in differences in belief levels, but it cannot account for the differences in belief-basis, nor the association with thinking style, the latter being an oxymoron in terms of the rational actor perspective, since people are all deemed to have a rational thinking style, only differing in ability and quality of information. Furthermore, at the point of belief change the lack of a differential effect from material type, once again poses a theoretical challenge. The general rational actor account does not explain why processing of the same type of information would change from one time point to the next. Again, this explanatory challenge comes from the order effect present in the current findings in addition to the belief-basis and thinking style effects. The present research therefore adds weight to existing literature on the limitations of the rational actor programme, at least with respect to belief formation and change.

However, the rational actor literature is diverse and there are models that propose ways of taking into account things like order effects. For example, the type of information used to form a belief may influence the type of information that is more likely to change it. For example, Paik et al. (2009) found that beliefs formed via category-level information were more likely to change in response to category-level disconfirmation. This requires that the beliefs are encoded with association to category-level information and the theory is that this then means information encountered later needs to be of a similar kind in order to best disrupt and modify the existing associations. Otherwise new associations, such as individual-level

information, are only being added alongside the existing category-level associations, or even being dismissed without integration; either way leading to a reduced amount of belief change.

However, while this type of model takes order effects into account, it is nevertheless unable to explain the present body of findings. Firstly, the differential effect of material at belief formation must be taken as an indication that there is some kind of difference in the information being presented (the exact difference need not be specified) and therefore some difference in the encoding of beliefs. Furthermore, according to rational actor models, degree of belief should be dependent upon the quality of the information rather than the surface presentation of it. However, if it is assumed that the lower quality information (the intuitive material) actually acts as a proxy for a different type of information, then a path-dependent effect would be predicted, similar to the one predicted by the dual-process path-dependency model. However, this was not found to be the case when the type of material at belief change was varied. Similar limitations also hold true for Bleile's (2014) prior experiences account of belief change. Bleile argues that in the real world there is an incredible amount of information and that this therefore needs filtering, and the way this is done is via prior experiences directing current focus on available information. However, it is unclear why there would be no differences at the point of belief change when evaluation of material at this point would be shaped by the previous experience at the point of belief formation. Moreover, as with all rational actor models, there is the difficulty explaining associations of beliefs with thinking style.

Moving on from a purely rational actor approach, a popular class of explanations for belief formation and change are the deficits models. These accounts take the view that non-normative beliefs are held due to deficits in knowledge and/or thinking skill – i.e. deficits of rationality (Ahteensuu, 2011; Alcock, 2018; Ko, 2016; Lilienfeld et al., 2012; Lilienfeld et al., 2009; Simis et al., 2016). Both exceptionalist and inoculationist accounts gain some support from the present programme. In the exceptionalist account differences in beliefs are thought to be due to differences in knowledge. Experts believe one thing and the public believes another because the public has a

knowledge deficit in comparison to the experts, who have exceptional knowledge in the topics of relevance. This account received some robust support from the intervention studies in the present research programme. At no point were there any individual differences found at belief change and the material presented was very much knowledge-based, as is typically the case in such university lectures and courses. As argued in Study 5 there is also potential evidence for a dose-response effect, as predicted by a knowledge-deficit hypothesis – a longer intervention should impart more knowledge, closing the knowledge gap further than a shorter intervention, and thereby reducing belief by a greater amount as well. Technically, of course, the exceptionalist account does not concern itself with how a belief was formed. The focus is on belief change and it is assumed that beliefs are of like kind once formed (Alcock, 2018). However, this does mean that this model on its own is an insufficient explanation of the asymmetry found in the present programme. Pairing it with its counterpart, the inoculationist view, may therefore prove beneficial.

Indeed the inoculationist account, that belief formation can be inoculated against in the first place (e.g. Alcock, 2018; Lilienfeld et al., 2012; Lilienfeld et al., 2009), also finds support from the present research programme. Consistently across the study series belief in ESP was associated with a more intuitive belief-basis, which was taken as a proxy for the mechanism of belief formation. Similar association was also found between thinking style and belief in ESP (apart from Study 4). And in Study 6, a more rational thinking style was found to help avoid forming beliefs based upon intuitive material. All of this suggests that non-normative belief formation can be inoculated against if people can acquire relevant thinking skills and tendencies. Taking a pure inoculationist view one can agree that the account would explain the differences at belief formation. After this, once inoculation has had its effect, there is no further effect to be had when encountering additional material; if inoculation fails at belief formation then the same level of inoculation will fail later as well. Besides, beyond this point it would no longer be inoculation and the exceptionalist account must be drawn upon. Indeed, this combination works well as an explanatory account across most of the study series, but once again the thorn in the side of this combined account is the lack of a differential effect of material at the point of belief change. Neither inoculationism nor

exceptionalism specify underlying mechanisms and in that sense they are immune to the issue, but at the same time this also means they fail to fully explain the results. It may be that the combined account is true, but there are important explanatory details missing regarding why one account applies at belief formation and the other at belief change. And moreover, why this should be so even after a very short time period, which is clearly not enough to deeply encode a belief.

Once again, then, the order effect presents a problem for theories that suppose that beliefs are all encoded equally. These types of theories explain the findings of the intervention studies, with just one kind of disconfirming material, but are not able to explain the findings when multiple types of disconfirming material are used. Non-rational actor accounts that deny underlying differences between types of belief once formed include Alcock (2018) and Kruglanski and Gigerenzer (2011). While Alcock very directly acknowledges that beliefs may be formed via exposure to different materials, he states equally clearly that beliefs are all formed in the same way and therefore they are the same thing at their core. In this light, while people may report different belief-basis scores or score differently on measures of thinking style, the beliefs that are actually formed are nevertheless of the same kind beneath their surface features. This applies as much to belief in evolution as it does to belief in ESP. However, the asymmetry in belief formation and change is harder to explain in this way. By treating beliefs as encoded in the same way regardless of the route to their creation, Alcock's account is unable to reconcile the non-effect of material type at belief change with the differential effect of material and thinking style at belief formation.

Similarly, Kruglanski and Gigerenzer's (2011) theoretical paper focuses upon the processing of information in different ways, but their focus is only on single judgments rather than sequential ones. In line with Gigerenzer's idea of 'bounded rationality', heuristics used during intuitive thinking are in fact a form of highly optimal, condensed learning, providing 'rational' responses in suitable situations, thanks to being 'learned' over a lengthy evolutionary period. They go further in this instance, however, arguing that ultimately intuitive and rational thinking are, in fact, subject to the same underlying rules. By extension, this means that beliefs formed via either

intuitive or rational thinking will be of the same kind. However, as with Alcock's account, and others discussed in this chapter, this means that the asymmetry found in the present research programme cannot be explained.

One alternative type of explanation that does take account of the encoding of beliefs is the existence of defence mechanisms. The type of backfire effect this engenders (e.g. Betsch & Sachse, 2013) can be compared to the kind of defence that one would make to a physical attack. When one's deeply held beliefs are attacked, the instinct is to protect them. The stronger the attack, the stronger the defence, potentially even causing the attack to backfire and beliefs to strengthen in the face of disconfirming evidence. This kind of effect is found after the failure of end-of-world predictions made by cults, for example (Russell & Jones, 1980). Their adherents commonly believe the teachings of the cult even more strongly than before. This type of explanation can also fit alongside other accounts, such as exceptionalism, to help explain anomalous results in response to disconfirming material.

However, the problem that defence-based theories face in explaining the present findings is that they focus on explaining resistance to change from deeply rooted and strongly held beliefs. These theories could be applied to outlying cases in the intervention studies, since there the beliefs were naturalistically formed, and therefore potentially deeply rooted and strongly held. However, this type of theory clearly does not apply to the findings of Study 6, in which absolute belief levels were actually very low (around 20 on the 100-point scale), therefore arguably not what would count as 'belief' that needed defending. Yet, the same asymmetry in belief formation and change was found as was found in the intervention studies. It is difficult for defence-based theories to reconcile the similarity in results between minimal changes to low levels of belief and similar changes to real world, potentially, deeply rooted and long held beliefs. At best such theories must be considered outside of their sphere of relevance in relation to the findings of the present research programme.

In summary then, there are a number of potential explanations for belief formation and change in the literature. While some do a good job of explaining elements of the present findings they all fail to explain the body of findings as a whole. This is true

even when theoretical accounts are combined, such as inoculationism and exceptionalism, or in the previous section the combination of inhibition and cueing. Typically, these explanatory failures are due to the need to take encoding of beliefs into account, or failing to account for the encoding in a way that explains the observed results. This challenging data comes in large part from Study 6, which was a single study within a single research programme, and therefore bears replication. However, pending failure to replicate, theoretical accounts of belief formation and change arguably need to take encoding into account in order to fully explain the belief process. The present chapter will now turn to discussion of the findings in relation to thinking style and belief-basis more generally, before applying the findings and theoretical ideas to paranormal belief.

Thinking Style & Belief-Basis

The general background chapter to this thesis began with a discussion of what belief is and the need to operationalise it for the purpose of research. The conclusion was that belief is a person's assertion about the state of the world or some part of it and that this assertion may vary in the degree of confidence with which it is held. Indeed, the present research has upheld the notion that beliefs are a matter of degree rather than all or nothing. Participants' belief ratings tended to spread across the whole of the rating scales being used. Furthermore, belief change recorded was very much a shift in belief rather than a wholesale change of sign, from belief to disbelief or vice versa. This was perhaps best highlighted in Study 6, which used a 100-point sliding scale from disbelief to belief. Observed changes in belief were small, but nonetheless detectable. Belief ratings were at the low end of the scale (at around 20) and there were no sweeping changes to the opposite end of the scale after pro-phenomenon material. And after sceptical material the belief reduction was of similar magnitude to initial belief formation increase from baseline. This adds empirical weight to what is already assumed in most of the literature on belief formation and change and in some case specifically stated by researchers (Hample, 1979; Politzer & Carles, 2001).

The possibility of a dose response effect was also cautiously suggested in Study 5, supporting Ghose et al.'s (2004) contention that belief change is a step-wise process, since over the course of a longer intervention a greater number of belief change steps could occur. Indeed, the step-wise nature of belief change is particularly well demonstrated in Study 6 due to the fine-grained measure that was used. It was not expected that strong belief would be induced by vignettes and it was anticipated that changes in belief would also be small, so a 100-point scale was used to provide a more sensitive measure. A striking finding was that even though these belief ratings were below the threshold of what might be considered belief in a topic (50 would be neutral and the mean rating was around 20), the relative changes in belief followed the same patterns as seen in the naturalistic studies. Therefore, not only did the small changes illustrate step-wise belief change, but they also demonstrated that belief/disbelief is a continuum along which the cognitive processes involved are consistent; the types of processing applied do not switch kind when crossing between belief and disbelief. Of course, the beliefs were not generally at the extremes so it may well be that at some point something similar to the backfire effect would be observed (e.g. Betsch & Sachse, 2013).

Another key aspect of belief raised in the general background chapter was type of belief. The research programme provided strong evidence for this notion also, in line with Griffin and Ohlsson's (Griffin, 2008; Griffin & Ohlsson, 2001) original findings. Beliefs in different topics tended to show a belief profile, with reasons for belief being more rationally or intuitively based. While the topic of 'opposites attract' showed some variability across the studies, this is not a major problem for the notion of belief-basis, since it should be expected that belief-basis ranges along the continuum and some topics may fall in the middle, thus showing no clear intuitive/rational basis, perhaps switching sign readily between different sample groups. However, most salient to the present research programme, it was consistently found that belief in ESP and afterlife were associated with a more intuitive belief-basis, which agrees with the literature on belief-basis for paranormal beliefs in general (Aarnio & Lindeman, 2005; Boden et al., 2012; Clarke, 1995; Irwin & Young, 2002; Wolfradt et al., 1999).

Finally, in relation to belief, one of the underlying assumptions of the study was that there are different mechanisms involved in the formation of different beliefs. Indeed, this assumption underpinned the theoretical predictions about belief-basis in the path-dependency model. For the most part belief-basis was therefore used as a proxy for the underlying mechanism of belief formation. However, correlation between thinking style (tendency to inhibit intuitive thinking) and belief, and thinking style and belief-basis in the intervention studies, helped to provide a less circular rationale for the proxy use of belief-basis. Nevertheless, Study 6 did away with the use of self-reported belief-basis entirely and investigated the point of belief formation directly. In doing so it was demonstrated that thinking style did have the expected effect on the processing of intuitive material: a tendency to inhibit intuitive thinking made the intuitive material less persuasive. The unexpected finding was that rational material was *more* influential on belief formation. Nevertheless, the findings demonstrate that the mechanisms involved in belief are indeed important to study.

The asymmetry in relation to belief change presents a different kind of theoretical challenge, of course, and is discussed in the preceding sections of this chapter. Indeed, the asymmetry was robust across the study series, with belief-basis correlations at belief formation being as robust as the lack of an association at belief change. There is always the risk, however, that self-reports are inaccurate. As noted, this was controlled for in Study 6 by directly manipulating the material via which belief was formed. However, this is not practical in naturalistic studies, such as the intervention studies in the present programme. It would therefore be useful to test the hypothesis that belief-basis is accurately self-reported. For example, using the Affect Misattribution Procedure (Payne et al., 2005) demonstrated a dissociation between self-reported racial attitudes and implicitly measured racial attitudes, for participants who were motivated to express positive views even if their real views might differ (as measured by the Motivation to Respond Without Prejudice Scale). This or a similar test, such as the Semantic Misattribution Procedure (Imhoff, Schmidt, Bernhardt, Dierksmeier, & Banse, 2011), which extends the IAT, could be used to evaluate the reliability of self-reported belief-basis. The SMP, for example, works on the principle that participants misattribute associations triggered by a prime stimulus (typically a picture), projecting

them on to a neutral target (such as a Chinese ideograph), which they are asked to make a semantic judgment about. In short, the priming stimulus colours participants' evaluation of the neutral target and depending upon the association that a participant makes with the stimulus their evaluation of the target varies similarly (see also: A. G. Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Anthony G. Greenwald, Uhlmann, Poehlman, & Banaji, 2009; Job, Dweck, & Walton, 2010; Nosek, Banaji, & Greenwald, 2002; Payne et al., 2005). A similar approach could even be taken when measuring belief in a topic if the time is available to do so.

In terms of critical thinking skills, a common finding in the literature relating to non-normative beliefs and thinking errors is the dissociation between having critical thinking skills and applying them (e.g. Blackmore, 1997; Dagnall et al., 2007; Ferreira et al., 2006; Hergovich & Arendasy, 2005; Royalty, 1995; Stanovich & West, 2007, 2008b). Instead, thinking style has been found to be a better predictor of beliefs such as belief in ESP, and of susceptibility to thinking errors, such as the conjunction fallacy (Epstein et al., 2016; Tversky & Kahneman, 2002). This is particularly interesting as it suggests that simply learning to think critically is not enough and that one must also learn to apply critical thinking. The findings of the present study add further support to this area of literature via the association found between inhibition and belief in ESP, amongst other topics. Apart from Study 4, the programme as a whole found that a greater tendency to inhibit intuitive thinking was associated with lower levels of belief in ESP. Moreover, Study 6 showed that greater tendency to inhibit intuitive thinking reduced the persuasiveness of intuitive material, while doing nothing to enhance persuasiveness of rational material. This therefore offers a more direct demonstration: within the same sample people processed rational material the same way, arguably using rational thinking skills, but processed intuitive material differently depending upon individual differences in thinking style. The implication is that people's thinking skills did not vary, but their style of thinking did.

As discussed earlier in this chapter this also explains the belief-basis observations in this area of the literature, and adds weight to the use of belief-basis as a proxy for belief formation mechanism in the present study programme. Indeed, this particular finding,

from Study 6, also provides support for the area of literature associating the Cognitive Reflection Test (Frederick, 2005) with inhibition of intuitive thinking (measured in the present programme by the CRT5 – see Study 4). The finding can be interpreted as relatively direct evidence that people were inhibiting the intuitive processing cued by the intuitive pro-phenomenon material, since it did not have an enhancement effect on rational material. This is particularly notable in light of the failure of any of the studies to validate the CRT5 (or original CRT) against carefully selected validation items, relating to delay of financial gain. The Study 6 finding therefore adds an important element of construct validity to the CRT5 within the context of the present research programme, adding to its existing, strong face validity. The fact that the original CRT itself failed to validate is also of interest, since it has been validated by a number of other researchers (e.g. Frederick, 2005; Oechssler et al., 2009). The reasons behind the failure to validate CRT in the present studies would therefore need further investigation.

Something not investigated in the present study, however, is the possibility of differences within the concept of intuitive belief-basis itself. The programme treated belief-basis as a continuum and those on each side of the intuitive/rational divide as members of homogenous groups. However, this may be an incorrect assumption. Firstly, Sappington (1990) demonstrated, across 6 studies that intellectual and emotional beliefs could be independently induced. This included ‘warm forming’ (or spoon bending), an alleged psychokinetic phenomenon, where people believe they are bending metal objects with their minds. It was found that the beliefs even influenced participants’ ratings of how likely they would be to take part in a warm forming party. As the present study showed, self-predictions of future behaviour may be unreliable. Nevertheless, Sappington’s studies demonstrated very clearly that affect-based beliefs can be induced. In this sense, this is replicating the robust finding of the present study, as ESP was consistently rated as a more intuitively-based belief.

However, Edwards (1990) took this further. Similarly to Study 6 in the present programme he looked at both points in the belief process: formation and change. However, the focus was specifically on affect-based beliefs. The result was a path-

dependent effect for affect-based beliefs, but not for intellectually based beliefs. Obviously, the intervention studies in the present programme only presented rational disconfirming material, so could not test Edwards' claims. However, Study 6 did provide different types of material at belief change and the findings were contrary to Edwards'. This raises the question of whether affect-based beliefs are different from intuitive-based beliefs more generally. Edwards induced affect-based beliefs subliminally with a priming and association task using Chinese ideographs. This meant that the induced affect was relatively subtle. Similarly, the present study did not use high valence material, suggesting that a difference in valence does not explain the differences in the findings. Edwards does not mention any use of filler tasks, although the emotional priming element acted as filler between the textual material (fabricated expert views on a Chinese ideograph drawing). Timescales were similar to Study 6, however, and therefore there is apparently no substantial difference in this respect between the two studies. This leads to the conclusion that future research on belief-basis should be precise about what type of intuitive belief-basis is being studied so that the appropriate comparisons with existing findings and theory can be made.

Of course, such a difference raises theoretical challenges as well. The obvious answer to this would be that affect is encoded differently from other intuitive processing. The present research programme specifically did not rely upon affect being present in intuitive material or belief-basis, nor did Griffin and Ohlsson (Griffin, 2008; Griffin & Ohlsson, 2001). However, it may be that this operationalisation of intuitive thinking is too broad and that 'intuitive' should not include 'affect', or that subtypes should be separated out. Replication of the Study 6 findings would be required before this suggestion can be followed up seriously. However, even if the two types were to separate then the implications for the findings of the present programme would seem likely to still hold true. There would need to be some modification to the belief-basis measure to avoid confounding the two types of belief-basis, but Study 6 obtained similar findings at belief formation, without any affect-based confounds. This indicates that the intervention study findings would also be likely to remain as they currently are.

Finally, Morley and Walker (1987) touch upon a combination of factors not addressed in the present research programme, but likely to be incidentally present in it. This is potentially important for future research and replications (Brandt et al., 2014). Morley and Walker presented participants with excerpts from a fictitious trial transcript where a police officer was giving evidence in a road traffic accident case involving two people. Initially they read information about one of the participants, that he had either been drinking or speeding, and then rated how likely they thought it was that he was at fault in the accident. They then read some testimony from the police officer, which was manipulated in terms of importance, plausibility, and novelty. They then rated again how likely they thought it was that the person was responsible for the accident. Despite this giving a complex 2x2x2x2 design, the results were remarkably clear that belief change only occurred when all three factors were high: information that was high in importance, plausibility, and novelty led to belief change, but information low in one of these areas did not lead to belief change.

With respect to the present research programme belief change was certainly evident, other than in Study 3. The implication is therefore that importance, novelty, and plausibility were all high. Arguably, for first year undergraduates much of the anomalistic psychology lecture material would be novel, and one would assume plausible due to its rational nature. Final year students might not find the information so novel, however, reducing the effect (although see Study 5 for discussion of possible dose-response effect). The importance of such intervention material for participants is harder to judge, however, but as it was delivered in an educational setting it might be seen as being important. Study 6, also arguably fulfils the novelty and plausibility factors (the latter being an explicit requirement for the vignettes). Meanwhile, importance was indicated at the start with the reference to the potential use in police work, so Study 6 would provide a good fit with Morley and Walker's belief change requirements. It may be that the present programme, and others in the literature, incidentally meet these criteria for belief change, while other research does not. Success in research on beliefs may therefore need to ensure control of some variables additional to those that are the main focus of study. Variations on Study 6, such as varying

importance, novelty, and even plausibility, could be used to determine if this requirement is a necessary one.

In summary, the present research programme adds support to a number of more general areas in the literature, including belief-basis, thinking styles, and CRT as a measure of inhibition of intuitive thinking. It also found support for the operationalised assumptions about belief used in the programme and implicit in much of the literature. However, future research and replication studies should take care to consider necessary variables for belief change, and be cautious in assuming rational or intuitive beliefs to be two homogenous categories of belief.

Believing and Unbelieving in the Paranormal

The present research programme has demonstrated that beliefs vary in being held for rational or intuitive reasons, and that this difference emerges at the belief formation stage due to the nature of the material encountered and the person's cognitive processing style. However, neither the nature of the material nor the person's cognitive processing style influences belief change. Belief in paranormal phenomena is generally considered to be non-normative due to the lack of credible evidence for the reality of such phenomena, and the availability of convincing non-paranormal explanations (French, 2014) – although see Cardena (2018) for an example of rational type of material that some people may base their belief on. However, paranormal beliefs are widespread (Castro et al., 2014; Goritz & Schumacher, 2000; Haraldsson, 1985; Rice, 2003) and, despite some evidence of reduced belief in people educated to a higher level (e.g. Aarnio & Lindeman, 2005), thinking skills per se are not good predictors of belief in this area. Indeed, this can be likened to the dissociation between thinking skills and thinking errors discussed at the start of this thesis, and it is also argued that such thinking errors, in fact, underlie formation of a number of paranormal beliefs, if not all of them (e.g. Lindeman & Aarnio, 2007). The idea of widespread beliefs that are based upon thinking errors and run counter to the best scientific

knowledge, is obviously concerning, due to the fact that people act in the world based upon their beliefs about it. While there is some truth in Kruglanski and Gigerenzer's (2011) argument that non-intuitive thinking processes do not necessarily produce inaccurate results, there is clearly a problem when such thinking processes produce results that are in contradiction to the body of science. Since people act on their beliefs in the world, it is important that the knowledge gained about belief formation and change has some applicability to the real world. The present section in this chapter will therefore relate the understanding gained in the present study to the understanding of paranormal belief formation and change more generally.

The findings from the research programme produced an interesting pattern of results that support an inhibition and cueing account of belief formation, which in turn explains the results of a broad body of literature on the psychology of paranormal belief. The inhibition and cueing account proposes that the type of material people encounter cues people to process it differently, while individual differences in thinking style interact with this. Encountering rational material cues rational thinking and encountering intuitive material cues intuitive thinking, but the latter may be modified by a person's tendency to inhibit intuitive thinking. Overall, due to reduced influence from intuitive material, this leads to an averaged tendency for rational material to be more persuasive, when the material is encountered on its own (i.e. not in competition with intuitive material).

Initially, this does not appear to explain findings from the literature on paranormal belief. Aside from Schouten (2010), the consistent observation in the literature is that paranormal beliefs are associated with intuitive reasons for belief (e.g. Clarke, 1995; Griffin, 2008; Griffin & Ohlsson, 2001; Lindeman & Aarnio, 2007). However, imagine the kind of scenario in which paranormal beliefs are formed. According to Clarke (1995), the most common reason for belief is personal experience and second to that is recounting of an experience by a third party. A person may experience a hallucination, for example, or a case of waking sleep paralysis in which they feel they are being attacked by a supernatural being (French, 2014).

Waking sleep paralysis is a particularly good example, since it is amenable to investigation in sleep laboratories under controlled conditions, including video recordings, thus ruling out that the experience was of something real. In brief, waking sleep paralysis is the opposite of sleep walking: in sleep walking the body wakes up while the brain stays asleep, whereas in waking sleep paralysis the brain wakes up, but the body remains asleep (i.e. unable to move). This is possible because the mechanisms for preventing the body moving during sleep and for the brain actually sleeping are different, so on some occasions they can happen independently. For sufferers of waking sleep paralysis, this can be a frightening experience, since the brain tries to make sense of the situation in which it finds itself. In particular, the experiencer may feel that there is a heavy weight bearing down on their chest, since during sleep breathing is controlled automatically and any conscious attempt to breathe deliberately will have no effect. Experiencers may also experience floating sensations and other anomalous feelings unlike those from their day to day life. The brain, of course, fills in the gaps and comes up with a dream-like interpretation of what is happening, except that the experience itself feels very real indeed, and not at all like a dream. After all, the person is effectively awake not sleeping. In this situation, and other situations involving anomalous experiences, the person is encountering a wholly intuitive type of material. In this scenario they will therefore be cued to think intuitively and this will therefore lead to intuitive reasons for belief rather than rational ones. Similarly, third party accounts of anomalous experiences are also intuitive in nature and will cue people to thinking intuitively about them. Indeed, third party accounts of experience were used as the intuitive material in Study 6. If the kinds of scenarios where paranormal beliefs might be formed are scenarios where only intuitive material is encountered then people will be situationally cued to think intuitively and thus form intuitively-based beliefs. This explains why the literature on paranormal belief finds such a robust association with intuitive belief-basis: rational reasons would require the cueing of rational thinking, which in turn would require a scenario in which rational material is encountered, which is generally not the case.

Study 6 also showed something else, however. It showed that a person's thinking style influences how persuasive the intuitive material is. So while people might be cued to

think rationally by a chemistry textbook or other rational material, some people have a tendency within themselves to inhibit intuitive thinking even when external, situational cueing is absent. According to the findings of Study 6, this means that the persuasiveness of the intuitive material will be reduced and those people with a less intuitive thinking style will be less likely to form a belief. If paranormal belief formation is likely to be situated in scenarios that cue intuitive thinking, this individual difference in thinking style should show up as an inverse correlation in the research literature. In contrast, intellect and thinking skills would have no bearing on the likelihood of belief formation in such a scenario and should be found to dissociate from paranormal belief. These are, indeed, exactly the findings from the body of literature on psychology of paranormal beliefs: beliefs tend to be held for intuitive reasons and intuitive thinking style is associated with greater levels of belief, while critical thinking ability is not.

In relation to real world interventions that might be applied to reduction of paranormal beliefs, one of the key strengths of the present research programme was the use of naturalistic intervention studies to reduce paranormal belief (specifically belief in ESP). This involved lectures and courses on anomalistic psychology, mirroring similar intervention studies found in the literature (Banziger & College, 1983; Happs, 1991; Harrington, 2013; Jones & Zusne, 1981; McLean & Miller, 2010; Morier & Keeports, 1994). The proposal was that belief change would be path-dependent, meaning that beliefs held for rational reasons would be more likely to get reduced in response to encountering the rational material presented in university lectures and textbooks (e.g. French, 2014). Although there was nascent support for the model from earlier findings (Griffin & Ohlsson, 2001), those findings were not real-world ones and the findings of the present programme did not support the predictions of the model. Nevertheless, the intervention studies mirrored those in the existing literature, with a tendency to reduced belief. Study 3 was the exception to this, but it may be due to the length of the intervention being short and initial belief levels of the participants being lower to begin with; Study 5 presented a course-length intervention and significant reduction in belief was found even though initial belief levels were lower than those in Study 3.

This, of course, raises the question of why such interventions are effective. In the existing literature on interventions to reduce paranormal belief, the directly stated or implied reason is addressing a knowledge deficit, sometimes in combination with a thinking skills deficit. In other words, the exceptionalist view that differences in belief are due to a knowledge gap and that closing that gap reduces non-normative belief, such as belief in the paranormal. According to research and general theoretical opinion, however, deficits models are not a useful approach to take. In general, it is argued that a deficits approach to belief change is, at best, suboptimal for changing people's beliefs (Ahteensuu, 2011; Ko, 2016; Simis et al., 2016; Wright & Nerlich, 2016). Indeed, it is suggested that the one of the main reasons such approaches are still used are that scientists have a persistent bias towards thinking that lay people will process the evidence in the same way that scientists do. Furthermore, it is argued that educational policy is easier to produce based upon a simple deficits framework than something more nuanced.

However, anomalistic psychology courses and lectures seem to work quite well at reducing belief, albeit that the belief reduction is not wholesale. This is as expected, since belief change is a step-wise affair rather than an all or nothing binary change (Ghose et al., 2004; Hample, 1979). The present research and the existing literature therefore suggest that addressing knowledge deficits is effective in reducing paranormal beliefs. Taking into account the earlier discussion on inhibition and cueing, it can be seen that the material presented in such interventions is largely of a rational nature (e.g. French, 2014) and therefore is, according to findings from Study 6, liable to cue all of the participants to think in a rational way. This in turn should lead to some degree of persuasion if the material is deemed sufficiently important, novel, and plausible (Morley & Walker, 1987). This helps to explain why such material may be effective in changing beliefs, despite the arguments that a deficits approach is suboptimal.

Indeed, Sturgis and Allum (2004), for example, present a more nuanced account of the influence of knowledge. They found that knowledge was a key factor in predicting attitudes towards science, but they also looked at political views and found that

contextual factors modified the influence of knowledge. More broadly speaking, contextual factors such as the trust people have in the authority delivering the information and how the information aligns with existing group affiliations (see also Kahan & Stanovich, 2016) will influence the degree to which knowledge influences people's views. In the context of anomalistic psychology courses, the authority is generally a trusted academic expert, and topics such as ESP are less likely to have powerful group affiliations opposing disbelief in the phenomenon. In contrast, such group affiliations might be found regarding topics such as creationism or afterlife. Notably the latter is usually classed as a paranormal belief (Tobacyk, 2004; Tobacyk & Milford, 1983) but did not show consistent belief reduction in the present research programme, particularly in the longer intervention used in Study 5. Arguably the material in the intervention covered the topic of afterlife by means of various topics, including ghosts, communication with the dead, and memories of previous lives (French, 2014). The fact that this particular belief showed no significant reduction may be due to group membership, such as religious belief in the existence of an afterlife.

Overall then, anomalistic psychology interventions can be effective, and knowledge appears to be an important part of this. However, contrary to many rational actor models of belief, access to good quality knowledge is not a panacea for belief change. This raises the question of how anomalistic psychology interventions can be improved. The explanation presented earlier for findings in the literature on paranormal belief, favoured the inhibition and cueing account. On the face of it, this implies that the material presented in such interventions is already highly suitable, due to being of a rational nature. However, the earlier account of the ratio-bias phenomenon, involving jellybean selection, highlighted the point that intuitive information can be more persuasive than rational information. In that particular study participants went with their intuitive feelings despite knowing that they were making an objectively suboptimal choice. That is to say, people may be persuaded more by intuitive material than rational material when the two are placed in competition with each other.

In a similar vein, horoscopes printed in magazines and newspapers present a situation where people encounter rational information alongside intuitive information.

Rationally speaking, the horoscopes say very similar things, even within the same edition. Yet people tend to read only their own horoscope, ignoring the rest of the information – they rely entirely upon their subjective interpretation of how just one horoscope explains their life, instead of testing how convincing their horoscope is against the others that are in front of them. In practical terms, all of the rational evaluative information that they need is there, but there is a tendency to rely upon the intuitive information instead. The present research programme demonstrated the persuasiveness of rational material in the absence of competition from intuitive material, but the implication is that anomalistic psychology interventions should take care not to present rational disconfirmation directly alongside competing intuitive material as this may reduce or nullify the effectiveness of the intervention. It is likely that those higher in a tendency to inhibit intuitive thinking would favour the rational information, but in order to attain the most effective communication of the rational material it should be communicated on its own, so that rational thinking is cued for everyone.

However, rational material is not the only kind of material, and intuitive disconfirming material can also be persuasive. In Study 6, it was found to be equally as persuasive at the point of belief change, for example. And other research has also had success using intuitive material, such as videos of failed dowsing attempts, or non-psychic psychic demonstrations (Benassi et al., 1980; Happs, 1991). In fact, it may even be the case that in some instances intuitive disconfirmation may be more effective than rational disconfirmation (Edwards, 1990). This latter point is similar to the kind of prediction made by the path-dependent model proposed at the start of the present research programme. Indeed, a key conclusion from the programme is that differential encoding of beliefs is necessary to fully explain the findings. Currently this is something that requires further research, but should such understanding be produced then this may also bear on how interventions can be improved.

Finally, with respect to improving anomalistic psychology interventions, a leaf might be taken from other research on the relevance of importance, novelty and plausibility (Morley & Walker, 1987). It was argued previously that such interventions often meet

these three criteria. However, this is largely incidental, and the design and presentation of material on the topic of anomalistic psychology should take particular care to make sure that the importance of the material is conveyed, as well as making sure that it can be understood and thus be plausible. Arguably, novelty is less of an issue in this topic area. However, some phenomena have similarities that mean similar explanations are drawn upon (e.g. dowsing and Ouija boards – French & Stone, 2014), and in these cases emphasizing novelty or differences between them might be useful.

Belief change interventions, such as anomalistic psychology courses or lectures, may also play another role in belief, however. They may also take on the role of reducing the likelihood of new paranormal beliefs forming at a later time. In the present thesis this approach has been referred to as inoculationism, after the terminology used by proponents, such as Lilienfeld (Lilienfeld et al., 2012; Lilienfeld et al., 2009). The basic premise is that by acquiring new thinking skills people can avoid falling foul of thinking errors. In terms of Stanovich's (2008b) dual-process account, this is equivalent to installing new 'mindware'. Or in other words, rather than a knowledge gap, there is a mindware gap; a deficit in thinking skills. Anomalistic psychology lectures and courses do tend to teach such mindware alongside the knowledge conveyed. This is a necessary part of the teaching, since evaluation of anomalous experiences involves thinking critically about them, in order to arrive at the alternative non-paranormal explanations. For example, thinking about how horoscopes rely upon thinking errors, such as confirmation bias and the ability of the human brain to make connections between things even where none really exists (French, 2014). In this sense, such interventions should be installing mindware that prevents future non-normative beliefs from forming.

However, as already discussed, one of the most robust findings in the literature is that critical thinking skills and thinking errors tend to dissociate, as do critical thinking skills and paranormal belief. Therefore, in order to inoculate against future paranormal belief, anomalistic psychology interventions need to provide something more than this. The present research programme and the wider literature show that in contrast to thinking ability, thinking style is associated with paranormal belief. This

implies that it is mindware for thinking style that is required; a Type-2 Activation 'App', so to speak, which can be 'installed', leading to greater tendency to inhibit intuitive thinking/activate rational thinking. Previous studies have found long-term belief change (Banziger & College, 1983; Happs, 1991), but to what extent this was simply the continuing reduction of the previous beliefs or an additional inoculation against new ones is unclear. Nevertheless, it seems that anomalistic psychology courses should try to teach thinking style and not just thinking skills. This is not a well-researched area, however; it is not clear whether such mindware can in fact be installed or to what extent it relies upon innate tendencies.

Further research is therefore clearly needed in a number of areas. However, the use of paranormal beliefs as a research tool in the present study was largely successful. The use of paranormal beliefs was highly successful in providing a good spread of belief levels and a good spread of belief-basis, while also providing a clear association with intuitive belief-basis and thinking style. The choice of ESP as the phenomenon to focus on was a key part in this success. For example, had Afterlife been chosen then the results would have been very different. This illustrates the need to take care when using paranormal belief as a research tool, since paranormal beliefs are not a homogenous set. Care should be taken to pick a belief that will allow investigation of the factors that the researcher wants to look at. If group membership is a factor of interest then Afterlife might be a useful phenomenon, for example. But, if group membership is not the research focus, then it may hide the factors that are of interest (Kahan & Stanovich, 2016). One alternative to this is to use an omnibus scale, such as the Paranormal Belief Scale (Tobacyk, 2004; Tobacyk & Milford, 1983), but this may lead to the effects of various factors cancelling each other out, and is also less useful when the intervention is more topic-specific.

Overall then, the use of paranormal belief as a research tool was largely successful and can be recommended for future research into belief formation and change. Moreover, the findings of the present research programme offer sound support for key findings in the literature on the psychology of paranormal belief, as well as suggesting coherent theoretical explanations for those findings. Ultimately, there remains a need to explain

how encoding of beliefs differs, in order to fully explain the findings. However, the findings of the programme can still be usefully applied in explaining why anomalistic psychology lectures and courses lead to reductions in paranormal belief, via knowledge-gap reduction and cueing rational thinking, while also being able to provide suggestions and cautionary notes to help maintain and improve the effectiveness of such interventions, such as taking care to avoid competition between different types of materials.

Concluding Summary & Reflections

The present research programme was motivated by the idea that there is a connection between how beliefs are formed and how they change. The aim of the programme was therefore to look beyond simple associations with belief and infer something of the underlying mechanism involved in the process. Specifically, based upon dual-process accounts of cognition, it was proposed that belief would be path-dependent, with belief change being more likely when disconfirming material was of the same type as led to the original belief. However, since people not only hold beliefs, but also act on them, another key aim was to ensure, as far as possible, that the findings would generalise. With this in mind, a number of different samples were used in the studies, from student samples to general public, and special interest groups, and research focused mostly on naturalistic interventions. Arguably the research programme was successful in achieving most of its stated aims, although with respect to the link between belief formation and change it was not able to elucidate the exact mechanism. However, pending replication, it did succeed in establishing that a relationship between belief formation and change exists, and that this must be due to differential encoding of types of belief.

Considering the importance of beliefs, an important goal of the study was that the findings would generalise to a useful extent. Indeed, one of the motivations for understanding mechanisms of belief, rather than just making associations, was because of the importance of beliefs in shaping the world via people's behaviours in it. The

introduction to the thesis illustrated this with a number of topics and scenarios, such as climate change denial, the use of scientifically unsupported traditional medicines, and belief in magic (Associated Press, 2018; Liu et al., 2014; Snow & Snow, 2015). However, for practical reasons, the research programme itself could only focus on a limited scope. To this end, the focus was paranormal beliefs and specifically belief in ESP. Other beliefs were included alongside this: creationism, evolution, afterlife, and the idea that opposites attract in romantic relationships. These were intended to act as a check on whether the interventions were selectively influencing belief in ESP and to provide a broader range of data for pre-intervention analyses, such as the correlation between belief-basis and belief. Of course, paranormal beliefs are not necessarily the same as other types of belief, but it is also true that there is a very broad spectrum of belief in general and a focus needs to be chosen. Paranormal beliefs successfully provided the programme with a type of belief that is relatively widespread, ranges widely in levels of belief, and ranges in reasons for belief, although with a general association with intuitive belief. Much of the research on belief already focuses on rational beliefs. It was therefore hoped that by focusing on a belief typically associated with a more intuitive belief-basis, the findings would be more informative and thus have wider application, since intuitive reasons for belief are not uncommon in the real world.

In this regard the research programme was successful in its aim. Indeed, a whole section of the present chapter was given over to generalising the findings to paranormal beliefs beyond ESP. However, the theoretical implications have a wider reach than this. The findings offer good support for a combined inhibition and cueing account that has applicability beyond the original belief in ESP that was studied in the interventions or the fabricated anomalous phenomenon used in Study 6. This general account was applied to the specific topic of paranormal belief in the present chapter, but generalises to belief change interventions more generally. This claim may require modification in future, however, once the link between belief formation and change has been fathomed, since paranormal beliefs have a specific type of belief-basis generally associated with them, due to inhibition and situational cueing. On the other hand, it may be that non-normative beliefs in general have a similar association and

that therefore the mechanisms elucidated by research on paranormal beliefs will generalise to other non-normative beliefs, such as flat-earth theory and climate change denial.

In terms of generalisation it was also important to try to use naturalistic studies where possible. This was greatly helped by access to anomalistic psychology lectures and courses running at Goldsmiths College, University of London. The initial replication study deliberately avoided providing a naturalistic test in order to provide a better replication. This proved its worth when comparing findings with later naturalistic studies. Had the research programme only used self-predicted belief change then this difference between real world and self-predicted behaviour would not have been known, and generalising of the present findings would have been undermined.

It was therefore not without a sense of irony that in the final research study in the programme the reverse process was undertaken: generalising from the real world back into the laboratory. Important lessons about belief change had been learnt in the naturalistic setting, however, and the laboratory experiment measured actual belief change, rather than self-predictions or intentions (e.g. Sappington, 1990). It was with a further twist of irony therefore, that the move to the laboratory occurred, in part, due to concerns over the reliability of self-predicted belief-basis, which was the only measure available in the naturalistic studies. The laboratory study therefore aimed to induce and reduce belief under controlled conditions. Reassuringly the laboratory experiment replicated key findings from the naturalistic intervention studies: the lack of a differential effect of rational material at belief change regardless of belief-basis, and the association between thinking style and belief. Although the experiment requires replication, the additional information from laboratory study can be interpreted with greater confidence than if there had been no naturalistic studies.

In the effort to provide greater confidence in generalising any findings of the programme, the step was also taken to recruit beyond the usual student samples (McNemar, 1946; Smart, 1966). A special interest group relating to anomalistic psychology and the paranormal was recruited in the initial replication study to provide a stronger replication, while the final laboratory study recruited from the general

public. Non-student samples were, unfortunately, not a possibility in the naturalistic intervention studies due to the interventions being university lectures and courses. Nevertheless, key findings appear to be robust across the groups, giving greater confidence in generalising the findings to the wider population.

It was also argued that in order to understand belief formation and change it is necessary to understand the mechanisms involved and not merely the associations of belief with factors, such as belief-basis. The primary aim of the research programme was therefore to investigate the connection between belief formation and belief change. The idea that the two are linked is plausible if one takes heed of dual-process accounts of cognition. If there are two 'systems' in the brain operating independently then beliefs formed by one system may be encoded differently than those formed by the other system. This, in turn, implies that different types of material will be more or less likely to influence those beliefs, since different types of materials would be processed by the different systems – see for example, Edward's (1990) finding that affect-based disconfirmation was better at changing affect-based beliefs than intellectual disconfirmation was. In this sense, differential encoding of beliefs provides a mechanism linking the two points in the belief process. Therefore, to investigate mechanisms of belief, the present programme tested a path-dependent model of belief change.

In respect of the specific model that was proposed the programme was, unfortunately, unsuccessful in its aims. The proposed link between belief-formation and change was disproved across the studies series as a whole, particularly in the later studies. However, the programme was successful with regard to its core aim, to investigate mechanisms of belief. Although the programme was not able to elucidate the exact mechanism, it was able to establish that explanations of the belief process need to take encoding of belief into account. And in this sense it was successful in shining a light on that area of the belief process. It achieved this, in part, via the consistent lack of individual differences in response to the intervention material. Furthermore, there was a correlation between thinking style and belief. But, this on its own was insufficient to establish the point, since it might simply be that beliefs are all encoded the same way

and all kinds of evidence are equally influential on belief change. Indeed, there was no presentation of intuitive disconfirming material and differences in formation of beliefs was inferred via self-report belief-basis. It was therefore the laboratory study (Study 6) that presented the key evidence. This study provided direct evidence that thinking style modifies how different types of material are processed. This led to the surprising finding that rational material induced more belief formation than intuitive material. However, upon further inspection, this was due to reduced effect of intuitive material on those participants with a greater tendency to inhibit intuitive thinking (as measured on the CRT5). This individual difference had no effect on the persuasiveness of rational material, however, allowing it to show a greater general effect.

With the association between thinking style and processing of types of materials firmly established at the point of belief formation, it was therefore unexpected that this association would be completely missing at the point of belief change. This latter point replicated the findings of the intervention studies, but with the additional information that there is no differential effect of intuitive disconfirming evidence either. The only way to explain why the same factors (material type and thinking style) have different effects at belief formation and change is either a memory effect, due to a methodological flaw in the study, or differential encoding of different types of beliefs. Therefore, assuming that the findings replicate and a memory effect is controlled for (e.g. a longer time gap, as in eyewitness memory studies – Wells et al., 2000), the present programme managed to establish that there is a connection between belief formation and change and that explaining it requires explaining how the beliefs are encoded at belief formation, which in turn influences how they are processed at the point of belief change. Therefore, while no specific belief mechanism has been elucidated by the present research programme, a little more light may have been shone on where to look for it.

As Ioannidis (2005) observes, null findings are important. The null findings of the present programme – lack of predicted results at belief change – were actually critical to the overall understanding that has been drawn from findings. Indeed, far from being a failing, they are simply part of the bigger picture. With this point in mind, the

present research programme provided more and more chances for the model to prove itself valid. Inhibition was added as a variable, intervention length was increased, and an experiment carried out in the laboratory. Having collected null results on the model from across this range of studies, it is possible to have greater confidence that this particular model does not provide the right explanation. Indeed, as noted by Kluger and Tikochinsky (2001), one must be careful not to overgeneralise from null findings, since small changes may mean the original ideas turn out to be true. Indeed, this was noted earlier in relation to choice of phenomenon when using paranormal belief as a research tool – afterlife may not be as suitable as ESP due to associated religiosity. The present research programme therefore offers replication of null findings with respect to predictions about belief change. This very much echoes Ioannidis' (2005) observation that a biased focus on positive findings can actually mislead scientific understanding; if null results are ignored then the true picture is never seen.

Nevertheless, the programme did also provide consistent positive findings as well, echoing the importance of replication of positive findings and not over-generalising from those either. Indeed, in relation to future research following from the present study programme, the biggest requirement is replication – particularly Study 6, which unlike the other studies, has not yet been replicated due to time constraints on the programme preventing this. At the same time, however, the potential memory effect in that study also needs to be addressed. A paradigm more similar to that used in eyewitness memory studies may therefore be appropriate. Also stemming from the present research programme is the critical need to measure actual belief change in research on belief and not to trust the validity of self-report measures of this. Beyond the specifics of the individual research studies, however, the biggest focus of future research should be on investigating why there is a differential effect of material type and thinking style at belief change in comparison to belief formation. If the findings from the present research programme are valid then the encoding problem needs to be solved if psychologists are to properly understand the belief process. Finally, with respect to belief change the present research has demonstrated that thinking style is the best way to inoculate against beliefs being formed based upon intuitive information. However, it is not yet clear whether such thinking *style* can be taught, whereas there

has already been a large amount of research demonstrating that thinking *skills* can be taught. It is already known that thinking processes can be cued, as demonstrated in the present programme, for example. The question is whether this tendency can be nurtured to become a trait instead of a state.

In conclusion, the research programme has shown that beliefs vary in being held for rational or intuitive reasons, and that this difference emerges at the belief formation stage due to the nature of the material encountered and the person's cognitive processing style. However, neither the nature of the material nor the person's cognitive processing style influences belief change/reduction. Explanations of belief formation and change need to explain this asymmetry, which requires addressing differential encoding of different types of beliefs within the brain in order to explain the mechanism that links the two points in the belief process. Overall therefore, the present research programme achieved its core aims, although with mixed success regarding the specific hypotheses under test. Therefore, while the findings offer substantial support to a combined inhibition and cueing account, the same findings indicate that the most important goal for future research is to solve the encoding problem.

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Appendix 1 – Study 1: Questionnaire

The following questionnaire was presented online. As such, the actual presentation is not included, but is indicated by implementation instructions in places.

Briefing and Instructions

We all have our own individual beliefs about a wide variety of topics. But, **why** do people hold their particular beliefs? This study is looking at some of the reasons people might hold their beliefs on a selection of common topics.

You'll be asked to answer some very quick questions on each topic: whether you believe in it, why you believe or disbelieve in it, and whether you might change your mind about it. The topics are: creationism, evolution, extrasensory perception (ESP), 'opposites attract', and the existence of an afterlife.

The topics will be presented one at a time. Please read the clarifying definition at the start of each topic and then answer the questions that follow it.

Taking part in this study is optional and you can quit the study at any time even if you've already started filling in the questionnaire. If you're not comfortable answering questions on a particular topic then please feel free to skip that topic or any individual question on that topic, although your responses are much more useful to us if you do answer all the questions. All data will be treated with full confidentiality and, if published, it will not be identifiable as yours.

This data is being collected by Duncan Colvin (d.colvin@gold.ac.uk) as part of his postgraduate research at Goldsmiths under the supervision of Prof Chris French (c.french@gold.ac.uk). If you have any queries about the research, feel free to contact either of them.

If you are happy to take part in this study, then please click to start.

NOTES:

In order to comply with BPS ethical guidelines on collecting data online, we will also need to have participants confirm they are aged 16 years or over.

Demographic information

Age

Presented as a series of age ranges to help people feel more comfortable giving this personal information: 16-25, 26-35, 36-45, 46-55, 56-65, 66+, and 'I do not wish to record my age'.

Gender

Male/Female, and a third option of 'I do not wish to record my gender'

Creationism

Definition:

For the purpose of this study Creationism is defined as the belief that the Bible gives a literally true account of the creation of the Earth and all life upon it.

To what extent do you believe in Creationism?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

What are the top 3 reasons for your belief in Creationism?

1. [text entry field]
2. [text entry field]
3. [text entry field]

For each potential reason below indicate whether that reason is why you personally hold your belief about Creationism:

1) My belief about Creationism makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) My belief about Creationism is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like Creationism, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) I don't need proof, I have faith that my belief about Creationism is correct.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) My belief about Creationism is supported by current scientific knowledge.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

**Now imagine that you were presented with strong evidence that contradicted your belief.
How likely would you be to change your belief?**

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

The remaining four topics are presented in the same way and with the same data being collected. The only differences are in the clarifying definitions and some of the wording of the questions.

Evolution

Definition:

For the purpose of this study Evolution is defined as the development of all the species of animals on earth from earlier forms (for example, land animals evolved from early forms of fish).

To what extent do you believe in Evolution?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

What are the top 3 reasons for your belief in Evolution?

1. [text entry field]
2. [text entry field]
3. [text entry field]

For each potential reason below indicate whether that reason is why you personally hold your belief about Evolution:

1) My belief about Evolution makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) My belief about Evolution is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like Evolution, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) I don't need proof, I have faith that my belief about Evolution is correct.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) My belief about Evolution is supported by current scientific knowledge.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

**Now imagine that you were presented with strong evidence that contradicted your belief.
How likely would you be to change your belief?**

not at all	1	2	3	4	5	6	7	8	9	completely
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Extrasensory Perception (ESP)

Definition:

For the purpose of this study Extrasensory Perception (ESP) is defined as the direct perception of information by the mind without using any normal way to find the information out.

To what extent do you believe in ESP?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

What are the top 3 reasons for your belief in ESP?

1. [text entry field]
2. [text entry field]
3. [text entry field]

For each potential reason below indicate whether that reason is why you personally hold your belief about ESP:

1) My belief about ESP makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) My belief about ESP is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like ESP, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) I don't need proof, I have faith that my belief about ESP is correct.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) My belief about ESP is supported by current scientific knowledge.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

**Now imagine that you were presented with strong evidence that contradicted your belief.
How likely would you be to change your belief?**

not at all	1	2	3	4	5	6	7	8	9	completely
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Opposites Attract

Definition:

For the purpose of this study the idea that Opposites Attract is defined as people being attracted to partners who are the opposite of themselves in significant ways (such as in their personality or in the hobbies that they like, and so on).

To what extent do you believe in the idea that Opposites Attract?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

What are the top 3 reasons for your belief in the idea that Opposites Attract?

1. [text entry field]
2. [text entry field]
3. [text entry field]

For each potential reason below indicate whether that reason is why you personally hold your belief about the idea that Opposites Attract:

1) My belief about the idea that Opposites Attract makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) My belief about the idea that Opposites Attract is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like the idea that Opposites Attract, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) I don't need proof, I have faith that my belief about the idea that Opposites Attract is correct.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) My belief about the idea that Opposites Attract is supported by current scientific knowledge.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

**Now imagine that you were presented with strong evidence that contradicted your belief.
How likely would you be to change your belief?**

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Afterlife

Definition:

For the purpose of this study Afterlife is defined as a place, or state, in which people continue to exist after their mortal bodies have died.

To what extent do you believe in the existence of an Afterlife?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

What are the top 3 reasons for your belief in the existence of an Afterlife?

1. [text entry field]
2. [text entry field]
3. [text entry field]

For each potential reason below indicate whether that reason is why you personally hold your belief about the existence of an Afterlife:

1) My belief about the existence of an Afterlife makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) My belief about the existence of an Afterlife is a result of examining all of the evidence I'm aware of and choosing the most convincing explanation.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like the existence of an Afterlife, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) I don't need proof, I have faith that my belief about the existence of an Afterlife is correct.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) My belief about the existence of an Afterlife is supported by current scientific knowledge.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

**Now imagine that you were presented with strong evidence that contradicted your belief.
How likely would you be to change your belief?**

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Thankyou

Thank you for taking part in this study. Research studies like this one cannot take place without volunteers such as yourself and we greatly appreciate your taking the time to fill out this questionnaire!

Once the overall study has been completed we would like to give you a more detailed debriefing on the study's aims and the overall findings that result from the study. To receive this short debriefing simply enter your email address below (this will not affect the anonymity of your data).

Email Address: [text entry field]

If you have any concerns or queries about the research study that you have just taken part in please feel free to contact either Duncan Colvin (d.colvin@gold.ac.uk) or Prof Chris French (c.french@gold.ac.uk).

Once again, thank you for taking the time to participate in this research study!

Debriefing

Hi,

You previously took part in a research study asking about your reasons for believing in a number of topics (creationism, evolution, opposites attract, ESP, and afterlife). You also requested additional debrief information when the study had been completed. The requested debrief is presented below:

The aim of the research study was to replicate previous research which found that people's reasons for belief in various topics can be broadly categorised as intuitive/emotional or rational/knowledge based (heart versus head, so to speak). In the previous research people were more likely to believe in creationism, ESP, afterlife, and opposites attract, for intuitive rather than rational reasons, whereas the opposite was true for evolution. This pattern of belief-basis was confirmed in the study that you took part in. You were also asked about how likely you would be to change your belief if faced with strong contradictory evidence. Previous research found that people who reported a greater rational component to their belief (or disbelief) also rated themselves as more likely to change their mind if faced with contradictory evidence. The study that you took part in confirmed that this was the case for most of the topics. However, the association did not hold for the topic of ESP. People's openness to changing their belief in ESP was not related to the reason that they believed in it. This is an interesting finding because members of the APRU emailing list have a special interest in topics such as ESP, and may also have a greater than average knowledge and experience of the topic as a result. Of course, at this point we can only speculate on the reasons for there being no association between belief-basis and the likelihood of belief change, but the results of the study do suggest that it may be important to take into account

whether people have a special interest in a topic when asking them about their reasons for belief or disbelief in it.

Once again, many thanks for your participation in this research study.

best regards,

~Duncan Colvin

Anomalistic Psychology Research Unit

Goldsmiths, University of London

www.gold.ac.uk/apru

Appendix 2 – Study 2: Briefing and Debriefing

The questionnaire used for Study 2 was the same as used in Study 1, but presented in pencil and paper format, and subject to the exclusions specified in the Study 2 Materials section of this thesis. Therefore only the briefing and debriefings are given below, as these differed due to the sample and presentation method in Study 2. A separate standard research consent form provided by the university was used in this study.

The debriefing is a combined debriefing with another study that ran at the same time under the same research supervisor and was sufficiently related that it was felt that the two debriefs could be presented together.

Briefing and Instructions

We all have our own individual beliefs about a wide variety of topics. But, **why** do people hold their particular beliefs? This study is looking at some of the reasons people might hold their beliefs on a selection of common topics.

You'll be asked to answer some very quick questions on each topic: whether you believe in it and why you believe or disbelieve in it. The topics are: creationism, evolution, extra sensory perception (ESP), 'opposites attract', and the existence of an afterlife. For clarity there is one topic per page.

Please read the clarifying definition at the top of each page. Circle the numbers in the Likert scales to indicate your views on each topic.

Taking part in this study is optional and you can quit the study at any time even if you've already started filling in the questionnaire. If you're not comfortable answering questions on a particular topic then please feel free to skip that topic.

Debriefing

Two of the scales you completed today relate to projects supervised by Prof Chris French (c.french@gold.ac.uk). This debrief sheet will supply you with more information regarding the hypotheses being tested in these studies.

The first study, carried out by Duncan Colvin (psp01cdb@gold.ac.uk) as part of his postgraduate research, is an investigation into factors that might possibly be involved in belief maintenance and change. Previous research suggests that people may have different reasons for holding the beliefs that they do. Some beliefs are held for knowledge-based reasons; that is, the person professing the belief believes that it is supported by the available empirical evidence. Some beliefs are held for intuitive or emotional reasons; that is, the beliefs in question simply make us feel good. Previous research by Griffin and Ohlsson (2001) showed that people who said they held their beliefs for knowledge-based reasons reported that they would be willing to modify their beliefs if presented with evidence that appeared to undermine them. Those who held their

beliefs for emotional/intuitive reasons reported that they would not be willing to modify their beliefs under such circumstances. However, the study was entirely based upon self-report, i.e., what respondents *thought* they would do.

This study attempts to test what respondents *actually* do. Two weeks ago and again today, you filled in a questionnaire asking you about your beliefs on various topics and your reasons for holding those beliefs. One week ago, you heard a fairly sceptical lecture by Prof Chris French in which he pointed out the lack of reliable evidence for extrasensory perception (ESP). Thus the hypothesis we're testing in this study is that those of you who said you believed in ESP for knowledge-based reasons (i.e., you thought that scientific evidence supported such a belief) may well have reduced your level of belief but that those of you who said you believed in ESP largely for emotional reasons will not have done so.

The second study, carried out by Snayt Malaki (ps901sm@gold.ac.uk) as her final year undergraduate project, investigated factors associated with paranormal belief/experience and susceptibility to false memories. Previous research has suggested that a number of psychological variables that correlate with susceptibility to false memories, such as dissociativity and fantasy proneness, also correlate with paranormal belief and tendency to report ostensibly paranormal experiences (French, 2003). This raises the possibility that some reports of experiences of paranormal occurrences might be based upon on false memories. Two weeks ago, you completed scales measuring these personality variables along with your level of paranormal belief and experience.

This week, we hoped to measure your susceptibility to false memories by using the so-called 'crashing memories' paradigm. This paradigm is so named because early research by Crombag, Wagenaar, and van Koppen (1996) showed that 55% of their participants reported, when asked, that they had seen news footage of a plane crashing into an apartment block in Amsterdam. Although the accident really had occurred, it was not caught on camera. Therefore these reports must be based upon false memories. Using this paradigm, Wilson and French (2006) showed that participants who reported this type of false memory scored higher on measures of paranormal belief/experience. The current study probes memories for classic British TV clips, one of which was a non-existent paranormal clip in which Uri Geller appears to levitate a match box in by the power of mind alone and a fictitious non-paranormal clip in which Margaret Thatcher appears to be crying whilst visiting the victims of a terrorist attack. You were asked for details of the nature of the footage, the content of the clips and to provide descriptions of the sequence of events showed in the footage. Although these TV clips do not exist, previous research suggests that a few of you will think that you have actually seen them. Our hypothesis is that those participants who falsely report having seen these non-existent clips will score higher on paranormal belief/experience, dissociativity, and fantasy proneness. Furthermore, this will be more pronounced for the paranormal event.

References:

French, C. C. (2003). *Fantastic memories: The relevance of research into eyewitness testimony and false memories for reports of anomalous experiences*. *Journal of Consciousness Studies*, 10, 153-174.

Wilson, K., & French, C. C. (2006). *The relationship between susceptibility to false memories, dissociativity, and paranormal belief and experience*. *Personality and individual differences*, 41, 1493-1502.

Griffin, T. D., & Ohlsson, S. (2001). *Beliefs Versus Knowledge : A Necessary Distinction for Explaining , Predicting , and Assessing Conceptual Change*. In L. R. Gleitman & A. K. Joshi (Eds.), *Proceedings of*

the Twenty-Third Annual Conference of the Cognitive Science Society. Mahwah, NJ: Lawrence Erlbaum Associates.

Appendix 3 – Study 1: Free-Text Responses

Free-text responses given for reasons for belief and non-belief in the five topics, in Study 5. Each participant could provide up to three responses. Responses are not listed in any particular order.

Creationism

1. Because science hasn't yet answers every question
2. no evidence for it
3. I do NOT believe in creationism.
4. have a total dis-belief in the possible existence of the single omnipotent and omniscient being usually called GOD.
5. If there was/is no GOD, there could not be any act of creation.
6. There is ample evidence of evolution
7. science
8. Because there is absolutely no empirical evidence which supports creationism, and all the evidence points to natural selection with extreme strength
9. The Bible is just a story
10. This question is badly phrased since I do not believe in creationism. It should be 3 reasons for belief/disbelief. In my case there is one - theory of evolution is extremely very supported by the evidence. No other reason is necessary.
11. The big bang theory remains inconclusive
12. Creationism does obviously and indisputably exist, as in fact it is the idea/ideology according to which God created the world in the way the bible describes. This idea seems to have many followers, the creationists, one could say. I do thus not hold a ""believe about"" creationism, I simply observe a socio-historical phenomenon"
13. It is incompatible with the physical evidence as we know it today.
14. I believe there must be an intelligence behind the formation and evolution of the cosmos. This is not a belief in deity as such - and certainly not an anthropomorphic god - but neither is it a acceptance of the idea that the laws of physics and other natural phenomena came about of themselves, by blind chance. The great ancient civilizations - if we are not too proud to think that they knew nothing! - had the notion of a universal consciousness, which preceded matter, and indeed brought it into being. This is the common belief in Hinduism, Buddhism and all the esoteric traditions of the Rosicrucians etc. but in the West it was lost due to the destructive schisms early Christianity had on the Pagan world view.
15. No evidence
16. It is totally contrary to scientific evidence.
17. Science and religion have a same universal theory, nature of the universe as a hole from the smallest to the biggest particle. 0=infinite ...oneness.

18. Existence of evidence to the contrary
19. I am a christian
20. I don't believe in it - it is a mythological account from within a particular religious tradition
21. Creationism is not based in scientific fact.
22. Although the other belief is that the universe was created by the big bang, it doesn't stand to reason as to how life came to this planet
23. The Bible is a historical text written over hundreds of years by unreliable sources.
24. Trust in "science" and its aesthetics
25. Science
26. Scientific evidence
27. As the scientific version is backed by evidence, it seems more plausible.
28. All of the physical evidence flatly contradicts the biblical creation story.
29. there are no reasons I just believe that there was a kind of metaphisic force involved in the creation of the world. I do not believe that the Bible gives a literally true account.
30. Science
31. No scientific evidence whatsoever
32. Between evolution and creationism, the latter is much more unlikely.
33. You mean disbelief. I do not believe in a creator.
34. I am a Christian, and so believe that it has some truth to it, but the conventions of the narrative clearly require it to be placed in the genre of poetic folktale; thus it should not be taken literally. And this is confirmed by a longstanding tradition of interpretation that includes, e.g., St. Augustine and St. Jerome.
35. Culture
36. The description in the bible is not consistent with geological, chemical, biological, physical or cosmological evidence in the world around us.
37. Lack of evidence for creationism.
38. Not practical from a scientific perspective
39. I do not believe in God.
40. GOD exists
41. I don't believe in creationism!
42. It is preposterous.
43. There is not one shred of evidence that a magic man poofed us into existence using magic words. Nor is their evidence for the magic man, or the efficacy of magic words.
44. some truth in it such as the order of things from tohuwabohu to creation of man but literally it has not happened in seven days
45. I am practising christian.
46. It's childish
47. Fossil evidence
48. It comes from a discredited book
49. by looking around myself I can easily infer that There must be somebody who created this universe which includes everything as well as humankind.
50. Evolution gives a much more reasonable explanation for the origins of the earth and its inhabitants

51. Atheist
52. I dont believe in the bible
53. The Bible is a religious book not a scientific document.
54. Evolution
55. no evidence
56. Don't believe in Creationism at all
57. The bible was written long after what it states to be fact.
58. being brought up in the Christian faith
59. Evidences of evolutionist theory
60. Evolution.
61. We cannot exist merely because of the big bang
62. What the Bible claims to be true is not supported by scientific evidence e.g. big bang, evolution
63. Life itself is a miracle, the way the mind works and the whole solar system. There must be something greater out there which has created this.
64. lots of evidence supporting evolution
65. The Bible account of the creation is incompatible with historical and scientific understanding of the pre-Christian period of time, for example, the age of the earth as scientifically calculated.
66. No evidence for creationism
67. science
68. Because all creationism (and religion in general) does is invents a simple cover-all, non-testable excuse of an answer which blindly stops all questioning and investigation and perpetuates lies to block out evidence which is to the contrary
69. Consciousness is not physics dependent
70. the creationists are not the only people who take what is written in a holy book for the truth. One example: Those people in Isreal (and the occupied territories) who ""believe"" Palestine was given by God to the jewish people and thus non-jewish people can be driven out.
71. Religions create cosmologies, taking such cosmologies literal is either very unenlightened or politically motivated.
72. It was clearly just made up in an era when there were no other explanations.
73. Goes against natural laws
74. Just because some intelligent and interesting people came up with a good story a few thousand years ago, is no reason to believe the story.
75. Intuition have to come from electromagnetism that compose the universe >>how travel informations.
76. I do not believe that the world was created in a big bang
77. All relevant scientific evidence demonstrates that the biblical description of creation is untrue
78. I'm not sure of other reasons, sorry
79. Creationism is contradicted by strongly supported scientific theories.
80. Evolution "more convincing"
81. Archeology
82. Bible origins

83. My exposure to religion was very intermittent (going to C of E churches at Easter/Christmas), and my father is very interested in science, so I was never taught creationism as being true.
84. If I wanted to believe in a religious creation story, the biblical account is no more likely than any of a hundred other creation myths.
85. Politics - the obvious way in which senior religious people manipulate their faith for their own gain and their church's political ends.
86. I don't believe in God.
87. I am an atheist
88. Evolutionary science suggests both different orders and different timescales for the formation of general kinds of life.
89. Religious belief
90. The bible is a human endeavour, written and selected for transmission by humans for human purposes. It has no relation to the actual beginnings of the world/universe.
91. Strong evidence for natural origins of complexity in life (even if not for where life began).
92. Religion as we know it is man made, originally a way for the few to control the many
93. Scientific data on the formation of planets, data about evolution, etc.
94. Bible is not Just a Book
95. It doesn't make sense.
96. Genesis is almost certainly a hodge-podged three way edit of a range of conflicting Sumarian, Caananite and proto-Jewish beliefs that internal conflict.
97. time in the bible is understood differently today, like people vein 300 years old. same is true for creation in seven days. tim win the bible is not literally as understood today.
98. I believe it is ignorant to believe we were not created by a divine being.
99. I find it insidious
100. The Bible is just part of a series of different writings by different people from a time when knowledge about the universe and about science was even more primative than today
101. It's not internally consistent
102. Reasonable, logical Explanations and miracles of Quran
103. I don't believe in a divine being and therefore the world cannot be created by them
104. evolution
105. The bible isnt scientifically proven
106. I don't believe in God.
107. the bible being lost in translation over the thousands of years
108. evolution
109. Don't believe in Creationism at all
110. I do not believe in God.
111. Strong doubt about the existence of any kind of deity
112. I am also not a religious person, at any level, and I especially do not care for the archaic, manipulative, contradicting, and hypocritical texts of organised religion.

113. I believe in God and God's words
114. Bible written by human beings who use it to justify the status quo e.g. all disciples male, womans fault there is sin (Eve) etc
115. I believe in creationism as it gives me a nice way to think about the world in a better light which makes more sense to me. It gives life a meaning.
116. I don't believe in God, so believing in Creationism would be a little tricky
117. Life biologically can be demonstratively shown to have evolved in the past and to continue to do so in the present. We creatures are capable of biological change and adaptation; we are not as supposedly created.
118. I'm not religious
119. science
120. Because it is completely nonsensical and frankly retarded, and the believers are generally highly uneducated and obnoxious, bigoted people who use their deluded beliefs to try and feel superior to other groups and thus perpetuate hate
121. Creation is an interactive process that is neither dependent on creationism or physicalism
122. Metaphor is very important and reveiling or obscuring. It is usually greed for land power and money that makes people read a metaphor in the wrong way.
123. Other things in the Bible are clearly implausible
124. nonsense
125. The bible stories of creation have internal contradictions.
126. Research of truth ...We are all creators, multidimensional individuals.
127. >>> Creativity manifeste reality."
128. Creationists' arguments are not logically persuasive.
129. Cursory knowledge og Biblical criticism
130. The Bible is an interesting hand-me-down story book
131. Lack of evidence for any divine being
132. Creationism neglects some phenomena (e.g. evolution) which have later been found and (as far as is possible) proven.
133. The biblical version of creation, and especially the concept of original sin, presents a God that is immoral and cruel. Which isn't impossible, I guess but I'd prefer to think he doesn't exist.
134. Philosophy
135. It is prima facie implausible that a precise and literal account of the origination of all life would be necessary for the overall point of the Bible, which is the interaction of God and mankind.
136. Brought up with this belief
137. Origins of the Bible likely to have come from man, not God.
138. The bible as we know it today is a manipulation and only part of the origianl text, therefore cannot be considered to be a true account on which anyone can make a rational, objective decision.
139. I don't believe the Earth is more special than any other life-bearing planet in the universe. An Earth-centric view of the universe cannot be correct.
140. Its faith

- 141. It's a closed belief system.
- 142. im not sure whether it is right to have a hierarchy of beings where humans are the crown of creation.
- 143. This idea has been instilled in me from a young age
- 144. Rigidy never works
- 145. It is principally used as a political attack
- 146. The life and miracles of Prophet Muhammad according to authentic narratives.
- 147. There is no evidence to believe in Creationism
- 148. bible gives two different accounts of creation.
- 149. It has too many holes in the theory
- 150. The Bible is even internally inconsistent. There are two creation stories in Genesis that contradict each other.
- 151. Rational thinking
- 152. not a Christian
- 153. Don't believe in Creationism at all
- 154. Evolution and science disagrees with many things in the bible
- 155. Poor to no evidence of creationist theory
- 156. The fact that people have killed, are killing, and will probably continue to kill for their religion, firstly disgusts me to the core, and secondly makes me fear for the future, or inevitable doom of the human species.
- 157. Us humans are evidence of creation
- 158. Don't believe any religion should be treated as complete truth, but be judged on how useful it is to believe these things e.g. how does it lead you to behave towards other people, or feel about yourself

Evolution

- 159. becuase I think it makes some sense to believe that thinks have changed and involved over the years.
- 160. good theory, with plenty of supporting evidence (though incontrovertible)
- 161. Lots of evidence to support it
- 162. Plausibility of Darwin's 'Descent by Modification' argument
- 163. Seems logical
- 164. It is scientifically demonstrable
- 165. Fossil record
- 166. Fossil evidence
- 167. scientific evidence
- 168. Because all evidence strongly suggests it (it is more strongly supported as a theory than gravity).
- 169. Is supported by wide ranging evidence, which seemingly gets stronger.
- 170. It is extremely well supported by the evidence.
- 171. Darwin
- 172. Darwin's argument has scientific validity
- 173. "Strange misconception about ""believe"".

174. Why would I "believe" in evolution- I can read a science book. Of course, the results of scientific research do not represent the absolute truth but rather a level of insight. But I should hope that scientist can refrain from "believing" in such results and thus be open to a challenge."
175. It makes logical sense
176. "Evolution is a fine model and works well to show how the adaptation of species comes about in response to changes in local conditions.
177. How far it goes to explain the origin of the original root types that make up a new species I believe is still an open question and is subject to ongoing research.
178. The best scientists are through who keep an open mind about the nature of matter and the origin of consciousness; it's quite well noted that a wholly materialistic mindset does much to preclude such an open-minded investigation."
179. Scientific evidence
180. Evidence of unity of all life-forms known (same DNA coding).
181. Evidence backing up the theory, such as fossil records and genetic lineage.
182. Logic
183. Necessity, given reproduction with variation and selection.
184. Existence of evidence in support
185. Some animals might have changed certain features to adapt to the current climate, but I do not believe that humans were evolved from apes.
186. Research show that evolution is one good scientific theory
187. Scientific evidence
188. The theory of evolution is currently the most scientifically convincing theory about our existence on the planet.
189. Through research it seems more plausible
190. Reconstructions from the fossil record appear to provide a substantially complete model.
191. Seems convincing
192. evidence from several scientific disciplines has reached similar conclusions
193. Science
194. Scientific evidence
195. Scientific and archaeological (is that the right -ology-) evidence appears to support it, and leading scientists and scientific organisations seem to believe it.
196. All of the physical evidence supports it.
197. Scientific evidence
198. science
199. Science
200. Scientific evidence supporting the theory
201. Fossil evidence
202. strong scientific evidence.
203. There is evidence theory is convincing but it also has an open end
204. It is logical

205. Scientific evidence
206. While some of the details are outdated, the general argument of Darwin's Origin of Species is well-constructed, persuasive, and thorough.
207. Scientific knowledge
208. The biological evidence in the world around us.
209. Scientific evidence for it.
210. Evidence from fossils etc
211. Science
212. Makes sense given what we know about mutation. Over millenia, mutation can give rise to entirely new species.
213. It makes sense for me.
214. Strong scientific evidence from things such as fossils
215. Scientific Evidence.
216. The overwhelming scientific evidence, from dozens of diverse fields and tens of thousands of peer reviews and repeated papers.
217. scientific evidence
218. The strength of the evidence for evolution
219. Fossil evidence
220. I am intimately familiar with the scientific evidence at ALL levels.
221. evolution became a more than science, it may be seen as one of the dogmatic, blind eye religions like ...
222. It is logical and is supported by a wide range of evidence such as via examining fossils
223. evidence
224. Its provable scientifically
225. It is supported by current scientific knowledge
226. I find the evidence for it overwhelmingly convincing.
227. Fossils showing stages of evolution
228. evidence
229. scientific evidence
230. Scientific evidence
231. scientific proof
232. Strong evidence supporting this theory
233. the evidence.
234. unlike creationism, evolution is a process that can be seen in action, rather than some ridiculous "unseen phenomenon" created long ago by the deity of whatever culture you were born into worships.
235. God is the creator of all living things
236. Supported by a lot of evidence
237. I dont think this contradicts too much with my belief in creationism
238. not just god theory but also intuitively appealing and can be observed (e.g., in embryos)
239. It seems to be a logical theory
240. Plausibility of evidence from fossils, geological evidence for the age of the earth
241. Some scientific evidence
242. Historical research supports the theory

243. Evidence from DNA & Genetics
244. DNA/genetic evidence
245. coherence and predictive qualities of evolutionary theory
246. Because it is posed scientifically - if we discovered something earth shattering which changed everything, we would embrace it, rather than stick our heads in the sand and pretend it were not so as creationists do
247. Is backed by experts that I revere
248. However, Darwin' theory does not include, but should include the evolution of consciousness
249. Most ground braking scientific research goes back to a "hunch" or inspiration. That is not the same as "belief", which seeks not the truth, but trust in some higher force.
250. It is supported by the evidence
251. People I trust feel the same way
252. Genes transferred from one species to another will still operate and produce the specified protein (even with creatures from different kingdoms).
253. Disbelief in deities.
254. Experience
255. The fossil record
256. Archeology facts
257. Scientific evidence is the only reason
258. I believe the species is always changing and constantly developing for survival
259. Evolution is visible in the breeding of new plants, dog breeds, etc.
260. Seem to have the support of experts in biology and genetics etc.
261. the evidence is convincing
262. Biology
263. Reason
264. It seems very logical and plausible.
265. There is no credible alternative theory.
266. Scientific evidence
267. Mathematics
268. Biological mechanisms for natural selection
269. makes sense.
270. It is backed up with loads of evidence
271. Big bang theory
272. The consensus of biologists supports such a view as overwhelmingly indicated by the evidence.
273. History
274. Scientists continue to flesh out the theory, always filling in gaps in our knowledge. The evidence is not only solid, but growing.
275. Support by scientific community.
276. critical evaluation of that evidence
277. Logical reasoning
278. Goes hand-in-hand with "survival of the fittest," which makes ecological sense.
279. There are many scientific studies validating the Evolution belief.

280. Scientific evidence from physics which tells us about the big bang etc. which disproves creationism
281. That evolution has been observed hundreds of times both in the lab and in the field in micro, macro, cellular and complex levels.
282. makes sense- everything must come from something
283. The age of the universe
284. Logic
285. It cannot be false, because evolution is the same as the process by which we have produced the increased variety of dogs in the past 400 years.
286. although there is very very simple and small possibility for it , as lots of scientists believe in it , many ordinary people also believe in evolution without investigating whether there is enough evidence or not
287. There has been no fundamental criticisms that completely undermine evolution to a convincing effect
288. evidence
289. It makes sense
290. It is supported by my own observation
291. It makes philosophical sense to me.
292. The most rational explanation
293. fossil record
294. makes sense to me
295. seems the most reasonable explanation
296. Lacks in theory as part of the normal scientific method
297. I furthermore do not care for the way that all forms of organised religion have manipulated the human race, in terms of the racist, sexist, and often abusive attitudes it has encouraged.
298. Who created the first animal -
299. Dominant theory taught in schools/universities
300. Because there is evidence of things evolving..
301. I have had the experience under powerful psychedelics of extending back through my own phylogenic history as far back as primordial soup, so it is also experiential - I think this is just as important as the other two, in concert with them, and makes my belief stronger (though not absolute)
302. I like being related to chimpanzees (also I think it is way better if we have evolved over millions of years to get to where the Universe is able to be conscious of itself
303. Computer models of evolution show how proliferation of species can occur
304. No reason to make it up
305. Evolution is a viable reasoned alternative to a belief based entirely upon faith.
306. Observation of evolution of short lived life forms, e.g. fruit flies and bacteria and Glaswegians
307. Lack of viable alternatives
308. lack of contradictory evidence
309. Because it is logical, and the more you study it the more amazing it is and the more everything makes sense and fits together. The opposite is true

with religion and creationism - the more you think about creationism the more absurd it becomes

310. Is the best theory I know of to explain and predict evolution of the species
311. I hope this questionnaire improves as I go on.
312. It comes from a scientific evaluation of knowledge
313. Instinct
314. Once you have reproduction of almost (but not exact) copies of the parents, evolution is a (logical) necessity.
315. Disbelief in other explanations.
316. Intuition
317. Cristian religion is one ideology founded by superstitions ideas.
318. Evolution withstands scientific scrutiny.
319. My own cursory run-through of the evidence convinces me
320. the explanation is simple but elegant
321. Archeology
322. Obvious lack of intelligent design
323. Probably my having been exposed to the theory of evolution and taught it as being true from an early age has had an impact on me.
324. Scientific evidence
325. Philosophy
326. Observation of evolution in action at present
327. Everything changes and adapts over time
328. While details have changed, positions of this general sort have been a common feature of the history of the subject; and thus the position should at least be taken seriously as one of the plausible hypotheses. And as it seems to be a hypothesis that has resulted in good research results, this makes it a reasonable hypothesis to accept in the absence of definitive contrary argument.
329. Musems
330. No reasonable alternative that stands up to scrutiny has been proposed.
331. Extent to which it fits in with other areas of science; it slots in to existing knowledge and helps other things make sense (unlike creationism).
332. fits the theories as regards functional adaptation to environment
333. Have not seen any strong evidence contradicting evolution.
334. For me, generally, science is more impartial then the bible.
335. It just makes a lot more sense than what can be read in the bible. I've never understood why human beings can believe that Eve could be made from Adams rib when human beings are made through gestation/pregnancy/birth and then through human development. It just doesn't make sense to me that someone would believe that.
336. The simple fact that without evolution, billion dollar industries in pharma, biotechnology, genetics etc. would simply not be able to make money as all their research is based upon it.
337. i doubt the details of it and there are many problems in ordering the development of species. I'm not sure whether evolution is always to the better or just means change
338. experimental evidence, eg Mendel

339. Did I mention that I've deciphered the genetic codes of plants to see the things that caused evolution-
340. Evolution is believed in order to produce a contraargument to support the atheist movements. Its a kind of philosophy. It can not be said a pure science. For instance although it is just a theory, you did not mention the term "theory". you also may believe in it without investigation
341. There is no alternative that is as satisfying
342. evidence
343. We can see it in action on a daily basis
344. It is believed to be true by most people
345. There are no convincing alternatives.
346. evidence and falsification.
347. workable theory
348. The idea that we all come from almost the same few forms of life is quite "comforting" and makes me think of human being not as the best living creature, but just as part of the nature of this planet
349. there's too many other reasons to list, to be honest, but another one from the top of my hungover head would be that creationism does not explain phenomena such as dinosaurs, which, if the world WAS created by an intelligent designer, would not exist.
350. I dont believe in it
351. Explains lots of our own thinking/behaviours e.g. system 1 and 2 - conflict between more primitive instinctive qualities and more recently evolved rational qualities

ESP

352. I believe that some people are more in tuned- better at reading people in general. (body language- in tuned with someones emotions)
353. I have studied it experimentally under very carefully controlled conditions and I am compelled by my own findings
354. It seems very unlikely
355. There are recorded instances of things that we, as yet, cannot rationally explain.
356. Anecdotal evidence, whilst flawed, is strong
357. No evidence
358. anecdotal evidence
359. lack of scientific evidence
360. No evidence whatsoever in support of it which has not been found to be fraudulent
361. There doesn't seem to be proper evidence - just unrefutable anecdotes.
362. There is no evidence for it.
363. Subjective experience
364. There is no plausible evidence for it, despite rigorous attempts to find it
365. "Proofs of ESP (an oxymoron perhaps, better to call it 'super sensory perception'-) come from two sources. The first one is an inner proof such as thinking about the person 1 minute before they ring on the phone, or having a

- dream which provides information that later turns out to be accurate. These are generally quite hard (but not impossible-) to substantiate scientifically to others.
366. The second type are say from a vision that provides facts from past life events, which were impossible to know from ones experience in this life.
367. This last type has been extensively documented in the painstaking research of the late Prof. Ian Stephenson of Virginia University, USA.
368. It is important to remember that we know so little about the mind and states of consciousness that it is hard if not impossible to say what is the ""normal way"" of using one's perceptions unless we restrict them solely to the waking conscious state."
369. Personal experience
370. There is no evidence for it in properly-controlled experiments.
371. Some things cant be easily explained. Although not likely to be a 'magical reason', some people are better at perceiving certain subtleties - such as in cold reading
372. Intuition
373. Personal experience
374. Research show that ESP is one good scientific hypotheses.
375. It's a muddy definition - I think there are ways (non-paranormal) that our minds perceive and receive data that we can't yet give a convincing scientific account of, such as emotional contagion.
376. I do not believe in extra sensory perception. I do think it is possible that it could exist. There is no scientific evidence for it, but that doesn't mean that it doesn't exist. I think that some human beings have greater perception than others.
377. Psychology lessons
378. There is no convincing argument for how this might take place. However, I do not discount the possibility that one might some day be found through scientific study.
379. Prolonged fieldwork among spiritualists have convinced me that the supposed evidence for ESP is invalid
380. unconvincing
381. Research
382. Lack of evidence
383. As far as I am aware, when tests have been conducted with people who claim to have ESP, the results have not shown any evidence of ESP.
384. It has failed every well controlled test.
385. There's no evidence for it
386. empathy
387. Science
388. No supporting evidence to show it exists
389. No evidence of the phenomenon
390. I don't really believe in it, as there is no evidence that it exists, but i would like it to.
391. I have never heard of any evidence that it exists
392. Too many personal experiences to now disbelieve

393. Anecdotal evidence for the phenomenon is extremely common; however, that replication has been so elusive is highly worrisome.
394. The better controlled the experiment, the smaller the effect size (leading to the strong possibility that factors other than ESP are creating the effect). Experiments are often unreproducible when done by people who are not believers in ESP.
395. Lack of evidence.
396. Have had "ESP"-type experiences many times
397. Experience
398. Have not seen convincing proof of its existence.
399. For me It can be possible.
400. No proof so far, all studies "proving" are methodologically incorrect or have been doctored.
401. There is, as yet, no evidence that such a phenomenon exists, however, enough witness testimony exists that it should not be discounted.
402. i don't think it is extrasensory, i believe that science today has not discovered a. all the channels of perception and b. all the perceivable entities.
403. It's bunkum for children
404. Personal experience
405. It fails occam's razor
406. There is difficulty in ESP being proven in controlled experiments
407. evidence
408. Its possible - we know so little of the minds potential
409. I don't know whether or not I believe in it. I'd like to believe in it and I've had personal experiences which support it. However, it's not been proven by science.
410. I have never seen convincing evidence of it.
411. Popov exposure
412. I don't know enough about it to decide
413. Experienced it myself
414. Has not been proven by science.
415. do not entirely believe but feel there may be the existence of it after further scientific exploration or after development of more advance scientific research
416. Contrasting (mostly negative) scientific evidence supporting the phenomenon
417. Not much evidence that this phenomenon exists, therefore, I am uncertain about it to the point of disbelief.
418. There are many things we don't know about the human brain and potential, so I am open minded to the possibility that this ability could exist.
419. The power of the mind is great
420. I have read a lot of the scientific literature regarding ESP (for about 20 years) and have weighed it fairly
421. There is little convincing evidence for it
422. While I have little belief in the existence of ESP, I* do like to retain an open mind.
423. Often used as a reason to deceive people

424. evidence from parapsychology labs which suggests something may happen some time.
425. lack of plausibility of evidence allegedly showing it exists
426. Makes absolutely no sense and defies the laws of nature, and thus to defy everything which is so solidly and repeatedly supported, it would take monumental and replicable evidence to overturn hundreds of years of scientific study
427. I would quite like magic to be true too, but I can't think of any psycho/physiological mechanism to support such a phenomena.
428. It is inconsistent with our best current scientific theories.
429. Overwhelming scientific evidence
430. It is fair to think that other people's belief comes from their cognitive biases
431. Experience
432. Scholarly published research, eg SPR
433. Laboratory investigation
434. It all just looks fake and some of it is easy to figure out how they're doing it
435. Arguments adduced in favour of extrasensory perception often fall when submitted to logical scrutiny.
436. Have more convincing alternative theories -- psychological, sociological -- for the supposed "phenomena"
437. no evidence
438. Studies
439. Physically impossible
440. Quite often, it seems that what people believe to be ESP could be down to coincidence.
441. There is no theory for how it could possibly work.
442. Falsifiability of all claims so far
443. No possible mechanism available
444. It would seem very unlikely that it exists
445. Evidence from those passed to spirit
446. In at least most cases there is no known medium or force by which such information could be conveyed; this, however, while troublesome for any belief in ESP is not a conclusive refutation.
447. Any effect sizes are very very small, and have been shown to be (most likely) artefacts of the way the data was processed.
448. Large number of frauds falsely claiming ESP.
449. I have the evidence of my own eyes and ears
450. Reading accounts of research and other accounts
451. Am not aware of any biological or physical mechanism in the human body/brain that would allow ESP.
452. There are many cases that the ESP can be real.
453. I don't believe things until I see proof of it.
454. It seems to exist in some other species, why not in ours
455. Every rigorous scientific study has strongly insinuated it's a lie
- 456.

457. It doesn't seem possible, I am yet to hear a logical explanation for how this would occur
458. evidence
459. Some appear to have abilities even though i think theyre rather hit/miss
460. I think there are much more interesting existing phenomena to be concerned about.
461. individuals claim but nothing has actually been proven
462. Some theories, like Sheldrake's, support my observations
463. Many people are shown to have lied about their "abilities"
464. Replication of the experiments led to no proof
465. ESP has a heavy presence in religious beliefs, which I do not adhere to.
466. I have had numerous ESP-like experiences which would be difficult to explain in ordinary terms, although I am very familiar with explanations such as poor probabilistic reasoning, confabulations of memory and perception, delusion, etc. I have studied my own experiences scientifically, and am left very compelled by them
467. It appears incompatible with the laws of physics
468. I do not personally believe in ESP, but I cannot totally disprove it, YET.
469. that's it
470. it is possible it might exist so I'm not 100% convinced it doesn't
471. because those who believe in it are generally either simple or fantasists who have psychological problems, or "pretend" to believe in order to con vulnerable people (which is what most/all "psychics" do)
472. The people associated with this phenomena have little credibility.
473. Modern scientific studies is psi phenomena and consciousness studies
474. Observation / Logic / Understanding of part of history
475. The orthodox idea about physical world is not correct.
476. The majority of people who claim to possess esp are found to be frauds
477. Examples of ESP can be explained in other, more logical ways (e.g. subconscious perception).
478. the accounts are based too much on personal experiences
479. Personal experience
480. Laws of physics leave no room for such phenomena
481. I haven't read or heard anything which would lead me to believe in the existence of ESP.
482. No need for it to explain anything
483. If it existed, would be easily observable, but it isn't
484. I would probably put people who believed in ESP in the same category as homeopathic doctors and psychics i.e. deluded or quacks
485. My ability to read psychically and get information correct
486. Given the difficulty of eliminating all ambiguity and ruling out all alternatives, it seems that it is very difficult to rule out all possible alternatives. This favors, but does not rigorously prove, the no-ESP position as the simplest hypothesis.
487. Despite decades of study, research into ESP and related phenomena has not advanced in the slightest.

488. No currently known or understood viable mechanism to allow ESP to exist.
489. I hope I am a critical thinker who has ruled out other explanations!
490. People who believe in ESP also tend to believe in other pseudoscientific phenomena like the healing power of magnets and reiki, which I don't believe in either. If they have shown themselves to be illogical in other areas, it decreases their ethos with me.
491. Some studies must be done yet to prove whether ESP is true or not.
492. Twin studies
493. I haven't personally witnessed any experience of ESP in myself or others I know and trust
494. evidence
495. We rely so heavily on our 5 senses we forget about all the others we possess.
496. Even if "proof" were presented, I think we would find a scientific rationale eventually for any such phenomena.
497. I haven't experienced it
498. I have observed this phenomenon in other people
499. ...but we can't test every single moment of people's real lives, in the lab...
500. Most people who claim to have, or claimed to have witnessed this phenomenon are...well...a bit loopy, I'm not gonna lie.

Opposites Attract

501. I think we often aspire to be like people we're not like at all.
502. I don't really 'believe' it, as such, but I am open to the idea that it is more true than not.. clearly though it is not absolute, so I don't need to believe it. Consequently I did not place it at 1, because I don't totally disbelieve it, I think it is probably a partial truth
503. I have studied psychology; actually research has shown the more similar two people are the more likely they are to stay together
504. true for some people!
505. Generally speaking, they don't. Which is why vegetarian deer don't graze with carnivorous lions
506. I've seen some couples who are different, not opposite, and they function ok. I've seen just as many couples with lots in common work too. And how do we define 'opposite' anyway-
507. We know that similarity predicts attraction quite strongly
508. couples with a lot in common appear to have more stable relationships
509. It may attract people in the short term, but in the long term in my experience, people get very annoyed by people they can't understand who make no sense to them and that they don't fit with. BUT I do not see this as evidence, it is an anecdote, hence I have not made a strong judgement here
510. Its folklore but its embedded in my consciousness
511. I believe that the evidence runs against this claim but I have not bothered to closely examine it.
512. Complementarity

513. I do not have strong views on this
514. By analogy, in physics positively and negatively charged particles will attract, as do the N and S poles of a magnet. It may be a helpful psychologically in order to bring balance and harmony to relationships. Biologically the male and female sexes attract (considered as positive and negative) and from whose combination of these opposites alone arises reproduction.
515. I don't have any particular belief about this.
516. I know of instances where, after initial attraction based on like-mindedness, differences in political and religious views led to breakdown.
517. Personal experience with certain character traits. Observing myself, and friends and acquaintances.
518. Opposite or complement are needed to sharing what you have and receive what you do not have...to create a higher state of being in a relationship and become one.
519. "Sometimes they do, and people notice. Mostly they don't and people don't notice.
520. Sometimes similars attract, and people notice. Mostly they don't and people don't notice."
521. No views at all
522. I don't know if have any scientific explanation.
523. It is striking the extent to which people find or make connections with other people who - often unhelpfully - meet a need or fill a gap for them. This includes 'opposites attract'.
524. I do not believe that opposites attract. That some people considered opposites attract is as likely as people who are similar attracting to each other.
525. Not everyone in the world has someone who matches them completely
526. There are many examples of when people who might be described as 'opposites' have long and happy relationships, but there are also many counter-examples.
527. Its a metaphor -- might have some relation to factual phenomena. Or it may not.
528. unconvincing
529. Research
530. Experience
531. I don't think it's true that people who share absolutely nothing in common could happily coexist - some common ground is usually necessary for any sort of relationship to form. However, strong differences might not necessarily drive people apart.
532. Purely anecdotal - I know people for whom it seems to be true, at least in some respects. I know other people for whom it doesn't appear to be true at all.
533. I don't have a belief on this. I'm unaware of evidence one way or the other.
534. need of common grounds and shared values
535. You see both cases in real life.
536. Evidence suggests this is not the case.
537. Personal experience

538. I think they do, but only in the same way that similar things attract and so on.
539. relief from boredom
540. I have never thought about it. Something to do with genetics and pheromones maybe
541. complement each other
542. Clearly they often do; the only question, then, is how this compares with like attracting like, which also seems often to happen.
543. People tend to find partners who are of very similar background to them (socio-economic, education, etc.). They therefore tend to have many things in common.
544. Research seems to be against this (2005 study from University of Iowa found that Personality was especially important to be similar).
545. Too general a statement! There must be many occasions where opposites do not attract
546. They can and they cannot - dependent on a persons experience whilst growings up, their beleifs and bout the world and themselves and relationships etc
547. My boyfriend and I are opposites in some ways, and it seems to work well.
548. I don't believe in the idea of opposites attract.
549. I think this is sometimes the case, sometimes not, and cannot be fitted into a box.
550. psychology studies show you stay together longer if you are similar in you values, beliefs and needs.
551. Again it is childish bunkum for immature people
552. My personal experience has been otherwise
553. I have seen counterexamples
554. This is by no means the case for everyone, in my own experience I have observed many long-term couples that are similar or at least not opposite to one another
- 555.
556. I believe that opposites can sometimes be complementary but this will be very individual and different for each couple
557. Ive been attracted and attracted interest from people my opposite
558. It isn't supported by current scientific knowledge
559. Scientific evidence suggests that people are attracted to people who are similar to themselves.
560. My girlfriend is very different to me in what hobbies she has
561. most couples seem similar in fundamental beliefs e.g. politics / religion - depends what opposites you mean!
562. Personal experience
563. most relationships i have viewed where partners are opposite tend to not last as long as those who are equally matched
564. No scientific evidence of this idea
565. too simplistic a concept.

566. while you can't really generalize that opposites attract, I have witnessed the existence of this, when 2 of my friends started dating each other
567. There is some evidence that opposites attract, but actually more often it seems the case that people are attracted to people that are similar to them, not different to them.
568. We see it as mysterious.. as we may not fully understand that person
569. It does not hold up when considering people I know
570. not true for other people!
571. One can see examples of symbiotic co-operation in nature.
572. initial attraction of difference may later turn into conflict
573. I dont have overly fixed views, I think in some instances opposites may attract, while other people prefer those like themselves. I prefer people like me. I could not abide someone who had different values or attitudes for more than a minute. Again, this is not evidence either way so I have not given a strong decision
574. I know of no scientific findings to suggest its true/false: I haven't really critically thought about it before actually
575. What I know of psychology of relationships appears to contradict it, also.
576. Positive and negative balancing for equilibrium
577. It does not seem to be supported by the relationships I see around me
578. It seems unlikely, a priori, that people who have widely different views and tastes would be able to live together happily for long.
579. I've also felt the opposite to be true.
580. "Observation.
581. Be attract by similitude is an easy way to interact , feeling apart to a group, but disturb the way an observer could perceive the others ""group"" and then create a danger for the harmony in the community."
582. Make no sense from psychology and social point of view, because peoples are strongly different between them.
583. Personal experiences show that opposites attract
584. I think it more likely that people are attracted to those who are similar to themselves. This is indicated by the examples of siblings who have met only in later life and are attracted to one another.
585. its a subjective notion that cannot be proven
586. Understanding of the Laws of Attraction
587. Relationships differ from person to person, so I think that in some cases, 'opposites' probably do attract, but in other cases they don't.
588. I would add that while opposites may attract, they are probably less likely to stay together long - term.
589. It's sociology/anthropology, so not a science but soft and vague, so I have no strong belief either way.
590. Similarity between husband and self
591. Contra-indicated on an evolutionary basis
592. personal experience. probably know more couples who have lots of things in common than not.
593. novelty

594. ying and yang
595. It's entirely possible that Opposites Attract is true for some attributes and not for others.
596. People are very complicated and can't be reduced to just a personality type or hobby. Even if some of these features are seen to be opposite they will only be a small part of what makes up each partner.
597. Evidence not nearly as solid as creationism/evolution/ESP, so ranked as 3, not 1.
598. Even where people are attracted to others who are the opposite of them in significant ways, this cannot be generalised from.
599. From what I have seen in other people's relationships, it can work well to have a calm person in the relationship to calm down the energetic one, and an energetic person to provide the impetus to get stuff done.
600. My personal experience suggests this is rarely the case. Almost all the long and short term relationships I have been in or have even heard about involve similar couples
601. i have longer, and closer relationships with people who are like me
602. My experience of other peoples' relationships has been otherwise
603. I have seen examples
604. There is a general consensus that this can be a common occurrence, however is not a general rule.
605. actually I think people are more often attracted to someone who resembles them in values and attitudes
606. Could be pheremonal and biochemical for reproductive requirements
607. My own observations of couples suggest that opposites do not attract.
608. I think generally girls will have different hobbies to boys. Or different personalities in same sex couples will attract
609. Philosophy Schopenhauer
610. Personal experiences (my parents, my friends, my last relationships). Though this wouldn't be considered a scientific evidence...
611. However, that was one relationship out of the many relationships I've seen, therefore it IS an unlikely phenomenon
612. Our personalities maybe be oppsite but together make the perfect team
613. I do not believe it to be true
614. I don't have a strong opinion either way
615. In biology, opposites attract when there is some mutual benefit to be had. In Psychology 9and politics), opposites can frequently detract rather than attract.
616. there is some truth in it as it's good to have complementary characteristics in a relationship but not too many differences
617. Seeing as we are genetically very similar to each other (bearing in mind virtually none of our DNA is free to vary) and our environment is very similar, we live in the same era, we are all generally extremely similar to each other in most respects, our differences seem big to us, but in the bigger picture our differences are trivial compared to our similarities. Therefore by logical expansion, if we were attracted to opposites you would see cross-species, human/plant partnerships, human/mineral partnerships etc, whereas generally

- people go for people! Therefore with us being so incredibly similar in most respects it only makes sense for like to attract like (which in the middle ages was the principle of thaumaturgy LOL)
618. From my personal experience I'd say maybe its true for some people some of the time Certainly my personal experience contradicts it.
619. Observation
620. "This is a comment about Afterlife where no boxes are offered.
621. Which kind of afterlife are we talking about- This is clearly a religious concept and in this case I assume you are thinking of the Christian afterlife. I am not Christian"
622. However, it is possible that the novelty of someone with different views would be attractive and exciting - for a short while.
623. Natural law of interconnectivity , only exist in relation of each other.
624. This idea can be a product of mass Medias curiosity only.
625. Science and metaphysics
626. "I think that really, ""opposites attract"" is just a meaningless phrase, and relationships are a lot more dependent on individual circumstances.
627. Meh.
628. Data suggests the opposite
629. things like that suffer from observation bias, if you focus on opposites attracting that's what you will find, because that's what you set out to find.
630. makes the relationship interesting
631. won't get bored
632. If specified further, accepting it tentatively might lead to interesting results in further research.
633. Partners can often have complementary features (e.g. one who plans very carefully for the future - to the point of stress, while the other is more easygoing). These complementary aspects can lead to a very successful relationship in which a middle ground is sought. In this sense opposites can make a good team (though I wouldn't say that it is the reason for the attraction). And I maintain that partners tend to be more similar than dissimilar.
634. Whereas the previous questions were either is true / is not true, this question is likely to have a large number of exceptions. Some people won't follow the rule.
635. It sounds more like an old wives' tale than scientific finding :~)
636. Haven't seen strong evidence to the contrary.
637. eHarmony would be out of business.
638. people that are very different might be interesting but you cannot be too close to them
639. It's just a saying
640. I don't really care.
641. It depends on the individual and personal preference, I don't think there is any particular generalisation to made here
642. attraction has so many facets it is hard to reduce it to a simple dimension
643. would you really want to live with yourself or someone so like you- i wouldnt - it would do my head in.

- 644. I am not sure what is meant by "opposites". Opposites in what sense-
- 645. There are so many other factors that are involved in a relationship working isolating one variable is very difficult
- 646. Observation of others
- 647. I don't personally think this kind of aspects could influence relationships

Afterlife

- 648. Becuase I cant imagine all this thought mind a life ever just stopping..
- 649. Persistant universal belief in spirits and afterlife in folklore in every culture, no matter how culturally or geographically separated.
- 650. Science
- 651. scary to think there is nothing
- 652. I know of know evidence to support the theory of life after death.
- 653. No evidence
- 654. lack of scientific evidence
- 655. No evidence whatsoever, and it makes no sense. Also, noting that people with brain injuries often have dramatic personality changes and people with alzheimers lose their memories, personality and memory are the two fundamental things which make us who we are. I have just demonstrated that both of these are biological within the brain, so upon brain death you would not remember anything or be the person you feel you are. So if there were anything after, what exactly would it be- It is a nonsensical deluded idea. We like to think we are more than electrochemical impulses and storage of data in an organic machine, but all the evidence pretty conclusively shows that is all you are!
- 656. I can't imagine how it would be sustained/work
- 657. There is no evidence.
- 658. Subjective experience
- 659. Sorry, there was a box after all, but only after I had conceded defeat by ticking an option under an assumption (Christian afterlife) which may or may not have been permissible
- 660. It seems to have been made up to satisfy psychological needs
- 661. The survival of consciousness after death has been studied by many and is being supported as more evidence emerges, including from past the life studies by Stephenson et al and from NDEs.
- 662. I am very aware of wanting it to be true rather than believing it to be true.
- 663. No convincing evidence.
- 664. Not being able to fully comprehend not existing as a thinking being.
- 665. Electromagnetic law of energy, energy do not die but mutatae.
- 666. Personal experience, accepting various explanations.
- 667. Some scientific explanation can be done.
- 668. 3 indicates agnosticism. It seems unlikely, but I can't rule it out.

669. There is no scientific evidence for the existence of an afterlife. I am open minded about there either being an afterlife or not. The truth is, that we do not know what happens to us when we die, aside from that our bodies cease to live.
670. The typical image of the Afterlife/Heaven appears to be mere wishful thinking. There is little scientific evidence in support of it.
671. As in belief in ESP
672. no convincing evidence
673. Just too much anecdotal data to ignore
674. No evidence exists to support it
675. I find the idea of death frightening - I like the idea that my mind would exist in some form after death.
676. No credible evidence exists to support it.
677. When you're dead you are dead. After life comes death - it's as simple as that.
678. faith
679. Science
680. No evidence to show there is such a thing
681. No evidence
682. i don't believe in the soul as something that is separate from the body.
683. I think it is a concept invented by people unable to accept the finitism of life
684. Been given evidence in the form of messages
685. Religious authority, both Scriptural and in the testimony of saints.
686. there is no reason in dwelling about this question. We are going to die and find out anyway. Afterlife cannot be tested scientifically, at least to the best of my knowledge, for this reason any evidence supporting afterlife is as good as evidence contrasting it.
687. Religious belief
688. It goes against the second law of thermodynamics.
689. Lack of evidence.
690. No objective proof that such a place exists!
691. Experience
692. No scientific explanation.
693. There are many evidences that science must study yet.
694. There must be something more, what a waste otherwise
695. No way of proving such a thing.
696. There is no evidence whatever that such an afterlife exists, nor is there any way of finding evidence.
697. you might live on in your ancestors
698. Come on-
699. It's comforting
700. It fails Occam's Razor
701. quran has good explanations. If we can see the miracles and authenticity of Quran(that means if we can see that its the word of God) we can easily understand The creator of the universe can easily create the afterlife
702. There is no scientific proof
703. atheist

704. Just because i dont know for sure that it exists doesnt mean that it cant
705. I find it hard to believe that I could just stop existing.
706. I think that the Afterlife is a convenient fiction. I think it stems from the concept of a just God. Evil people clearly often prosper in this life and good people suffer. If God is just, how can He allow this- There must be an afterlife in which we get our just deserts.
707. I just don't believe life occurs after death. It's impossible to prove.
708. no evidence
709. I don't believe in a personal, individual afterlife
710. No scientific evidence
711. being brought up in a religious background
712. Almost negative scientific evidence supporting this idea
713. no evidence!
714. No evidence.
715. Again, there is a lot we don't know about human potential, and I open minded to the possibility of an afterlife.
716. I believe life continues and this is just the first test to get to heaven
717. We have not as yet understood everything, so must remain open to the possibility of things like an afterlife, if they do not contradict our basic data about the universe
718. No way for a person to retain their essential qualia after death due to brain stopping working
719. helps when thinking about loved ones who have died
720. If there was an afterlife, current life would have no purpose to exist.
721. Religious superstition to make people happy with the fact that they will eventually die
722. the current evidence for its existence is unconvincing
723. It is a hideous horrible idea to think that for eternity you would be stuck, bored out of your mind, doing nothing much... ugh!!!! If you study physics you see the universe will end too at some point, and for the last few trillion years there will be practically no light left even, so there would be nothing much to watch... imagine how horrifically bored you would be
724. There is no evidence, reason to believe so
725. Contradicts science.
726. Overwhelming scientific evidence
727. see previous box for comment on afterlife
728. It is tied up with the idea of a God who interferes in the running of the universe, for which there is no evidence
729. It's also a philosophical necessity in order to form the basis of of ideas such that impersonal justice exists in nature, on reaps what one sows, the old idea of Karma that exists almost universally in all the world's belief systems.
730. The idea goes against science in many if not all ways.
731. Intuition
732. Scholarly research eg SPR, Resuscitation Jnl
733. Field investigation present one point of view that can't be neglected
734. I am not convinced that human consciousness could survive the death of the brain.

735. Seems to me there's a strong case for the claim that mind is dependent on physiological processes in the brain.
736. accounts are based on personal experiences
737. Laws of physics
738. No evidence has been found to prove the existence of ghosts/an afterlife, and I'm not sure how it could exist.
739. What evidence there is (none of it credible) is also contradictory.
Reincarnation- Ghosts- Heaven- Purgatory- Pick one!
740. Philosophy
741. Impossible to disprove
742. we are animals, we live we die, we make the most out of it.
743. Can see energy forms
744. Traditional philosophical arguments for the likelihood.
745. Brought up to believe
746. I am a materialist. I think that dualism is deeply flawed (though I recognize that there is a lot we don't yet understand about consciousness)
747. Lack of currently understood viable mechanism to allow this to exist.
748. Can't think of an objective and dispassionate reason for its existence
749. Reading of others experiences
750. I am not religious, so I have no basis to believe that an afterlife or reincarnation would exist. If I had been taught about an afterlife since I was small, I might be more inclined to believe; but as that never happened, I don't even have a "nurture" component to this belief.
751. It provides hope that there was a point to a life
752. I find it hard to reconcile a continuation of the self after the life after the destruction of the brain, especially when destruction of the self can take place through damage to brains that survive trauma.
753. or the things you have moved and changed in the world
754. It is a widely held belief throughout history and in many cultures
755. It doesn't seem to affect the behavior or those who attest belief in it
756. without accepting gods existence believing in afterlife is nothing. After understanding logically the existence of God , mankind may look around itself and see that "this God musnt have created everything purposeless, everything comes and goes without tasting the life enough. However Gods attributes that we can easily understand from the nature, say us that He is merciful, Just, powerful . The Power with which The God created this universe can easily crate another one after all living beings died. the Mercy with which God gives every living being a life and its requirements from nothing, must give them an eternal hapiness and life as well. The just wit wich God gives to everything a suitable position in this universe, he gave a soul suitable for lion and gave a body suitable for plants. He must punish theevil people who may killed lots of people and do many evil things to innocent livingbeings. His just requires the punishment and reward as well. So we can understand from the universe around us that tghere must be an afterlife
757. Religious scriptures implying an afterlife are usually prior to scientific breakthroughs that would suggest otherwise, such as evolution contradicting the design argument

758. evidence
759. Prove to me it doesn't
760. Consciousness is little understood
761. I have never seen any scientific evidence that supports the notion of an afterlife.
762. I can't understand how we can exist without our bodies and brain
763. All that I am is absorbed by the universe
764. gives hope for something after death
765. Ockam's razor principle: maybe some "extraordinary" experience looks so because we just don't have an alternative simpler, "ordinary" explanation
766. Just another phenomenon used by religion to convert and manipulate people
767. There have been many anecdotal pieces of evidence e.g. near death experiences etc, which suggests that something is going on that many people have experienced, but whether or not this is evidence of afterlife is difficult to prove.
768. There's more to life than what we only see
769. There is some very tentative evidence from NDEs, mediumship, children who remember past lives, and apparition research that suggests that there may be something to it. However this evidence is not conclusive, but nor is it conclusively dismissed either. I prefer to keep an open mind, but not so much my brains fall out. I have also had experiences that on a personal level are suggestive of this interpretation when all else is considered.
770. I don't see how it could exist
771. on the other hand, not convinced such a place truly exists so only rated a 5
772. "I do not believe there is an after life, if I'm wrong, GOD help me !
773. I'm 81 years old, if I am wrong in my disbelief; I'll come back and let you know. :^D"
774. there is a very small chance science might discover it's true.
775. People hate to appreciate the reality of things, they like to kid themselves that everything is meaningful, that there is some grand scheme, that something is directing everything, that there is a point. NO there ISNT! And that in itself is freeing. It allows you to actually enjoy that you are HERE... not to live by evil archaic bigoted religious commandments, but to form your own morals, to be yourself, to be proud of that, to do the right thing because you think it is the right thing, to study, to understand as much as possible, and to appreciate every second because when the light goes off it all stops.
776. It's a bit scary actually - to be captive somewhere forever- being tortured or spending eternity doing I don't know what. I take comfort from the belief that I have not existed before and will simply not exist again
777. My own scepticism has been challenged by real events
778. You keep asking if I would change in mind in the face of strong evidence. You do know, of course, that it is very difficult to scientifically prove that afterlife does NOT exist. So I wonder how you can suggest that people who believe in it could be convinced that it does not on the basis of impossible science.

779. Consciousness is clearly produced by physical activity, i.e. the brain.
When the brain stops working, consciousness will stop.
780. There is no evidence for it.
781. Books by credible authors eg Moody, Ring, Sabom, Fenwick, Parnia.
Acknowledging anecdotal nature of material.
782. Not contradict the way that we can see the nature.
783. no one has returned from the afterlife to report its existence
784. Brains cease to function at death and all that we are exists within a
functioning brain
785. From what I know of science, there is no obvious way that an afterlife
could exist.
786. Religion - because it supports that idea to control and manipulate
people with false threats and promises
787. Impossible to prove
788. it would be a very crowded place!
789. too many things have happened in my life to disbelieve
790. The near-universality of such views.
791. Culture
792. The idea of an afterlife seems so very much like wishful thinking by
humans.
793. Extent of extra things that would be required for an Afterlife to exist (for
example, a soul or similar), none of which hold evidence for their existence (i.e.
an afterlife does not fit into current scientific principles).
794. I believe it's a fictional concept to comfort people who are afraid of
death
795. Prefer it to not believing there is anything at all!
796. Never felt that I've been contacted by anyone in the afterlife.
797. Multi personalities have been found in patients with mental diseases
and post corpus callosum surgery. I wonder - which personality is the soul and
so which will go to 'heaven'-
798. the should might be something that never dies, it only changes
799. It makes as much sense as not believing in it
800. Its absense is strongly insinuated by current scientific evidence
801. every prophets said the same thing. they showed people miracles to
make them accept easily. And this invitation has lots of reasonable aspects as
well. If somebody who had never tell a lie, comes to you and claim smthing you
tend to believe in his ideas even if you dont know ecxactly. BUt this messengers
are abundant in number and each and every of them said the same thing, all of
them recognised in their community as the truthfull and perfect individuals, all
of them supported their claims with miracles, so its not feasable after seeing this
and not believing in afterlife. Furthermore its a kind of arrogance and ignorance
802. I think humans are egocentric as a species and such is a strong
motivator for implementing the idea of an afterlife, through sheer want for an
afterlife is a poor basis for proof
803. Id like to think that my energy or personality extends itself after my
body dies in some form

804. I am a materialist. I believe that when the body dies there is no essence that can live on in any coherent form.
805. I believe ancestral memories are accessible during critical life developments
806. more meaning to life
807. Strong doubt about the existence of life after death (that doesn't mean I'm not hoping that there would be something else after death...)
808. It's a nice thought though...
809. Even if it were not true that there was an afterlife, it is often helpful for us to believe in it, as it helps give people hope/motivation etc.

Appendix 4 – Study 3: Questionnaire

Briefing and Instructions

We all have our personal beliefs about a wide variety of topics. But, **why** do people hold their particular beliefs? This study is looking at some of the reasons people might hold their beliefs on a selection of common topics. We will be collecting data on beliefs at a number of points in the first term.

You'll be asked to answer some short general questions before being asked to rate your belief in a number of topics, as well as rating the reasons why you believe or disbelieve. The topics are: creationism, evolution, extrasensory perception (ESP), 'opposites attract', and the existence of an afterlife. The questions on each topic span two pages – please be sure to answer the questions on both pages for each topic.

Please read the clarifying definition for each topic. Circle one number only on each scale to indicate your views on each topic.

Taking part in this study is optional and you can quit the study at any time even if you've already started filling in the questionnaire. If you're not comfortable answering questions on a particular topic then please feel free to skip that topic or any individual question on that topic, although your responses are much more useful to us if you do answer all the questions. All data will be treated with full confidentiality and, if published, it will not be identifiable as yours.

This data is being collected by Duncan Colvin (d.colvin@gold.ac.uk) as part of his postgraduate research at Goldsmiths under the supervision of Prof Chris French (c.french@gold.ac.uk). If you have any queries about the research, feel free to contact either of them.

If you are willing to take part in this study, please sign below and provide us with some basic background information:

* * * * *

I understand what is involved in this study and I am willing to take part.

Signed:

Date:

Name:

Goldsmiths email address (needed so that we can award you your credits):

Age: years months

Gender (M/F):

THANK YOU FOR YOUR PARTICIPATION!

If you require any further clarification, please feel free to ask by raising your hand

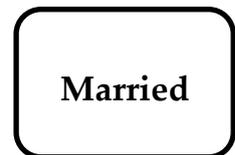
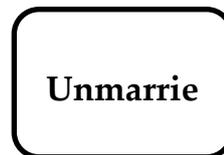
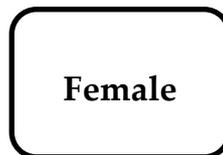
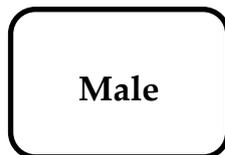
To begin with we'd like to ask you five very short general problem solving questions:

- 3) A bat and a ball cost £1.10 in total. The bat costs £1 more than the ball. How many pence does the ball cost?

Answer:

- 4) The City Council of Padua has asked for volunteers to take care of visiting English schoolchildren. Volunteers have to fill in a card. Mr Rossi and Mrs Bianchi are about to sort the cards. Mrs Bianchi argues that only women will volunteer. Mr Rossi says she is wrong, and states that men will volunteer as well. Mrs Bianchi counters that if that is the case, then the men will be married.

Cards filled in by the volunteers show gender on one side and marital status on the other. Given the four cards below, circle the two cards that you must turn over to check whether or not Mrs Bianchi is correct that the male volunteers will be married.



- 5) If it takes five machines, five minutes to make five widgets, how many minutes would it take 100 machines to make 100 widgets?

Answer:

- 6) In a lake there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how many days would it take for the patch to cover half the lake?

Answer:

- 7) How many letter F's are there in the following paragraph?

FINISHED FILES ARE
THE RESULT OF YEARS
OF SCIENTIFIC STUDY
COMBINED WITH
MORE THAN A FEW
YEARS OF EXPERIENCE

Answer:

Before we proceed to the specific questions about belief/disbelief, we'd also like you to answer a few very brief questions about your preferences. Simply circle the answer that would be your personal preference in each of the following cases:

8) Which would you prefer to receive?

- c) £100 now
- d) £140 this time next year

9) Which of the following would you prefer?

- a) £100 guaranteed
- b) A 75% chance of winning £200

10) Which would you prefer to receive?

- c) £3000 now
- d) £3800 this time next month

11) Which of the following situations would you prefer?

- a) Definitely having to pay £100
- b) A 75% chance of having to pay £200 (*note: this also means a 25% chance of not having to pay anything*)

Creationism – page 1 of 2

Definition:

For the purpose of this study Creationism is defined as the belief that the Bible gives a literally true account of the creation of the Earth and all life upon it.

To what extent do you believe in Creationism?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

For each statement given below please circle a number from 1 to 9 to indicate how much it contributes to your particular view about Creationism:

1) I hold my particular view about Creationism because my view makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) I have arrived at my particular view about Creationism after careful evaluation of the objective evidence, both for and against my view.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like Creationism, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) Personal experience or observation is the reason for my particular view about Creationism.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) Science is the reason that I hold my particular view about Creationism.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

6) I hold my particular view about Creationism because the arguments offered for other points of view are internally inconsistent – i.e. other points of view contain contradictions within themselves and so cannot be true.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

Creationism – page 2 of 2

Now imagine that you were presented with strong evidence that contradicted your view about Creationism. How likely would you be to change your mind on this topic?

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Evolution – page 1 of 2

Definition:

For the purpose of this study Evolution is defined as the development of all the species of animals on earth from earlier forms (for example, land animals evolved from early forms of fish).

To what extent do you believe in Evolution?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

For each statement given below please circle a number from 1 to 9 to indicate how much it contributes to your particular view about Evolution:

1) I hold my particular view about Evolution because my view makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) I have arrived at my particular view about Evolution after careful evaluation of the objective evidence, both for and against my view.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like Evolution, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) Personal experience or observation is the reason for my particular view about Evolution.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) Science is the reason that I hold my particular view about Evolution.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

6) I hold my particular view about Evolution because the arguments offered for other points of view are internally inconsistent – i.e. other points of view contain contradictions within themselves and so cannot be true.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

Evolution – page 2 of 2

Now imagine that you were presented with strong evidence that contradicted your view about Evolution. How likely would you be to change your mind on this topic?

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Extrasensory Perception (ESP) – page 1 of 2

Definition:

For the purpose of this study Extrasensory Perception (ESP) is defined as the direct perception of information by the mind without using any normal way to find the information out.

To what extent do you believe in ESP?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

For each statement given below please circle a number from 1 to 9 to indicate how much it contributes to your particular view about ESP:

1) I hold my particular view about ESP because my view makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) I have arrived at my particular view about ESP after careful evaluation of the objective evidence, both for and against my view.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like ESP, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) Personal experience or observation is the reason for my particular view about ESP.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) Science is the reason that I hold my particular view about ESP.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

6) I hold my particular view about ESP because the arguments offered for other points of view are internally inconsistent – i.e. other points of view contain contradictions within themselves and so cannot be true.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

Extrasensory Perception (ESP) – page 2 of 2

Now imagine that you were presented with strong evidence that contradicted your view about ESP. How likely would you be to change your mind on this topic?

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Opposites Attract – page 1 of 2

Definition:

For the purpose of this study the idea that Opposites Attract is defined as people being attracted to partners who are the opposite of themselves in significant ways (such as in their personality or in the hobbies that they like, and so on).

To what extent do you believe in the idea that Opposites Attract?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

For each statement given below please circle a number from 1 to 9 to indicate how much it contributes to your particular view about Opposites Attracting:

1) I hold my particular view about Opposites Attracting because my view makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) I have arrived at my particular view about Opposites Attracting after careful evaluation of the objective evidence, both for and against my view.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like Opposites Attracting, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) Personal experience or observation is the reason for my particular view about Opposites Attracting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) Science is the reason that I hold my particular view about Opposites Attracting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

6) I hold my particular view about Opposites Attracting because the arguments offered for other points of view are internally inconsistent – i.e. other points of view contain contradictions within themselves and so cannot be true.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

Opposites Attract – page 2 of 2

Now imagine that you were presented with strong evidence that contradicted your view about Opposites Attracting. How likely would you be to change your mind on this topic?

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Afterlife – page 1 of 2

Definition:

For the purpose of this study Afterlife is defined as a place, or state, in which people continue to exist after their mortal bodies have died.

To what extent do you believe in the existence of an Afterlife?

completely disbelieve	1	2	3	4	5	6	7	8	9	completely believe
-----------------------	---	---	---	---	---	---	---	---	---	--------------------

For each statement given below please circle a number from 1 to 9 to indicate how much it contributes to your particular view about the existence of an Afterlife:

1) I hold my particular view about the existence of an Afterlife because my view makes me feel good or is comforting.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

2) I have arrived at my particular view about the existence of an Afterlife after careful evaluation of the objective evidence, both for and against my view.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

3) When it comes to issues like the existence of an Afterlife, I trust my 'heart', not my 'head' to tell me the truth.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

4) Personal experience or observation is the reason for my particular view about the existence of an Afterlife.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

5) Science is the reason that I hold my particular view about the existence of an Afterlife.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

6) I hold my particular view about the existence of an Afterlife because the arguments offered for other points of view are internally inconsistent – i.e. other points of view contain contradictions within themselves and so cannot be true.

not at all my reason	1	2	3	4	5	6	7	8	9	completely my reason
----------------------	---	---	---	---	---	---	---	---	---	----------------------

Afterlife – page 2 of 2

Now imagine that you were presented with strong evidence that contradicted your view about the existence of an Afterlife. How likely would you be to change your mind on this topic?

not at all	1	2	3	4	5	6	7	8	9	completely
------------	---	---	---	---	---	---	---	---	---	------------

Debriefing

One of the studies you took part in today asked you about various beliefs and reasons for belief. The aim of the study was to replicate research (Griffin & Ohlsson, 2001) which found that people's reasons for belief in various topics can be broadly categorised as intuitive/emotional or rational/knowledge based (heart versus head, so to speak). In the previous research people were more likely to believe in creationism, ESP, afterlife, and opposites attract, for intuitive rather than rational reasons, whereas the opposite was true for evolution. You were also asked about how likely you would be to change your belief if faced with strong contradictory evidence. Previous research found that people who reported a greater rational component to their belief (or disbelief) also rated themselves as more likely to change their mind if faced with contradictory evidence.

However, the previous research did not look at *actual* belief change. The present study is therefore looking at real world belief change in relation to ESP, following the lecture on Anomalistic Psychology that you attended earlier in the term. In addition to this, the study also aimed to control for people's varying tendencies to inhibit their more intuitive responses to things – hence the additional questions at the beginning of the questionnaire you completed earlier in the year (e.g. reading is automatic and counting the F's in a paragraph requires inhibiting default reading behaviour). It is hoped that this research will shed light on why and when people change (or do not change) their beliefs, particularly with respect to belief in the paranormal.

Once again, many thanks for your participation in this research study.

Duncan Colvin (d.colvin@gold.ac.uk)

PhD Supervisor: Chris French (c.french@gold.ac.uk)

References

Griffin, T. D., & Ohlsson, S. (2001). *Beliefs Versus Knowledge : A Necessary Distinction for Explaining , Predicting , and Assessing Conceptual Change*. In L. R. Gleitman & A. K. Joshi (Eds.), *Proceedings of the Twenty-Third Annual Conference of the Cognitive Science Society*. Mahwah, NJ: Lawrence Erlbaum Associates.

Appendix 5 – Study 5: Briefing and Debriefing

Study 5 used the same questionnaires as study 3, apart from exceptions specified in the Study 5 Material section in the present thesis. Only the briefing and debriefing are therefore provided here, due to differences required for the sample. The briefing was on paper and the debriefing was sent by email due to some respondents completing an online equivalent for the second half.

Briefing and Instructions

We all have our personal beliefs about a wide variety of topics. But, **why** do people hold their particular beliefs? This study is looking at some of the reasons people might hold their beliefs on a selection of common topics. The questionnaire will be run again at the end of term – completing both questionnaires will make you eligible for the £50 cash prize draw (see below for details).

You'll be asked to answer some short general questions before being asked to rate your belief in a number of topics, as well as rating the reasons why you believe or disbelieve. The topics are: creationism, evolution, extrasensory perception (ESP), 'opposites attract', and the existence of an afterlife. For clarity there is one topic per page.

Please read the clarifying definition at the top of each page. Circle one number only on each scale to indicate your views on each topic.

Taking part in this study is optional and you can quit the study at any time even if you've already started filling in the questionnaire. If you're not comfortable answering questions on a particular topic then please feel free to skip that topic or any individual question on that topic, although your responses are much more useful to us if you do answer all the questions. All data will be treated with full confidentiality and, if published, it will not be identifiable as yours.

This data is being collected by Duncan Colvin (d.colvin@gold.ac.uk) as part of his postgraduate research at Goldsmiths under the supervision of Prof Chris French (c.french@gold.ac.uk). If you have any queries about the research, feel free to contact either of them.

If you are willing to take part in this study, please sign below and provide some basic demographic information:

* * * * *

I understand what is involved in this study and I am willing to take part.

Signed:

Date:

Age:

Gender (M/F):

THANKYOU FOR YOUR PARTICIPATION!

Debriefing

Hi Everybody,

Some time ago, on the anomalistic psychology, course you all took part in a questionnaire (some of you did two of them) relating to beliefs and why people hold the views that they do. And now that data collection and analysis have been completed we can give you the full debrief.

The study that you took part in was looking into factors that might be involved in belief maintenance and change. Previous research suggests that people may have different reasons for holding the beliefs that they do. Some beliefs are held for knowledge-based reasons; that is, the person professing the belief believes that it is supported by the available empirical evidence. Some beliefs are held for intuitive or emotional reasons; that is, the beliefs in question simply make us feel good or we are relying upon subjective personal experience, and so on. Previous research by Griffin and Ohlsson (2001) showed that people who said they held their beliefs for knowledge-based reasons reported that they would be willing to modify their beliefs if presented with evidence that appeared to undermine them. Those who held their beliefs for emotional/intuitive reasons reported that they would not be willing to modify their beliefs under such circumstances. However, the study was entirely based upon self-report, i.e., what respondents *thought* they would do.

The study that you took part in attempts to test what respondents *actually* do. Thus the hypothesis we're testing in this study is that those of you who said you believed in ESP for knowledge-based reasons (i.e., you thought that scientific evidence supported such a belief) may well have reduced your level of belief but that those of you who said you believed in ESP largely for emotional reasons will not have done so. The results at this stage of the research indicate that belief in ESP did reduce after Prof. Chris French's course on anomalistic psychology, but this wasn't related to why people said they held their views on ESP. Our next step then will be to look at this discrepancy between what people say they would do and what they actually do.

As you can see your participation has been genuinely helpful in advancing our knowledge in this area and suggesting new avenues of research, so once again, thanks to all of you for taking part!

Finally, you may remember that taking part in the questionnaires entered you into a prize draw for a £50 cash prize. So, congratulations to our winner Phoebe Mansfield! Just in time for the post-exam celebrations too!

:-)

best regards,

~Duncan Colvin

References:

Griffin, T. D., & Ohlsson, S. (2001). Beliefs Versus Knowledge : A Necessary Distinction for Explaining , Predicting , and Assessing Conceptual Change. In L. R. Gleitman & A. K. Joshi

(Eds.), *Proceedings of the Twenty-Third Annual Conference of the Cognitive Science Society*. Mahwah, NJ: Lawrence Erlbaum Associates.

Appendix 6 – Study 6: Experimental Material

This material was presented online. ‘System 1’ refers to material designed to appeal to intuitive thinking and ‘System 2’ refers to material to appeal to rational thinking. The material below is not in the actual presentation order (see Study 6 chapter for this). Participants would not see all material as they were assigned randomly to different conditions. The briefing and debriefing are at the end of this appendix. Finally, CRT related items are listed near the end of this appendix, as well.

Intro

The following is taken from the introduction to a news piece looking into claims about a new phenomenon known as DVP (Delayed Voice Projection). Names have been changed to preserve anonymity – any similarity to real persons is unintended.

In a new phenomenon that’s being dubbed Delayed Voice Projection, or DVP, it’s being claimed that when an audio recording device, such as a digital voice recorder, or even a mobile phone, is left to record in a quiet room, it can record extremely faint traces of things people said the day before, and perhaps even further back than that. If these claims about DVP are true then the applications for law-enforcement could be far-reaching. While it wouldn’t allow police officers to see into the future, like in films such as *Minority Report*, it could perhaps help them solve crimes by *hearing* into the past. Could DVP be the next big break-through in policing? We sent our reporter, Dean Michaels, to do some investigating of his own.

Belief formation

System 1 version

The following is taken from the same news piece on DVP.

Reporter: I spoke to some people who've had a go at DVP themselves, to see what they think of it.

Interviewee: We did like they said and we put my friend's mobile phone in the living room to record. And then we went out to the kitchen for half an hour while we cooked dinner. We weren't really expecting much to be honest, it was just a laugh. But, when we went back and listened to it we could hear this really faint recording of some of the things we remembered saying the day before. It was really spooky.

System 2 version

The following is taken from the same news piece on DVP.

Reporter: I spoke to one of the people who claims to have demonstrated DVP and asked him what he thinks is behind it.

Interviewee: We all know that sound waves are basically a vibration that travels through the air. But, actually all things vibrate in response to sound waves. There's already a good example from law enforcement, where they can focus a laser beam through a window onto an object in a room to hear what the people inside are saying. They do that by the laser beam detecting the vibrations that the sound waves are causing in the object. And then, of course, sound waves bounce around, from surface to surface in a room, they don't just stop. The waves get smaller over time, of course, like ripples on the surface of a pond, but it takes a while for them to die out. If you combine the fact that the sound waves bounce around and that it's not just the air that vibrates due to sound waves, then I think what we have with DVP is we're recording extremely faint sound waves that are still bouncing around or being emitted by objects in the room, long after the original sounds occurred.

Belief change

System 1 version

The following is taken from the same news piece on DVP. Names have been changed to preserve anonymity – any similarity to real persons is unintended.

Reporter: Some of the people I spoke to, who've had a go at DVP themselves, had a different story to tell, however.

Interviewee: We did everything you're supposed to do. The audio recorder in a quiet room with no one there. All that stuff, we were really careful. We recorded for about an hour and it was pretty exciting to hit play and see what there was. I listened to it first and I could hear some really, really faint words in it, like really faint. But then Gemma listened to it and she heard something totally different. Josey did too – and she heard something else. We all heard different things and none of it was anything we had said in that room before either, not ever. So I think it's just a trick of the mind or something. You just hear what you want to hear.

System 2 version

The following is taken from the same news piece on DVP. Names have been changed to preserve anonymity – any similarity to real persons is unintended.

Reporter: Some of the other people I spoke to had a different explanation for DVP, however.

Interviewee: The short story is that it's not physically possible for the sound waves to stay around for long enough to be recorded the next day. The energy of the sound waves isn't that great and it gets absorbed by the surroundings, especially by soft things like carpets and clothes. They just absorb it and the sound wave energy is reduced. Pretty soon all the energy is used up and the sound waves have disappeared. The sound waves won't be around for longer than a few seconds at most, let alone hours or days. What's happening in DVP is that the recording devices are recording white noise, random background static, and people are just listening to the white noise and hearing what that they expect to hear. It's like seeing patterns in clouds. The human brain is very good at finding patterns in things even where there isn't really anything there and that's what's happening here.

EVP Control Question

Finally, have you ever heard of a phenomenon called EVP (electronic voice projection), which claims that messages from deceased people, or spirits, can be recorded on an audio tape or digital audio recorder?

YES / NO

Physics Control Question

What is your highest level science qualification?

Do you have an interest in acoustics or physics?

15) In a lake there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how many days would it take for the patch to cover half the lake?

Answer:

16) How many letter F's are there in the following paragraph?

FINISHED FILES ARE
THE RESULT OF YEARS
OF SCIENTIFIC STUDY
COMBINED WITH
MORE THAN A FEW
YEARS OF EXPERIENCE

Answer:

Next, please answer the 4 very brief questions below. Simply circle the answer that would be your personal preference in each of the following cases:

17) Which would you prefer to receive?

- e) £100 now
- f) £140 this time next year

18) Which of the following would you prefer?

- c) £100 guaranteed
- d) A 75% chance of winning £200

19) Which would you prefer to receive?

- e) £3000 now
- f) £3800 this time next month

20) Which of the following situations would you prefer?

- c) Definitely having to pay £100
- d) A 75% chance of having to pay £200 (*note: this also means a 25% chance of not having to pay anything*)

Briefing and Instructions

You will be asked to read some excerpts from a news piece on a new phenomenon that some people claim is real and others claim is not real. First you will read an introductory description of the phenomenon and then you will hear comments from both sides of the debate. In between this there will also be a brief filler task so that some time has elapsed between you hearing each side of the argument.

Taking part in this study is optional and you can quit the study at any time. All data will be treated with full confidentiality and, if published, it will not be identifiable as yours.

This data is being collected by Duncan Colvin (d.colvin@gold.ac.uk) as part of his postgraduate research at Goldsmiths under the supervision of Prof Chris French (c.french@gold.ac.uk). If you have any queries about the research, feel free to contact either of them.

You must be over 16 years of age to take part in this research study. If you are over 16 years old and you are willing to take part in this study, please sign below and provide some basic demographic information:

* * * * *

I understand what is involved in this study and I am willing to take part

Age:

Gender (M/F):

Signed:

Date:

Debrief

Thank you for taking part in this study. Research like this would not be possible without volunteers like yourself.

In this study, we were looking at how people's beliefs are influenced by different types of material. In particular, we were interested in the effects of 'sciencey' material versus personal material, such as people's personal experiences. Depending upon the study condition you took part in you may have seen some types of material, but not others (e.g. you might have seen all 'sciencey' material and no personal experiences).

Another important question is whether the type of material we encounter first changes how other material influences us later on. For example, if someone believes DVP is real because of hearing about personal experiences of DVP working, will they be convinced to change their mind later on if they encounter scientific counter-arguments? Or would they be more likely to change their mind if they heard about personal experiences of DVP not working?

Finally, we have to confess that DVP doesn't really exist – we made DVP up for the purposes of the study! We did this because we wanted to look at people's evaluation of new phenomena. So we needed something that people would not already have heard of. As far as we know, no one has claimed that a phenomenon matching the description of DVP exists. However, it does have similarities with EVP (electronic voice projection), which claims that messages from deceased people or spirits can be recorded.

Once again, thank you very much for taking part in this research study.