

RELIGION AND SUPERSTITION THROUGH A COGNITIVE PERSPECTIVE:
EXAMINING THE RELATIONSHIP OF RELIGIOUS AND SUPERSTITIOUS BELIEFS TO
COGNITIVE PROCESSES

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ABSTRACT

Religion and superstition are complex constructs since they are intertwined with a variety of psychological aspects and are correlated to positive and negative-related effects. For instance, both phenomena have been associated with advantages at behavioural (i.e. performance enhancements) and cognitive levels (i.e. executive function deficits). This thesis represents a systematic attempt to study these constructs under a non-reductionist approach and emphasizes the cognitive processes. Despite underlying and behavioural similarities, both phenomena were treated as peripheral (although independent) constructs with the intention of: a) forwarding the idea that both religion and superstition can have a neuroscience edge and can be integrated thus into novel and/or well-established electrophysiological and cognitive paradigms, b) exploring the links between religious and superstitious factors (namely luck belief) in relation to behavioural performances and cognitive functions, and c) underlying the advantages of a multidimensional non-reductionist view for both constructs. Overall, results further indicated that it is necessary to treat religion and superstition as related (but not equal) multifaceted phenomena. Both negative and positive-related effects were found: physiological evidence showing a correlation between unlucky beliefs and deficits in executive functions (EFs), when comparing event-related potentials (electroencephalogram-derived technique) recorded during a Stroop task of a group associated to these beliefs; a performance enhancement effect related to the use of a religious amulet during an anagram task; finally, a high correlation between negative-oriented beliefs and EFs in a screening that was based on a battery scale containing a myriad of religious, superstitious and EF sub-factors.

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PREFACE

Background and Thesis Aims

When I decided to pursue a doctoral degree in psychology, I aspired to follow an area of personal affinity. Throughout the length of my broad based undergraduate psychology degree, I developed a particular keen interest in the belief systems surrounding magical/religious thinking; being highly curious about what impact these beliefs had on behaviour and cognition, a major influence quite capable to be reflected on people's life, and yet, overlooked in many established cognitive paradigms. Based on the premise that these types of beliefs are highly extensive, and most importantly, capable enough of evidencing an effect on the behaviour of believers (contrarily to casual beliefs that fail to have or show any appreciable influence), I thus was drawn to the conclusion that this area of research has an abundant opportunity for further examination.

Among the primary scientific works that pointed me in the direction of beliefs literature was Charles Darwin's *Descent of Man* (1871/2009), wherein he commenced to expand his ideas on natural selection reaching psychological domains (i.e. morality and religious beliefs); William James' *The Varieties of Religious Experience* (1902/1985), a classic study on religion, which has

led many to consider James as the founder of the scientific field of religion; to the more recent Pascal Boyer's (1994, 2001) religion and superstition major works from an evolutionary perspective, a work that catapulted him into the spotlight as one of the leading figures in the study of the cognitive psychology of religion. In conjunction, all these works paved the way for the formal scientific study of magical/religious behaviour, and consequently gave rise to the foundation of the aforementioned major approach of religion within this thesis, the cognitive psychology of religion, a recent field of inquiry which accounts for the psychophysiological processes underlying religious thought and practice. Over-time, these essential perspectives have taken hold. We are in a modern age, where we can look at physiological cognitive biases at a physiological level due the integration of a variety of experimental techniques, however, the marriage that Darwin saw almost a hundred and fifty years ago has not taken a full force yet, since the schools of biological and social psychology are still under an on-going process of unification.

The main aim of this current thesis is to explore both religious and superstitious belief via a methodological pluralism, (i.e. under cognitive, physiological, and behavioural approaches) in order to inspect possible effects of these influential universal beliefs. Some of the major and constant key themes throughout the length of this thesis are 1) forwarding the idea that those beliefs can have a neuroscience edge and thus be further investigated when integrated and approached systematically into cognitive paradigms such as cognitive bias research, 2) exploring the relationship of religion and superstitious beliefs (emphasising on luck belief), 3) their functional basis might indicate a common origin (but divided by culture), and 4) the need for a multidimensional view of both phenomena in research, aiming to support the notion that they

will benefit more significantly than under a reductionist perspective, which has been dominant throughout their history.

In summary, the primary intention of this doctoral work was to systematically inspect whether there are any effects of the universal tendency to hold religious and superstitious beliefs within cognitive, physiological, and behavioural methodologies. At the same time, any shared psychological-related factors (i.e. self-efficacy) from these historically and culturally separated sets of beliefs were also investigated. In order to reach these goals data was gathered via a series of computerized tasks based and derived from the Stroop task (i.e. Emotional Stroop task). These tasks were constructed to assess performances that each centred on a specific cognitive function, namely semantic inhibition processing (a component of the executive functions), and cognitive bias (attentional bias). The ERP technique was used as the electrophysiological method via a Stroop study. Finally, the use of a simple anagram task was also used to assess the effects on performance. In addition to the computerized and simple tasks, beliefs and personality aspects scales were administered too.

My hope is that in overall, this thesis can consequently expand the literature of beliefs, thus helping to gain valuable insight into the origins and functions of these type of beliefs, and more importantly, provide scientific evidence that supports a categorization of these beliefs, that would accordingly classify magical-religious practices and behaviour as a larger family of beliefs. The electrophysiological and behavioural effects leads found in this thesis can have important implications in relation to mental health and related clinical settings. For instance, when bearing in mind the religion and/or superstitious beliefs that a patient holds, accordingly incorporating these as official variables during healing/therapeutic processes (among other

factors covered throughout this thesis' investigations, including individual differences at a cognitive level, and psychological factors), this multifactorial approach could thus aid to set the pace for an overall more flexible, efficient and less frigid patient-health professional relationship.

Thesis Overview

The thesis structure is composed of four parts. Part I acts as the introductory chapter (Chapter 1). It encompasses a comprehensive review of the literature of both superstition and religion. Detailing a wide range of their concerning topics ranging from their philosophical roots, to its modern theories, and all the struggles and major watersheds that helped flourish their study, with the purpose of giving a systematic historical review of their scientific approach. The four subsequent (middle-chapters) comprise Part II, and Part III, and deal with the four conducted investigations within this thesis, all share a common theme, which is the application of experimental design for the study of superstition and religion, and the fact that there are many superstitious beliefs, but religion and the belief around luck are the most relevant and prevalent beliefs in the studied samples.

In part II (Chapter 2 and 3), two experiments are reported sharing the aim of integrating religious beliefs into a well-established cognitive paradigm that have yet to test this psychological construct and an idiosyncratic paradigm which has previously been used to test superstitious practices and performances. Part III (Chapter 4 and 5), comprises the remaining two investigations within the present thesis work. Both studies share a main theme, which is the relationship of superstitious and religious beliefs to Executive Functions (EFs), a construct that manages a diversity of higher-level cognitive processes, or functions such as inhibition, flexibility of thinking, problem solving, planning, and execution (Alvarez, & Emory, 2006), and

further extended EFs centring on emotions. Part IV is the end of the body of this thesis. It is formed by a final chapter (Chapter 6) which summarizes and explains the strengths and limitations of each investigation that was conducted during the course of the thesis, albeit in a linear story fashion. This chapter also reviews the theoretical implications that emerged (mainly from the major findings), which in turn led to the proposal for a prospective continuation into this area of investigation. Thanks to this thesis work it was concluded that the significance of believing in being unlucky could even be detected at a cognitive level, via a specific cognitive impairment. Moreover, another study found a performance improvement effect in a group of individuals that carried a personal religious amulet during an anagram task. When comparing these results to the findings found in the experiment that it was primarily based upon, it can be indicative that both religious and superstitious behaviour work as homologues, in the sense that these can improve a task's resolution via boosted underlying psychological mechanisms. Also, results are briefly associated with implications to other areas in psychology, for instance, the developing of a methodological plan that can further investigate the functioning of personal beliefs-related variables in clinical settings.

PART I: INTRODUCTION

CHAPTER 1: Overview of the Psychology of Religion and Superstition

Summary

This introductory chapter presents a literature review of the psychology of superstition and religion, highlighting their significance as universal variables within the human experience and the scientific benefits of their cognitive approach. Superstition is approached as peripheral to the psychology of religion, with a specific focus on the set of beliefs around luck. By presenting past and current demographical data, it commences giving insight of the religion and superstition daily life significance, followed by a brief review of their definitions, main basis, risks coming from reductionist approaches. Historical perspectives of both psychological constructs are briefly reviewed with the purpose of clarifying the exact relationship between them and shared fundamental processes. Initial problems revolving around their conceptualization, as well as the recurring cultural separation are also explored. The key theoretical and historical contexts that lead a move of the field from being governed by a dominant paradigm confined within a single academic discipline, to a modern interdisciplinary approach are discussed. Finally, it focuses on the essential cognitive literature of both constructs which form the rationale for the current research program. Additionally, key research findings and their respective methodological aspects that inspired the construction, structure, and development of the current thesis are described.

1.1 Introduction

As we live in a technologically advanced society that is highly dependent on scientifically derived products for its functioning and organization, one would expect that the majority of people would favour empirical scientific enquiry, rationalism, and scepticism over magical-

religious thinking. On the contrary, it is common for a great majority - if not all people - irrespective of their educational background, gender¹, income or race, to exhibit behaviour deriving from alleged irrational beliefs (Persinger, 1990). Superstitious and religious thought and behaviour is likely to be more common than what might be expected.

Religion is considered as one of the most powerful social forces, to the point of suggesting humans to be labelled as *homo religious*, since it has been present since the dawn of the *homo sapiens* (Albright & Ashbrook, 2001). There are numerous examples that can illustrate the significance of religion in everyday life, as well as how deep-rooted these beliefs are in human culture. For instance, in the Occident, several hundred names for places, cities, and countries, as well as over a couple of thousand proper names, originate from the Bible or are related to religion (Hitchcock, 1869; Tischler, 2006). In the US, the American Religious Identification Survey (ARIS; 2008) reported that 73 – 80% of Americans identify themselves as Christian, and other major religions such as Hinduism, Islam, and Judaism collectively account for about 4% of the population. But those are the numbers for socially religiosity behaviour; and when personal (intrinsic) religiosity is taken into account, the numbers rise further. Polls tell us that 97% of U.S. residents believe in God and that about 90% pray (Gallup, & Lindsay, 1999; Poloma, & Gallup, 1991). Over 59% of the worldwide population was reported as being religious according to a recent global index of religiosity and atheism (Gallup, 2012).

Like religion, superstition has remained constant throughout human history. In the present, it still maintains a strong presence, and shows no sign of diminishment. It is widely

¹ The years of university experience and gender variables showed no correlation with exotic beliefs or traditional religious beliefs in a study that assessed relationship between both beliefs in university students, using data collected over a 10-year period (Persinger, 1990). Although in this same study it was found that pre-teenage religious experiences (i.e. “My first religious experience occurred before I was a teenager”) did have a significant correlation with both beliefs.

reflected in our language as well as within a myriad of daily rituals (i.e. common gestures and expressions such as saying ‘good luck’ or crossing fingers for the same effect). Many forms of ritualistic behaviour (i.e. superstitious practices) in sportsmen and their effects have been well documented (for a full review see Vyse, 1997). Demographic results collated from a variety of different organizations, demonstrate that superstition is a widespread phenomenon, and give more an idea of how ingrained it is in everyday life. For instance, a major national survey carried out by CBS news in 2012 (as reported in Vyse, 2013) revealed that at least 50% of the American population was at least “somewhat superstitious.” The same poll also focused on specific superstitious practices; its results showed that a good number of Americans tended to practice a variety of superstitious beliefs such as knocking on wood (51%), walking under a ladder (24%) or avoiding opening umbrellas (16%). In the UK demographics information on superstition indicates that superstitions are even of greater importance than in the US (Wiseman, 2004)². Superstition has been confirmed to play a significant role in society, to the point of influencing the economy (Hira et al., 1998).

Thus, magical-religious beliefs are a constant in every society. More importantly, these forms of beliefs are not just isolated individual manifestations, nor a relatively recent phenomenon. Whether it has been faithfully, vaguely, socially, and/or individually, superstition and religion have been present in virtually every human society throughout history (e.g., Frazer, 1922). But what is the exact relationship between these psychological constructs? Do both share the same psychological process? Are these a same construct that has been continuously separated

² As Vyse (2013) has indicated, due to the harsh reception that superstitious has gained in a mostly predominant religious environment there are significant chances that superstition polls concerning level of superstitious belief might reflect biased results.

sociohistorically? Is it correct to use these as interchangeably phenomena in psychology research? These fundamental research matters are the central arguments within this chapter.

1.2. Relationship between Religion and Superstition

Donald E. Brown (1991) defined the term *human universals* as comprised by those features of culture, society, language, behaviour and psyche for which there are no known exception, in other words, human universals are elements, patterns, traits, or institutions that are found in virtually every culture worldwide. Beliefs such as beliefs in supernatural/religion³, about death, disease, fortune (luck) and misfortune (unlucky) were all present in Brown's (1991) List of Human Universals - among four hundred plus primarily 'surface' universals of behaviour and overt language noted by ethnographers and their investigations - in what is perhaps one of the first scientific-related efforts to categorize religious and superstitious beliefs as natural phenomena.

Some studies have focused on investigating the correlations between both religion and superstition. In a study (Persinger, 1990) where the Personal Philosophy Inventory (Persinger, 1984) was administered to university students, it was found that there was a statistically significant interaction between two clusters of beliefs (exotic and traditional religious beliefs) and church attendance, suggesting that exotic beliefs may substitute for religious beliefs (Persinger, 1990). Qualitatively speaking, it is evident that both phenomena share fundamental traits such as a strong similarity in behaviour, with overlapping ritualistic behaviour. For instance, the use of amulets and lucky charms or touching wood to evade a negative outcome and

³ It is worth to mention that in Brown's list both supernatural and religion beliefs are comprised as a single universal.

making the sign of the cross to help attain a positive outcome in an uncertain event respectively (for a review of comparisons see Maranise, 2013). Lastly, it has been theorized that both constructs are an adaptive outcome of a general ‘belief engine’ (Shermer, 1998) since in each of the one hundred thousand religions and superstitions that have been estimated to exist by cultural anthropologists seem to perform common similar psychobiological functions (Wilson, 1996) including the reduction of death and existential anxiety (Persinger, 1985), a desire to provide meaning to otherwise random and chaotic events (Silberman, 2005; Inzlicht et al., 2009), and enable humans to make causal accusations (Tinbergen, 1967; West et al. 2007). However, these shared traits cannot ultimately confirm religion or superstition to be the same phenomena.

A typical example of reductionism is to affirm that a given experience or concept is “nothing but” another similar phenomenon. Reductionism can be deceptive and dangerous to adopt in some cases of research, especially in psychology of religion. For example, this form of reductionism applied to religious experience occurs when religion is used as an interchangeably term as superstition, assuming hence that the explanation of religious basis will result in the understanding of superstition (Emmons & Paloutzian, 2013). Although religious behaviour are in fact closely related to superstition, possessing similar features such as ritualistic practices, a magical or non-rational thinking (i.e. assuming that an amulet confers protection; see Chapter 2), and avoiding of negative outcomes (i.e. being based in fear), it is not correct to treat religious behaviour, religious belief and/or superstition as equals.

Some definitions of superstition do not seem to help; on the contrary, they can even increase the confusion. For example, “superstition” has been defined as “any belief or attitude, based on fear or ignorance, that is inconsistent with the known laws of science or with what is

generally considered in particular society as true and rational; esp., such a belief in charms, omens, the supernatural, etc.” (Guralnik, 1986, p. 1430). The *American Heritage Dictionary* (Morris, 1969) defines superstition as “beliefs that are inconsistent with the known laws of nature or with what is generally considered rational in a society”. Both definitions could be also applied for religion since they do not contain any definitive distinction that separates both constructs (this is especially true for the first part of both definitions). On the other hand, the same source defines religion as a "Belief in and reverence for a supernatural power recognized as the creator and governor of the universe; a particular integrated system of this expression; the spiritual or emotional attitude of one who recognizes the existence of a superhuman power or powers." In this definition, it is difficult to be used to define superstition. Other definitions go further and explicitly link these two concepts, although at the same time also distinguish them, clarifying thus that these are not the same phenomenon. For instance, the *Oxford Universal Dictionary on Historical Principles* definition of superstition includes: “esp. in connection with religion” (Onions, 1955, p. 2084).

By relying on the definitions of both constructs, it seems thus that religion centres on the belief of god(s), and superstition does not. But, in this vein, it can be said that the belief in god is a form of superstition, and hence, it should be treated as an independent (although related) component to other superstitions (i.e. in the same way beliefs around luck are separated to belief in astrology in research, although both are forms of superstition).

1.2.1. The Risks of Reductionism in Psychology of Religion and Superstition: Is Religion “nothing but” Superstition?

Hood and Hill (2009) pointed the risks of reductionism in psychology of religion highlighting two points. First, as explained earlier, how inappropriate can be reducing a complex concept such as religion, and second, the original psychological accounts of religion which did little or nothing to encourage their scientific research, mainly due their reductionist approach tendency.

Sigmund Freud's view of religion was pessimistic, merely reducing it as a form of neuroticism and as irrational (1927/1961b). A decade later, behaviourist Raymond Catell (1938) offered a second wave of reductionist view of religion, in which it was defined as a "silly superstition" (Gorsuch, 2002) and considered it irrelevant for psychology. William James (1902/1985), one of the founders of psychology of religion, varied the approach towards religion, focusing on the benefits of holding religious beliefs rather than the reasons of holding such beliefs (i.e. infantile projections of the parental figure, according to Freud). In other words, James treated religion pragmatically. A view which was later supported with several evidence of religion as beneficial (Gorsuch, 1976, 1988; Larson et al., 1989; Pargament, 1997). James contributed greatly to the study of religion, changing an atheistic and futile perspective of religion into a more favourable and attractive research perspective. But James' perspective of religion was still reductionist, a more subtle form of reductionism, given that for James, religious beliefs were reduced to their pragmatic value, in other words he focused only on what were these beneficial for?

There are a few quantitative studies aiming to investigate whether these are a same construct, and although further work needs to be done in this area, data suggests religion and superstition are - and should be treated as - independent constructs. Separate factors were found for beliefs involving the paranormal, superstition, extraordinary life forms, and religion

(Johnston, de Groot, and Spanos, 1995), countering the early mentioned “functionally the same” hypothesis. It has been suggested thus, that for a more accurate definition of either religion or superstition, it should not include the other, and to treat superstition not as a substitute of religion or as equal constructs-, but as peripheral to the psychology of religion.

In this vein, the current thesis endorses treating religion or superstition in a non-reductionist manner. Studies carried out for this thesis does not consider these phenomena as equals, nor as single, absolute and identical constructs. Instead, the analysed religions or superstitions are specified, detailed, and located from the thousands that exist, as in studies that compare the effects between different religions and several psychological factors (see Section 1.4.1.1). Furthermore, both concepts are neither treated as simple one-dimensional constructs but rather as convoluted and complex multidimensional constructs composed of several components (i.e. intrinsic religiousness, extrinsic religiousness), subcomponents (i.e. extrinsic-personal, extrinsic-social; see Chapter 2, Section 2.2.2.1.), and also differentiated by their positive/negative value (i.e. beliefs in being lucky, beliefs in being unlucky).

1.2.2. On-going Cultural Separation

Despite the hypothesized fundamental similarities between superstitious and religious beliefs (see Section 1.4.1.), there is yet a strict cultural separation. The reason for this evident and strong division could be due the society’s hierarchical system, in which religion reached an overwhelmingly influential status. Even in present times, it is noteworthy to recognise how the mere term *superstitious* denotes a pejorative nature that can be often used towards its sympathizers (Vyse, 2013, p. 20). Ideas or behaviours labelled as *superstitious* and/or *paranormal* are practically associated automatically with harsh words including *ignorance*,

irrational, and such. These patronizing acts may thus be a social mechanism that aims to separate the established/official religious beliefs from the alternative/unestablished ones within ideological battles, by encouraging an unsympathetic and hostile view towards other supernatural belief systems. According to cognitive psychologist Steven Pinker (1998, p. 557), if we think of religion as a market-like perspective, this competitive mechanism makes sense since it benefits the experts of the religious organization (i.e. religious priests), exploiting the devotee's dependence, and hence their strong need to maintain their established belief system functions.

1.3. Historical Perspective of Religion and Superstition Research: The Road towards an Intradisciplinary Approach

The current section describes the key theoretical, historical contexts, and research of the psychological study of religion and superstition. Summarizing their trajectory, from initial pre-scientific premises up to their modern interdisciplinary approaches are briefly discussed.

1.3.1. Superstition and Religion Backgrounds: Philosophical and Early Scientific Views

The scientific roots of religion can be traced back over 2,000 years, beginning with ancient philosophy in the study of mind-body relations. Despite believing that the mind was a product of the heart, in what is known as the cardiac theory, Aristotle (n.d./2005) was one of the first to formally discuss a relationship between our emotions and our mental processes. By investigating the impact of cognition on emotion, he elaborated the notion that our emotional states are influenced - and therefore partially determined - by our cognitive processes. Additionally, he conversely held that the outcome of our feelings is dependent upon our expectations, considering cognition to be grounded in and logically dependent upon our emotional states. This early notion

of emotions represents the first indirect pre-scientific views of religion (and superstition), since emotions in present times are known to play a crucial role and be intimately connected to religious life (Watts, 1996; McCauley, 2001). Religion and superstition, after all, has always been a source of profound emotional experience (Emmons & Paloutzian, 2003).

A landmark event occurred in 1848 which opened up new avenues of research in virtually all mind-related fields (see Damasio et al., 1994 for further details). 25-year-old construction railroad foreman named Phineas Gage survived a bizarre accident at a construction site, when a large metal rod pierced through his cranium, substantially destroying the left frontal lobe. While his cognitive abilities remained intact, he suffered from a profound personality alteration. Prior to the incident he was well known for being responsible, trustful, socially well adapted, decent and respectful. His physician and friends stated that after the accident, he had become a completely different person; irreverent and capricious, demonstrating noticeable alterations in decision-making, social conduct, emotional processing, and allegedly, also on his beliefs. This case quickly influenced discussions about brain functioning and cerebral localization and years after passing away his skull was repossessed for further study (for full review see Damasio et al, 1994). This serendipitous accident was crucial in laying the foundations of a relatively recent cognitive science branch, cognitive neuropsychology, which dedicates to the formal study of cognitive effects and psychological impairment of brain injury or neurological illness. It has produced significant insights on cognition and has aided our understanding of the structure and normal function of the human mind through the study of mental malfunctions. But despite the knowledge derived from this ground-breaking case, the study of the mental processing of emotions did not have an immediate impact (in the mid-1900s), in great part due to the philosophical traditions of rational empiricism that reigned, the dominance of the behaviourism

school in psychology, and finally conceptualizations that held the body and brain to be machine-like. Moreover, pioneers and “grand theorists” of religion completed major psychological opuses dedicated entirely to constructing meta-theories of religion (Durkheim. 1912; Freud, 1928; Jung, 1938; see Section 1.2.1.). When approaching religion within these writings, those authors attempted to interpret religion through their own overarching theories that aimed to investigate every aspect of human nature. Although these works contributed little to a scientific understanding of religion, they did represent the first social accounts, and helped pave the way for a formal scientific study of religion.

1.3.2. Behavioural Approach: Superstitious Behaviour as a Conditioned Reflex

Although psychologists started studying both religion and superstition around the start of the 20th century, substantial scientific progress in these areas did not begin until the second part. Long before this period, anthropology struggled to distinguish superstition from religion and other peripheral concepts (i.e. often referring superstition as magic). But more importantly, by the use of methods from ethnology and social anthropology, the anthropological approach represented the first systematic efforts for the understanding of both constructs. In this period of time, those who had helped to build psychology into the immensely wide and rich field that it is now had also become dedicated to studying the psychological aspects of religious experiences (Hall, 1903; James, 1902; Starbuck, 1911). However, the progress that the psychology of religion had started to make suddenly slowed down in the mid-1920s, weakened by a lack of interest on the topic from the following generation of psychologists.

To explain this decline, Paloutzian (1996) summarized various interdisciplinary events which culminated in behaviourism becoming the dominant paradigm within psychology, filling it

with an array of tendencies that contrasted drastically with the philosophy of mind. These included a) the separation of psychology from the department of philosophy, b) conducting scientific psychology in the model set by physics, and c) the avoidance of ‘taboo topics’ (i.e. superstition, religion, politics and the arts) in psychology that were considered impossible to treat scientifically due to their excessive philosophical, theological, and controversial nature (i.e. dreams, spiritual experience, belief in god). Superstition was an exception, as it was one of the few complex topics that were explored in behaviourism, although it was reduced to being a mere conditioned response.

Few behaviourists were concerned with tackling the basis of superstition. An isolated and exceptional case was the attempt to explain superstitious rituals within a behavioural framework, undertaken by the famous behaviourist B.F. Skinner (1948). Based on Pavlov’s conditioned reflexes investigations (1927), Skinner experimented with hungry pigeons placed in a cage that delivered food via an automatic mechanism "at regular intervals and with no reference whatsoever to the bird's behaviour." The pigeons associated the delivery of the food with whatever random actions they had been performing as the time it was delivered, subsequently continuing to perform these same actions when they wanted more food. Skinner (1948, p. 171) interpreted this event as a learnt ritual and commented, “The bird behaves as if there were a causal relation between its behaviour and the presentation of the food.” This principle was later extended, implying that it is applicable to the human formation and maintenance of superstitious behaviour, and religious rituals (Skinner, 1953, p. 171).

Skinner used the term operant conditioning to describe what he thought of the underlying mechanism responsible for the maintenance of this type of learnt behaviour⁴, which could be further extended to superstition. According to Skinner, this associative learning process functions independently from any awareness of the response and reinforcing connection in organisms (pigeons and humans alike). The temporal sequence of response-reinforcement was the only characteristic mandatory for its functioning. By taking all of these points together, Skinner reached the following definition of superstition: “If there is only an accidental connection between the response and the appearance of a reinforcer, the behaviour is called ‘superstitious’” (Skinner, 1953, p. 85).

Gustav Jahoda (1969, pp. 78-81) labelled Skinner’s reasoning behind the formation of superstition as anthropocentric, and identified the central misconception within this behaviourist approach to superstition as follows: It was “the failure of Skinner to be unable to distinguish between a) a form of behaviour induced by the accidental sequence of response and reinforcement and b) the belief that a causal connection was involved.” In other words, Skinner’s reasoning did not make a clear distinction between superstitions and irrational behaviour (i.e. a child frightened by a dog, provoking a fear to all type of dogs, including harmless ones) while categorizing a given conditional reflex. At the same time, Jahoda thought that the greatest weakness in Skinner’s approach was the “failure to draw clear distinctions between three levels of analysis, which were animal behaviour, individual human behaviour and the functioning of a social system, respectively.”

⁴ Operant conditioning is distinguished from Pavlov’s *classical conditioning* in that the former deals with the modification of "voluntary behaviour," or operant behaviour, operating on the environment and maintained by its consequences. While the latter deals with the conditioning of reflexive behaviours elicited by antecedent conditions, behaviours learnt via classical conditioning are not maintained by consequences. This is unlike the process that takes place in operant conditioning,

With many new experimental and analytical tools having been developed in modern psychology, behaviourism is now widely seen as a somewhat naive and primitive forefather of the relatively mature field of psychology that exists today. On the other hand, it is necessary to study Pavlov's and Skinner's functionalistic views on conditional reflexes, which were essential in fostering modern interdisciplinary approaches to religion (see next section). Both behaviourists stressed evolutionary value dependences, explaining how these assisted organisms' in adapting to changes in their environments, which was useful for their well-being. Their ability to learn how to predict unwanted events could help them protect themselves, as the conditioned fear to a specific situation could become a permanent automatic response.

It is also equally important to value Skinner's contribution to a systematic approach in psychology. By starting some systematic empirical work with the investigations performed with pigeons, Skinner's work contributed greatly towards a psychological understanding of socially shared beliefs, since he provided an important key to the genesis of private superstitions. This refers to the kind of individual superstitions that can predominantly be displayed in the form of either superstitious and/or religious rituals (i.e. the use of amulets, prayers, repetition of behaviour associated to luck; Jahoda, 1969; Vyse, 2013). While behaviourism's views on these complex and multifaceted psychological phenomena were constrained, the work that was done within its paradigm helped shed light on the quantitative study of private rituals.

1.4. The Modern Psychology of Religion

From its origins in the 1950s up until present times, cognitive psychology has remained active and productive within the field of psychology contributing to advances in various subfields such as perception, memory, language, and decision-making. Its continuous and successful

development helped its horizons. This was manifested within the subsequent cognitive approach to the study of emotions and consciousness; perhaps two of the most convoluted and abstract topics in the science of the mind, given their strong influences upon the psychological aspects mentioned above (Blackmore, 2003).

Another subject that is equally influential and complex, although more controversial, is religion. This is primarily because it also represents multiple topics which relates to and are influenced by other psychological aspects. Different views and theories about religion, from scientific and non-scientific perspectives, are a constant source of heated debates between religious and non-religious believers. Presently, both social and cognitive science have yet to find a general consensus regarding a decisive theory of religion. Even the scientific community, just a few decades ago, would have thought that the pursuit for a general theory of religion explained in terms of universal cognitive processes was foolhardy. But unlike rather stationary theological views, scientific theories concerning religion have developed psychological aspects, but most importantly, it is also exhibited universally whether it is faithfully, vaguely, socially, and/or individually. Notwithstanding its many difficulties and resistance, the study of religious thoughts and behaviour under the cognitive and evolutionary sciences perspective also followed later (further covered in next section) and initial steps towards establishing a cognitive psychology of religion were taken by the cognitive scientists Dan Sperber (1975) and the anthropologist Pascal Boyer (1994, 2001).

In addition to the complications resulting from its controversial nature and resistance to its study⁵, a scientific approach towards religion is also largely affected by obstacles presented by parallel aspects of religion, such as spirituality and superstition. These seem to share the same cognitive foundations and frequently overlap with the tenets of religion, making it far harder to differentiate and understand them (see Chapter 6). Moreover, religion (as well as the arts) is frequently understood to be describing the highest forms of morality, which often impedes scientific progress (Pinker, 1998). Notwithstanding the many difficulties and resistance associated with its study, work upon religious thoughts and behaviour from the perspective of the cognitive and evolutionary sciences followed later (Emmons, & Paloutzian, 2003).

According to Hogg and Vaughan (1995), the 1960's and 1970's reflected a period of decay and pessimism in the attitude towards research conducted on attitudes, values, and beliefs (i.e. religious and superstitious beliefs), at least in part due to the apparent failure to find any reliable relationship between beliefs and personality. The panorama of all these phenomena remained relatively ignored, in contrast to the revolution occurring in the rapidly developing cognitive sciences during the same period, where isolated cases of brain injuries and exceptional clinical circumstances began shedding great light on human cognitive functioning.*

A specific finding was a turning point for the study of beliefs when Gordon Allport demonstrated a relation of religiousness to racial prejudice (Allport 1954; Allport & Ross, 1967). Following this lead, research in beliefs grew in great measure thanks to the cognitive approach,

⁵ A recent example of opposition is the pseudoscience inherent within the theory of intelligent design, a recent model of creationism based upon a teleological argument disguised and sold as a science. It was created by creationists in U.S. as an alternative to evolution, and it is currently taught in early elementary education in some areas of the U.S., and gradually making its way to public schools. Advocates of this model often defend and promote religious principles while dismissing evolution theory (Dawkins, 2009).

primarily given its far less expensive and accessible techniques, lab-work, equipment and disposable supplies (i.e. electroencephalogram-derived event-related potential technique used in the third study; see Chapter 4), compared to the fairly expensive fMRI, or the exorbitantly expensive PET. This new approach had a great impact in the field of Social Psychology, complementing several topics and establishing new areas of investigation. It contributed to and expanded knowledge about human cognition without needing to rely upon fortuitous and extremely rare cases such as the accidents that befell Gage and HM.

1.4.1. Cognitive Science of Religion

As authorities on the cognitive underpinnings of religion (McNamara, 2001; Barret, 2007) have pointed out, the scientific study of religion benefitted enormously after it took a different path. Instead of looking to provide a general account of religious experiences, a group of researchers started focusing more on the analysis of relatively well-defined components of religious behaviour (i.e. prayer, rituals, belief in god) (Lawson, & McCauley, 1993; Boyer, 1994). This change in perspective and methodology helped shape a new paradigm in the study of religion and was termed as the cognitive science of religion (CSR), firstly coined by E. Thomas Lawson a few years later (2000). The main objective of the CSR is to tackle questions revolving around the acquisition, recurrence, prevalence and continued universal transmission of both religious concepts and behaviour. The following details two aspects that this thesis work considered essential for the scientific study of religion and related beliefs and thus were used as a basis for the research developed in within; the executive functions, a cognitive system that can be used to further investigate important cognitive insights of religion; and the belief valence, and the importance of its emphasis in research.

1.4.1.1 Executive Functions and Religious Cognition

The paradigm switch mentioned above represented an essential step for the advancement of the scientific study of religion, religion benefited greatly from neural and cognitive sciences. The adoption and application of experimental methods such as neuropsychological tools (i.e. cognitive computerized tasks) and electrophysiological methods (EEG) signified important changes deriving from the neuroanatomical localization of a wide range of its cognitive components (i.e. basic processes of religious cognition). From all the identified cognitive processes, a specific cluster turned out to be of special interest for religious researchers- the executive functions (EFs).

The EFs are a theoretical construct of “higher-level” cognitive functions, such as mental skills, which include those associated with planning/execution (Chan, 2008), abstract problem solving (Monsell, 2003), and emotional regulation (Oschner, & Gross, 2005). The EF terminology began to be used primarily in clinical cases due to their ability to systematically describe and evaluate a series of behaviours and performance (Fuster, 1985). Given their clinical value as a set of diagnostic criteria, their use has been consistently increasing in clinical psychology and neural sciences. When EFs are greatly impaired in an individual, behaviour becomes poorly controlled in most cases. For example, EF impairment can greatly affect an individual’s ability to function independently, maintain appropriate social relationships, and function thoroughly in school or at work. Prominent cognitive researcher Michael Posner (1990) was the first to propose separating and grouping the EFs as a special branch of the attentional system, dedicated to focusing attention on certain aspects of the environment. Later on, advances in research concerning executive functioning shed further light into its localization. (EF) deficits

were invariably spotted in cases of prefrontal lobes dysfunctions. More specifically, they were present in cases where the anterior cingulate cortex (ACC) and the dorsolateral prefrontal cortex (DLPC) were affected, whereas other higher cognitive functions (i.e. language and memory) were virtually unaffected in the same individuals (Cummings, 1994; Fuster, 1989; Shimamura, 2000). It was generally held that these prefrontal lobe areas were greatly responsible for the mediation of EFs.

Similar to EFs, it has been well established that the frontal lobes specialize in mediating processes that are inherent and integral to any religion, or to any neighbouring belief such as pro-social behaviour, especially with regards to emotional processing. Consistent electrophysiological and functional imaging (PET activation) evidence pinpointed the right and left frontal lobes as being responsible for mediating negative and positive emotions, respectively (see review in Bear, 1983). This evidence lead researchers to assume that that part of the brain had to be critically involved in fundamental aspects of cognitive processes related to religion, and consequently to EFs also. With the evidence collected so far there is a strong indication that the frontal lobes are involved in fundamental aspects of processing religion and related beliefs. However, it is imperative to mention that even though it has been widely confirmed that the frontal lobes are participating in almost all of the EFs, they are not the only brain structure mediating them (Alvarez, & Emory, 2006). It is thus safe to assume that any complex phenomenon such as religion or a related belief system cannot be entirely mapped to a specific part of the brain. Given their importance within the cognitive processing related to emotion and the intimate connection of emotions to religion, EFs represent a key cognitive construct within this thesis work; three of the four studies presented here will be relying directly on EFs for the formulation of their hypothesis (see Chapter 3, 4 and 5).

1.4.1.2. Psychological Correlates with Superstitious/Religious Beliefs: Importance of Value-laden belief

Influential theoretical work in the area of superstitious beliefs viewed superstitious thinking within the context of the initiation and maintenance of maladaptive beliefs and behaviour. For example, the superstitious belief of luck was originally categorized within irrational belief theory (Ellis, 1994). Within this theory, luck has an external, unpredictable and uncontrollable influence upon individuals who believe that many aspects of life are attributable to chance, forming the basis of emotional distress (Ellis, 1994). In this view, believing oneself to be lucky or unlucky was not psychologically differentiated. The result of this tendency of focusing on negative beliefs can be observed in the Paranormal Belief Scale (Tobacyk & Milford, 1983; Tobacyk, 1988), which according to Goulding & Paker (2001), corroborated as the most widely-used measure of paranormal belief, and which items from its superstitious sub-scale are all negative oriented (i.e. ‘The number “13” is unlucky’).

However, there is a line of research (Taylor, 1989; Wiseman, 2004; Damisch et al., 2010) that emphasises on the value of a given belief (i.e. believing in good luck and believing in bad luck). These studies underlined the need of expanding this theoretical understanding and take into account both positive and negative beliefs. Furthermore, beliefs in being lucky were correlated with better mental health, optimism, greater control and self-efficacy during tasks (Darke & Freedman, 1997a, 1997b; Maltby, Day, Gill, Colley, & Wood, 2008). Performance enhancement when promoting lucky thoughts (via boosted self-efficacy) was also found in individuals given a variety of simple tasks to complete (Damisch, Stoberock & Mussweiler, 2010). For the construction of the Belief in Luck scale, a more recent distinction has been made

between a perception of being lucky (beliefs in good luck) or a perception of being unlucky (beliefs in bad luck) (Darke & Freedman, 1997). With the latter found to be associated with emotional distress, in terms of both hedonic and eudaemonic well-being (Maltby, Day, Gill, Colley & Wood, 2008), as well as with deficits in executive functions (EFs) (see Section 1.4.1.1) at a behavioural level, in what is considered as the basis of the Dysexecutive Luck hypothesis (Maltby, Day, Pinto, Hogan & Wood, 2013). Furthermore, a study within this thesis provided evidence that supports this hypothesis at a physiological level (see Chapter 5 for a full report of this finding). This collection of research suggests that positively oriented beliefs may actually be psychologically adaptive, conferring variety of positive psychological effects; however negative oriented beliefs can lead to psychological deficits (i.e. believing to be lucky rather than to be unlucky; or believing in a generally righteous god, rather than in an atrocious deity).

In addition, there is a history looking at individual differences in religion that have concentrated on personality characteristics or coping, which started to substantiate and give insights to the underlying cognitive mechanisms of distinct groups of religious believers. For instance, Sica et al. (2002) showed a correlation of greater OCD-related symptoms and cognitions with high and moderate levels of religiosity in Catholics, in relation to less religious Catholics. In addition, Abramowitz et al. (2004) corroborated the previous finding in a Protestants sample. Moreover, Rassin and Koster (2003) revealed in a group of Protestants a correlation of stronger religiosity levels with a greater tendency to consider thoughts as morally equivalent to actions, in comparison to Catholics, Atheists and other religions members. Lastly, Abramowitz et al. (2002), found a greater fear of God and sinful thoughts in highly religious Protestants when compared to Catholics, Jews and in less religious Protestants as well. All these results strongly suggest both the type of religious affiliation, and level of devotion (religiosity),

can correlate to cognitive biases. These outcomes occurring in conjunction are highly significant; they lead to the premise that a given religious belief can have correlations with personality factors.

1.4.2. Neuroscientific Research: Evidence for Causal-Reasoning

Risberg & Grafman (2006) have discussed the neuropsychological nature and function of religious beliefs: "Our religious thoughts are regulated by areas of the brain that have evolved over time and which also perform other functions. Those functions are closely related to the emotions and the memory." "Religious experiences form a small part of a wider cognitive process, which cannot be separated from it." However, as pointed out earlier (see Section 3.3.1), there are still unexplored gaps within a possible cognitive and neuroscientific approach to religion and superstition, leaving experimental cognitive and neuroscience processes underutilised in the area of beliefs. For instance, no study to date had focused exclusively on the interaction of specific cognitive processes, such as attentional bias, and beliefs. This acted as a driving force for the creation of a 'religious' Stroop (see Chapter 3), a cognitive task adapted to religion. If it had produced significant outcomes, it could have easily led to the integration of an electrophysiological paradigm, in the same vein as the line of research concerning the Dysexecutive Luck Hypothesis (see Section 4.4.1.).

A line of neuroscientific experiments using a variety of brain imaging techniques (i.e. event-related potentials, positron emission tomography and fMRI) helped researchers begin understanding how the brain responds during a range of complex reasoning processes such as decision-making, problem-solving, analogical reasoning, and inductive and deductive reasoning (Goel & Grafman, 2005; Colvin et al. 2001; Fincham et al. 2002; Wharton et al. 2000; Kroger et

al. 2002; Goel & Dolan 2000; Seger et al. 2000; Osherson et al. 1998; Parsons & Osherson 2001; Goel & Dolan 2003). This group of studies gave substantial evidence supporting earlier ideas that presumed an instinctive need for a causal reasoning in humans, who are strongly selected to infuse order into their surroundings and recognize patterns of regularity even in situations where there are none (Vyse, 1997; Gawande, 1999; Gilovich, 1993; Neuringer, 1986). This reasoning can be observed in a variety of scenarios involving human behaviour, which revolve around believing in luck and the rejection of random events, or white noise. For instance the gambler's fallacy is a cognitive bias which is commonly displayed in players when they mistakenly believe that independent trials in a random process (i.e. casino roulette) are really interconnected; for instance, believing that the probability of a red number is greater after a long sequence of blacks. Similarly, in the world of sports there are two well-known fallacious beliefs referred as the "hot hand" and "streak shooting." The first leads spectators to believe that a player has a greater chance of hitting a shot after two or three successful shots, rather than one or more misses. The second is the tendency of fans and players alike to believe that they are able to predict the outcomes of a shot after seeing previous attempts to make it (see Gilovich, 1985).

The examples described above, suggesting the need that humans have for an ordered world, are in line with recent avenues of neuroscientific research which suggest that people react more strongly to uncertainty and the unknown than to negativity (Hirsh & Inzlicht, 2008; Tritt, Peterson, & Inzlicht, 2011). These findings led to further research conducted on the basis that emotional needs drive people to give meaning to their lives and world, and explained how greater meaning can improve general well-being and health, supporting the "motivated meaning-making" model of religion (Inzlicht et al., 2009; Inzlicht & Tullett, 2010; Tullett et al., 2011; Inzlicht et al. 2011). The model holds the functioning of religion to be an anxiolytic that aids in

stress alleviation, due to the integrative network of beliefs, goals, and the perception of the environment that it creates. It could be said that some of the most adept scholars of religion are the creators of the motivated-meaning set of beliefs, given that they have already understood religion's role in giving meaning to life, and have observed the human need to feel as though they have a sense of control, which is obtainable by structuring the outside world according to religion (James, 1902/2002; Durkheim, 1912/1954; Freud 1939/1955).

1.4.2.1. Neural Localization of Beliefs: Functions of the Anterior Cingulate Cortex

After the paradigm shift within the study of religion and its derived major accounts (i.e. the meaning-making account) that treated this phenomenon as a complex scientific subject, the search for the parts of the brain responsible for these kinds of beliefs was the next step. The anterior cingulate cortex (ACC), the frontal part of the Cingular cortex, was identified as the part of the brain associated with the palliative functions of religion (Inzlicht et al., 2009; Inzlicht & Tullett, 2010; Tullett et al., 2011). This finding was achieved by using the Stroop-colour naming task (Stroop, 1935, MacLeod, 1991) as the primary methodological tool in a linked series of EEG investigations, ultimately providing substantial evidence for neural markers of religious conviction.

Moreover, within the set of studies focused on investigating the evolution and functions of causal thinking (see previous section), there is a particular study that directly links religion and superstition to this area of the brain, providing evidence on how humans can respond differently when facing evidence that is either consistent or inconsistent with their beliefs (Fugelsang and Dunbar, 2004). The study's results showed that when someone was presented with evidence that was consistent with their beliefs, there was significant activity in certain brain

regions (caudate and parahippocampal gyrus), which are widely associated with learning and memory formation. In contrast, when evidence inconsistent with their beliefs was shown it activated the Anterior Cingulate Cortex, Posterior Cingulate and the Precuneus, brain regions that are widely associated with error detection and conflict resolution. By demonstrating that there is a tendency to accept information that is consistent with our worldview, and a contrasting tendency to reject explanations that oppose this worldview, these findings provide neural evidence for the behavioural interactions between beliefs and evidence.

1.4.3. Intradisciplinary Approaches of Religion and Superstition

Psychologist and religious theorist pioneer William James (1902) suggested that the diversity of cultural folkloric factors comprising religion, such as rituals, creeds and trappings work as distractors that divert the attention from the understanding of its root phenomenon. Furthermore, significant sociohistorical events where religion played a fundamental role (i.e. crusades), might have generated an academic study of religion that was unidisciplinary emphasised on a historical perspective, which studied it on a social ground, rather than a natural phenomenon, resulting in a very limited knowledge of religion (Pinker, 1998). A reductive approach to such a complex construct such as religion would inevitably fail. It took various decades for psychology of religion to undergo a necessary dynamic paradigm shift. An important goal within this thesis is thus demonstrating the best way to develop the study of both complex intermingled psychological constructs is within an intradisciplinary approach and their multiple derived methods.

The paradigm shift in the psychology of religion and superstition resulted in its multidisciplinary active study, triggering a development of different interdisciplinary pathways

for the understanding of religion and superstition. Presently, many fields of psychology including neuroscience, cultural anthropology, and archaeology have departed from the older social sciences views, proposing an entirely new set of critical terms for an intradisciplinary understanding of almost all areas in psychology, including the origin and functions of religiosity and superstition. For example, the evolutionary paradigm (Buss, 1995; Tooby & Cosmides, 1992) which integrated a myriad of perspectives on religion offered by social sciences and psychological sub-disciplines. The evolutionary approach provided in turn a metatheoretical framework to the CSR (Andresen, 2001; Barrett, 1998), with a core theme that explains religion and its cultural parallels are a natural product of the human mind, this primary premise derives from the view that our brains consist of a complex array of innate cognitive processes (mental modules), in which each mental module functions as an adaptive problem solver faced by a given evolutionary context. Other interdisciplinary paths are the neurobiology of religious experience (Brown et al., 1998, McNamara, 2001, Newberg et al., 2001), and behaviour genetics (D'Onofrio et al., 1999).

1.4.3.1. Evolutionary Psychology: Beliefs as By-products

A full accordance regarding the theoretical basis for CSR research is yet to occur. Although there are theories developed within an evolutionary psychology framework that make possible to outline significant tendencies (i.e. the study of the components of religious behaviour) and work as the theoretical basis bridge to CSR (Boyer, 1994, 2001; Barrett, 1998).

According to the father of the interdisciplinary field of sociobiology, Edward O. Wilson (1998), religion is a product of evolution. The main basis for this view is that religious beliefs are universal (Wilson, 1999). Wilson argued that if the emergence of such beliefs, and its related

thoughts and behaviour, could be understood from an evolutionary perspective, the process of devising its study would also benefit from the study and comparison between religion and certain animal behaviours. It represents one of the first attempts towards integrating a complex psychological construct into an interdisciplinary research paradigm. However, religious (and superstitious) beliefs represent major concerns for behavioural ecology, given that some beliefs can represent high fitness costs to the believer (disadvantages) that are not outweighed by any obvious benefit (i.e. celibacy). With the goal of solving why certain beliefs have evolved and persisted despite this apparent contradiction, Beck & Forstmeier (2007) described a model that viewed these phenomena as inevitable by-products of an adaptive learning strategy, within those organisms that are capable of learning from associations. The model explained the persistence of these phenomena as the consequence of “an interplay of costs between superstition and ignorance on one side, and a worldview based on individual experience, cultural transmission, and genetically fixed bias on the other hand” (Beck & Forstmeier, 2007, p.43). Since the latter is a dynamic construct affected by many factors, it is implied that beliefs can be significantly influenced within this model by learning processes (but not determined).

The idea that beliefs can be self-created and maintained primarily via a learning process is not entirely innovative. It was first presented within a behavioural approach, in which Skinner explained superstitious behaviour as a product of conditioned learning (i.e. with the use of pigeons in an experiment (see section 1.3.2.)) Although beliefs are intrinsically linked to learning from observations of coincidence (associative learning) and can indeed originate from this learning process, it is not so entirely straightforward. Within this model of beliefs thus, learning is now an important factor among other multiple sub-factors, rather than an isolated mechanism. Furthermore, Beck and Forstmeier’s (2007) model predicted that in the long run organisms face

a trade-off between a failure to detect a pattern that actually exists (colloquially referred as ignorance), and erroneously seeing a pattern where there is none, and only seeing randomness (or where scientific consensus says that there are none), which is the basis of magical thinking. Learning organisms would need trade-off rules to distinguish these two circumstances. These rules have been compared to the distinction that is made in statistical analysis, when setting the levels of alpha for rejection of the null hypothesis (i.e. committing a type II error would be equivalent to being ignorant, whereas making a type I error would mean being superstitious; Dawkins, 1998: pp. 160-179). More importantly, the model is not limited to being just a hypothesis; there is actual neuroscientific research which forms the basis of confirming the model's trade-off belief, demonstrating at a physiological level how brain responses vary depending on the information that they are receiving (Fugelsang and Dunbar, 2004).

1.5. Conclusions

There is not a single definitive explanation for superstition or religion, and it is quite likely that this is far from happening. As examined throughout this chapter, superstition and religion are affected by a variety of other human behaviour aspects. This special interaction turns these phenomena into the most complex of all psychological constructs. However, for several years the study of magical-religious beliefs was overlooked in science, or at best was studied using a rigid one-dimensional approach. In recent times, the psychological study of superstition and religion has developed identifiable subfields of the discipline, constantly growing in recent decades. They are currently as vast and complex as superstitious or religious life themselves. There have been frequent attempts to provide an overview of the research conducted so far. For instance, several books exist that are dedicated to summarizing the work done within these various fields, in order

to promulgate their findings and ensuring that they flourish (Andresen, 2001; Boyer, 2001; Emmons, 1999; Fuller, 2007; Hill & Hood, 1999; Koenig, 1998; Miller, 1999; Pargament, 1997; Richards & Bergin, 1997; Shafranske, 1996; Vyse, 1997; Seybold, 2007). Furthermore, we can confirm now that we usually refer to as religions and superstitions are multidimensional constructs intertwined with several psychological constructs. It is well known that superstitious and religious beliefs have strong effects upon an individual's personality, interpersonal functioning and performance. As intrinsic parts of human behaviour, these are extremely complex psychological constructs.

It is also known that there is a strong similarity between superstition and religion. These sets of beliefs are not distant of each other in terms of occurrence (consistent demographics), the way they operate (i.e. ritualistic behaviour), functionality (e.g. boosting self-efficacy, relieving anxiety), transmission (verbal communication) and acquisition (experience), and which in turn are additionally influenced by both cognitive and social factors (Boyer, 1994). In fact, both phenomena are likely to be more than just cultural neighbours, or belonging to a loose family of phenomena that is formed by several cultural and psychological phenomena, likely deriving from a common origin, a general 'belief engine' (Shermer, 1998). In this vein, religion is not *just* superstition, but it can be a form of superstition that, unlike superstition, is based on well-developed theologies that tend to make irrational behaviour as rational. This is why researchers concerning superstition and religion should be especially cautious against reductionist tendencies, and encourage treating them as independent constructs, without overlooking at their similarities.

Major varying perspectives on the history of the scientific study of religious and superstitious beliefs (emphasising on belief around luck) are described in this chapter. When looked within an intradisciplinary context, many of the views and findings presented do not necessarily contradict, but are rather complementary. As Jahoda pointed out (for human behaviour) “there are bound to be numerous ways of discovering orderly patterns among its multitudinous facets” (1969, p. 72), suggesting that the best way to approach both phenomena would be to consider the most important findings from varying perspectives. In this vein, the following four chapters will discuss in detail each of the four studies that were carried out using a dynamic methodology that included self-reported scales, computerized tasks, EEG derived techniques, and performances derived from manipulated conditions.

Chapter 2 presents a study that aims to approach magical-religious behaviour through an idiosyncratic mechanism, in order to confirm a causal effect on performance. A condition related to religion was created to test whether it enhanced performance if activated via a boosted psychological mechanism. The idea to manipulate a particular variable was inspired by -the Damisch et al. experiment (2011), within which superstitious conditions related to good luck were created as experimental conditions via a range of idiosyncratic procedures. With its obvious similarities, this study aims to act as a religious homologue to the superstitious-activated condition experiment.

Chapter 3 is dedicated to an investigation that aimed to use a cognitive approach to find whether religiosity levels can be displayed in the form of an attention bias or an inhibition effect, when comparing religious and low-religious individuals. For this, a modified version of a verbal Emotional Stroop Test was made and converted into a ‘Religious’ Stroop. Even though there

were no significant findings resulting from this particular study, the purpose and constructed methodology represent one step forward in the application of cognitive bias research towards religious beliefs.

In Chapter 4, a third study is reported. Dysexecutive Luck findings, namely a belief in being unlucky correlation with EF deficits, lead to what is the most noteworthy experiment within this thesis. A main behavioural task (i.e. the Stroop task) was created for an Event-related Potential study to examine whether there were any differences between believers in being unlucky and a control group. The obtained results suggest the Anterior Cingulate Cortex (ACC) as a key brain structure involved in such beliefs, providing thus an initial electrophysiological lead supporting the Dysexecutive Luck hypothesis.

Chapter 5 presents an exploratory study that incorporates both religious and luck subfactors seen from their respective scales, with the aim of investigating their relationship with EFs, as well as with wider EFs that have been recently identified in a recent measure for an emotional control scale.

Overall, the current chapter suggests and promotes a need for a dialogue and collaboration -increase between different perspectives, in order to benefit and continue the evidenced progress in the psychology of religion and superstition. In conclusion, all the experiments conducted and presented in the following chapters represent a systematic attempt to support the view of religion and superstition as dynamic psychological constructs, furthering an interdisciplinary understanding of both phenomena cautious against reductionist views to both phenomena.

PART II: INTEGRATION OF RELIGION TO COGNITIVE PARADIGMS

CHAPTER 2: Evidence of a Performance Effect from a Religious Practice

“We are all creatures of habit, and when the seeming necessity for schooling ourselves in new ways ceases to exist, we fall naturally and easily into the manner and customs which long usage has implanted ineradicably within us.”⁶

Abstract

Ritualistic behaviour is a fundamental part of both superstition and religion. Despite the similarities between superstitious and religious rituals, religious practices have been generally treated as though they were a dissimilar phenomenon from their superstitious counterparts (Maranise, 2013). This study attempts to test the similarities between the effects of ritualistic behaviour for both beliefs, in terms of acting as psychological placebos (producing a mind-body effect). This current study is primarily inspired by the design put forth by Damisch et al., (2010). It consisted of an idiosyncratic procedure that required the creation of a new lucky superstition through the use of a lucky charm, which led participants to confirm a performance boost in subsequent tasks. It was also able to identify a heightened feeling of self-efficacy as the underlying psychological mechanism for the gains in performance that were produced. Thus, this

⁶ This quotation came from Burroughs (1916, p. 228)

paradigm was emulated by creating a parallel experimental design that aimed to use a religious homologue to a lucky charm (i.e. a religious amulet). By looking at how similarly (or dissimilarly) both religious and superstitious rituals function under specific controlled conditions, namely with regards to the performance assessment on a subsequent task, this current experiment allow to observe in an indirect way (comparing only the general outcomes, not data, with Damisch's et al. study) whether these two types of ritualistic behaviour can work under the same principles and produce thus similar effects. Results indeed showed that religious participants performed significantly better than a control group on simple tasks such as decoding anagrams, although the self-efficacy boost found in Damisch's et al. study was not replicated.

2. 1. Introduction

As it was previously outlined in the first chapter of this thesis, the psychology of religion has undergone many significant changes since its beginnings. To summarise, the study of religion has seen several paradigm shifts across the life of the discipline, from being approached through the lens of a single disciplinary paradigm at the beginning of the 20th century (i.e. when it was generally viewed as an exclusive social science subject of study with few advances in the stricter, data-based spheres), to what Emmons and Paloutzian (2003, p.395) have in recent times referred to in their *Annual Review of Psychology* as a *multilevel interdisciplinary paradigm*. The reasons behind these successful developments in the psychology of religion were mostly due to increasing collaboration and dialogue with several related disciplines also studying religion (i.e. biology, neural sciences, philosophy, anthropology, and cognitive science). This led researchers away from treating the study of religion as an isolated topic, considering it instead to be a topic which spans virtually all aspects of psychology, which in turn allowed the integration of a variety

of experimental tools from its maturing sister fields and helped shed more light on its etiology and maintenance.

A primary limitation during the development of the study of multifaceted beliefs such as religion, spirituality, and other related magical-religious beliefs (i.e. beliefs around luck) was a general focus upon only “negatively” valenced beliefs. For instance, the approach towards luck as an entirely negative superstition (i.e. what were the psychological negative outcomes from believing in bad omens), considered these beliefs as primarily maladaptive traits. A belief in luck was previously generalized and categorized within irrational theory, associated with emotional distress, and any possible psychological advantages that it could confer were overlooked (Ellis, 1994). The Paranormal Belief Scale (PBS; Tobacyk & Milford, 1983; Tobacyk, 1988), which focused solely on negative items and omitted any possible related beliefs, is a good example of this trend towards “generalization” and an example of the incompleteness of the research conducted upon beliefs, a major error when taking into account the diversity of outcomes that makes these phenomena so complex. Furthermore, there are findings highlighting this problem, which have already reported that psychological correlates of paranormal, superstitious and magical belief vary depending on the valence of a given belief (i.e. whether it is a positive or negative related belief) (Wiseman, & Watt, 2004; Damisch et al., 2010).

For this reason, in addition to perusing investigations involving its current multidimensional approach, this thesis work also proposes to advocate the views from authoritative works on the subject (Vyse, 1996; Jahoda, 1969), which aim to suggest that the study and comparison of religion, when compared to other similar beliefs and their outcomes, derives results that are highly beneficial for the study of religion. From this point on in this

thesis, there is a constant emphasis on treating religion and superstitious beliefs as parallel phenomenon. Since they are considered to share a magical-religious thinking basis, it is hypothesized that both might produce common effects. For instance, this study in particular compares the outcomes of religious practices to other similar practices that are present in historically separated beliefs (i.e. the religious and superstitious practice of carrying an amulet). The purpose is to be able to demonstrate that there is a diversity of beliefs that have magical-religious thinking as their basis, as well as further the idea that the study of religion also benefits from the study of other beliefs.

If we are treating religion (and its outcomes) as a multifaceted belief system parallel to superstitious beliefs, we have to assume all these beliefs operate with similar underlying psychological mechanisms. A psychological phenomenon that well represents the multifaceted and complex nature of belief is the placebo effect. This study trusts upon the placebo effect as the general underlying mechanism behind the outcomes of religious and superstitious behaviour.

2.1.2. Social Attitudes and Effects on Health

This study thus represents an attempt to investigate a connection between physiological functions and behaviour associated with religion, or social behaviour, at an experimental level. As will be later detailed (see Section 2.1.4), it explored changes in performance resulting from the use of a specific social religious ritual (i.e. the use of a religious amulet). There have already been several hypotheses in the literature regarding this effect. For example, in non-humans primates, social activities can be observed that resemble medical care and result in an improvement on health (Frijda, 2000). In the case of humans, it was revealed that grooming stimulates the release of beta-endorphins causing a relaxing sensation (Keverne et al., 1989), similar to the positive

placebo effects observed in clinical settings. This sequence of events could be interpreted as a latent need for the presence of a trusted healer person within a social group. Possibly commencing with a grooming partner in early hominids, followed by a shaman in primitive human societies, and finally with medics in the present day society. Health management must have evolved in a social context among different group of hominids given its advantages.

Following this line of reasoning, we can infer that physiology and social attitudes are deeply intertwined and often go hand-in-hand. Its underlying mechanism may be witnessed when individuals with high hopes, who put their trust within a trusted member of the group and undergo medical procedures, are rewarded with health advantages. The presence of a special character with these characteristics has been present in societies dating back to prehistory. Across time this specific individual has been a key element in the evolution of human societies, being a respected member whether in a small tribe or a highly developed society. The very act of caring and curing reinforces a pattern that improves patients' health outcomes (Kaplan, Greenfield, & Ware Jr, 1998).

As explained in Chapter 1, there is no universal consensus upon an absolute definition of superstitious beliefs. Moreover, there seems to be a thin and fuzzy line separating superstitious/religious beliefs from casually acquired beliefs (Vyse, 1996). Although precise and scientific dictionary definitions for intricate phenomena, such as superstitions, cannot be blindly trusted, a consensual agreement regarding its roots would aid in forming a starting point to detect and attempt to approach it using the scientific method. Jahoda (1969) emphasised that an emotional element lay at the root of superstitious thinking, and proposed that the potential to have any appreciable influence on behaviour (i.e. a psychological placebo) is the key attribute that can help researchers classify casual beliefs and superstitious/religious beliefs separately.

2.1.3. Superstitious Rituals in Sports Research

The world of sports is a particular niche that has proved to be universally prolific in superstition. The use of superstitious behaviour (SB) in athletes is a widespread phenomenon and has become increasingly popular, especially at an elite level. Anecdotes of superstitious rituals are practically endless, from simple rituals to bizarre actions that verge on obsessive-compulsive behaviour. There are instances involving lucky clothes- Michael Jordan wore his North Carolina college shorts underneath his National Basketball Association shorts in every single game throughout his entire career (Damisch, 2010; p. 1014). There are rituals involving lucky food- Major League Baseball hall of famer Wade Boggs noticed an ostensible causality between his multi-hit games and his consumption of poultry, and began eating a meal of chicken before every single game (Vyse, 2013, p. 4); others involving entering the field in a special way or in a particular sequence- top basketball player LeBron James always tosses moisture-absorbing chalk into the air prior a game. Lastly, one superstition involves avoiding mentioning certain things, fearing that a winning/good result streak would be ‘jinxed’ and finished (Howie, et al., 2011, p. 187). These are a few notorious cases of superstition in sports, but the list could go on and on (see Vyse, 2013 for more examples).

This many anecdotal accounts of superstition in sports have permitted the study of different variables involved in superstition outside clinical scenarios. For the purposes of this study, several findings within sports science literature, in conjunction with clinical studies such as the aforementioned Fabbro et al. (1999), have led researchers to conclude that there is indeed a well-sustained positive correlation between superstition and psychological benefits, which in turn would be translated into a tangible and substantial improvement of performance. Several findings further elaborated on the matter, and took into account different variables within the

sport, including the skills of the player and the presence of possible dynamics with the opponents. One finding concluded that the extent of ritual commitment is highly influenced by the presence of psychological tension. In other words, a tendency or an augmented need to enact a superstitious ritual occurs when uncertainty is higher, due the importance of the event (i.e. greater in a crucial game) and/or because of the adversary (greater against a superior opponent), with the ritual playing a mediating role that eases psychological tension derived from these external circumstances (Schippers and Van Lange, 2006). Similarly, Buhrmann and Zaugg (1982) found a positive correlation between superstitious beliefs and performance among competitive basketball players, their work showed that superior teams as well as superior players within a team, exhibit more superstitious behaviours. Additionally, it was also confirmed that a higher degree of religious involvement (religiosity) played a part in fostering superstitious beliefs among basketball players, indicating that these beliefs can regularly work together without conflict, despite the social separation. Becker (1975), and Neil (1980), proposed that superstitious beliefs have a psychological function as a placebo, working to reduce levels of anxiety and helping to build confidence (Van Raalte, Brewer, Nemeroff, & Linder, 1991). A theory for the general functioning of superstitious beliefs was outlined by Lahey (1992), who proposed that superstitions might be created in hindsight by attributing random events before performance with successful outcomes. Later on, Womack (1992) suggested that athletes use superstitious behaviours to achieve an optimum performance, maintain emotional stability, control stress and anxiety as well as danger.

Similar to the failure to differentiate between superstitious/religious beliefs and casual beliefs, researchers studying sports frequently fail to differentiate between superstition (namely rituals), and similar behaviours such as pre-performance routines, because both involve formal

and repetitive mechanical motions that are practiced prior to a game, or during a key event in the game (i.e. repeating the motion of a free-throw without the basketball prior the shooting). However, it is important to highlight that there are also important dissimilarities between both behaviours. The confusion between these can be clarified when the specific functions and expectations that performing the action holds for the athlete are taken into account; Foster, Weigand and Baines (2006, p. 167) summarized: “essentially pre-performance routines differ in that they involve cognitive and behavioural elements that *intentionally* help regulate arousal and enhance concentration (Crews & Boutcher, 1986) and thus induce optimal physiological and physiological states (Cohn, 1990).”. This view is in agreement with the uncertainty hypothesis, which states that individuals who tend to exhibit superstitious behaviours express little confidence in the fact that it will actually affect the outcome, using it instead as means to exercise some control over uncertain events (Malinowsky, 1954). This hypothesis was tested and sustained recently in superstitious baseball players (Burger & Lynn, 2005). It helped establish that a potential influence on emotions is the sustained fundamental element for the classification of superstitious and religious beliefs, and consequently generates a formal distinction that helps researchers avoid confusing with emotionally irrelevant casual beliefs, or any other similar behaviour. Overall, this distinction helps illuminate the path for this study which aims to examine whether religious practices can alter performance in the same way superstition does, contributing insights for the performance effects from practices related to magical-thinking.

2.1.3.1. Lucky Beliefs as Experimental Variables in Research

Jahoda (1969) offers a good overview of the implications of outcomes resulting from superstitious beliefs, pointing out they ‘are not just things inside people’s heads.’ He remarks that they have tangible consequences and can directly affect behaviour. For example, witchcraft resulted in the tragic death of numerous victims in the middle ages. There is a widespread superstitious belief in Western countries with regards to the number ‘13,’ and similarly in many East Asian countries it is normal to avoid instances of the number ‘4’ (tetraphobia), buildings usually lack the 4th floor, the rationale behind this is because its pronunciation conforms closely to the word for ‘death’ in Chinese language. In Japan the same occurs with the number ‘9,’ which sounds similar to the word for ‘suffering.” Jahoda invokes an imaginary exercise that helps us comprehend this complex process operating behind these casual sequences, which is that if a considerable number of individuals strongly believe that Friday 13th is unlucky, this belief might work to alter their behaviour on that particular day, making them more anxious or jumpy; a considerable change in behaviour that could possibly lead to tangible repercussions at a personal level or on a larger scale at the social level. In human affairs this process is not uncommon, and it is known as ‘the self-fulfilling prophecy (Merton, 1968).’

Despite a line of investigations that has identified a correlation between “negative” superstitious beliefs (e.g. beliefs in being unlucky) and executive functions, which represents the basis for the Dysexecutive Luck theory (Maltby et al., 2013; see Chapter 4), it is highly inadequate to associate superstitious beliefs effects merely with negative outcomes (i.e. cognitive deficits). Especially if we take into account the fact that superstitious rituals – as well as religious practices - are universal and constant and it is common across different cultures for people to

engage in a variety of rituals (usually labelled as superstitious beliefs), as aids for attaining better outcomes (for extensive reviews, see Jahoda, 1969; Vyse, 1997). Contrary to the common explanation for the origins and functions of superstitious beliefs – that people take comfort from favorable superstition thought or behaviour – reality is that there is a maladaptive psychological trait view, which disregards the previous line of thought and works to understand superstition as a part of irrational belief theory (Ellis, 1994). This view theorizes that these beliefs may be linked to a diminishment in human cognition. According to Maltby et al. (2013), “within this theory belief around luck reflect absolute beliefs about the world, where many aspects of life are akin to chance, with luck having an external, unpredictable and uncontrollable influence upon the individual, eventually leading to emotional distress” (p. 137). However, the widespread use of these practices asks us to question whether there are any direct and tangible benefits emerging from superstitious practices. After all, superstitious and/or religious believers are not psychotics who cannot fail to distinguish fantasy from reality. Magical-religious thinking is not solely confined to those living in the Dark Ages, the poor and ignorant, on the contrary it is an integral part of humanity, intimately tied to our character and environment. What then is the exact purpose of believing that paranormal entities could, for instance, be bribed to change the weather?

There is an emerging line of research that gives evidence for a direct beneficial effect from ritualistic behaviours in religion, which may simultaneously offer insight to the possible functions of superstitious beliefs. Fabbro et al. (1999) showed how knowledge of alternative treatments could be applied to clinical settings, by demonstrating the effects of praying in participants who were trained in meditation. The results showed that compared to the controls,

the meditation group presented a significantly reduced number of spontaneous verbal thoughts and visual images (frequent symptoms of clinical depression).

Apart from the abundance of evidence in sports science research, which confirms the correlation of psychological benefits with superstitious rituals in sportsmen, Damisch, Stoberock, and Mussweiler (2010) demonstrated a direct causal link between superstition and an improvement in performance, concluding there was a significant relationship between promoting lucky thoughts and a performance improvement in simple tasks, within different research not based upon sports. As a continuation of the theoretical conjecture of the current thesis, this study intends to test within a single design a religious condition that is considered strongly homologous to a superstitious practice, allowing both types of beliefs to act as foundations for the experimental variable simultaneously.

Damisch et al. (2010) created experimental designs by manipulating a variety of brief and precise procedures referred to as "superstition-activated conditions," prior to the start of a simple task, with the aim of comparing their performances with a control group. In the first couple of studies, superstitious conditions were externally activated by the researcher, by implementing 1) a superstitious command vs. a controlled command- the experimental group was told "keep your fingers crossed," while the control group was told "on three you go," prior to the beginning of a motor-dexterity task, and 2) in a putting task, when handling the ball before the beginning of the task- for one group it was referred to as 'the lucky ball' (superstitious condition), whereas with another group it was referred to as an ordinary ball (control condition). However, as was illustrated by Damisch and colleagues, "superstitious thoughts or behaviours are often initiated and performed by individuals themselves," which led them to perform two further related

studies, looking this time to internally activate the superstitious condition, to help clarify internal psychological mechanisms behind the external superstitious activation. They compared performances by groups on an anagram task and a memory task with groups defined by the presence or the absence of a personal lucky charm. Results indicated that participants from the experimental group in all these studies exhibited significantly better performances, thus benefitting from the activation of superstition.

Considering that the Damisch et al. (2010) study revolves entirely around examining whether or not paranormal beliefs (more specifically the belief in luck) affect overall performance in a variety of tasks, there was a noticeable limitation within their study paradigm. In one of their four studies, it was briefly explained that 80% of the participants believed in luck, forming a single major group of participants who were under the very same superstitious-activation mechanism prior the start of the task. They ignored the fact that the remaining 20% of participants could have been considered to be sceptics, and thus could have unbalanced the study design by disrupting the proposed effects, which were supposed to emerge from manipulating conditions and reviewing the effects in a single equal group.

2.1.4. Study Aims

This present study attempts to expand the Damisch et al., (2010) findings, to examine whether religious and superstitious beliefs indeed share important attributes (i.e. producing highly similar effects), and therefore help determine whether these systems of beliefs can be classified as homologous phenomena (i.e. magical-religious thinking). In order to achieve this, we will investigate to see whether there are any effects in performance emerging from an engagement with a religious ritual, and analyze the degree to which this can be comparable to superstitious

thoughts and behaviour. In the same way as Damisch et al., (2010), two groups composed of religious individuals who possess and tend to carry a specific religious amulet were brought together. In one of the groups (experimental group) a manipulated religious condition was created to study the effects in a simple anagram task performance, in relation to a control group. The experimental condition consisted of participants removing each of their respective amulets during the task, whereas individuals in the control group performed the task while normally carrying their religious amulets.

Given the nature of this study design, and what it was derived from (Damisch et al., 2010), there was a considerate risk involved in creating a bias outside the domain of the area of study (i.e. magical-religious belief), and attributing motivations and/or expectancies to task performance. It was important to avoid inducing any possible research bias within participants at the implementation of the ritualistic-activation condition. Therefore, all participants were given the same instructions, with the only difference being within the creation of the conditions (see Section 2.2.3).

2.2. Methodology

2.2.1. Participants and Design

The University of Leicester granted Ethical approval to carry out the study overseas (Ethical Application Ref: jm420-92e29). A total of 40 participants (31 women and nine men) were recruited from a community in the city of Aguascalientes, Mexico. Some were recruited with flyers that were posted on three different churches while others were contacted directly, after attending a religious mass. Participants who were called were asked if they had a personal

religious amulet that they used often, and people who did not possess or frequently use an amulet were not invited for the study. Participants who were invited were told it was necessary to bring their particular religious amulet to the study. The participants' ages ranged from 20 to 34 ($M = 24.4$; $SD = 4.4$). All were native Spanish speakers. The participation was voluntary and confidential, and participants were not compensated.

2.2.1.1 Participants' Profile

As a selection criteria, a pre-test was administered to assure that all the participants in our population were matching on 1) level of religiosity, and 2) the importance of the use of a particular religious amulet. The aim was to have a balanced group of participants who fulfilled the religious characteristics concerning our hypothesis, and therefore researchers would know whether the sample represented the population of interest. In this part, the selection criteria for the paradigm was improved, differing from Damisch et al. (2010), who missed a statistical proof concerning the participants' superstitious characteristics profile (it was reported that merely 80% of participants believed in good luck).

The pre-test consisted in six items from the Intrinsic Religiousness subscale of the Religious Orientation Scale (see next section), with the addition of three separate items concerning the use of the amulet ('do you possess a religious amulet?'; 'how often do you tend to use/wear it?'; 'do you generally feel more secure with the presence of a personal religious amulet?'). Furthermore, following the procedure from Damisch et al. (2010), in addition to the assessment of the participants religious characteristics during the pre-test, self-performance goals for the upcoming primary task (one goal-setting item: "Please set a goal. What percentage of all

possible word solutions do you want to detect in the following task”), and task persistence (e.g. time spent in working on the anagram task) were also assessed.

A one-sample *t*-test was conducted for the six items of the Intrinsic Religious subscale (see next section for characteristics of the scale) to evaluate whether their mean was significantly different from 2 (the midpoint on the scale), representing a mid-score on the intrinsic subscale. Results showed there were indeed no statistically significant differences in the intrinsic religiosity factor within the sample of participants. With alpha set at .05, the one-sample *t*-test was significantly different from 2, $t(39) = 15.96$ $p < .01$. The effect size (Cohen’s) d of 2.5 indicates a large effect size (Cohen, 1988) (d = mean difference divided by the standard deviation of the sample). All the data analyses were performed using the IBM Statistical Package for Social Sciences (SPSS) program, Version 20.

2.2.2. Materials

2.2.2.1. Scales

Next described are the two scales used during this study. The first measure was a religious scale (previously used in the previous study; see Chapter 2) that was used for the pre-test, which worked as a filter for the participants’ selection criteria (i.e. confirming all participants had high levels of religiosity). Secondly, a self-efficacy scale measure was employed to determine whether there was a significant effect with the experimental condition.

Religious Orientation Scale, the ‘Age-Universal’ I-E Scale version (Back-translated to Spanish from Gorsuch & Venable, 1983; Maltby, 1999; see Appendix 3.2.). It is a revised and amended measure deriving from the Religious Orientation Scale (Allport & Ross, 1967).

Changes in this version aimed to consider an ‘intrinsic’ orientation towards religion as a constant feature of religious orientation, while an ‘extrinsic’ orientation towards religion was to be represented by two separate factors -- extrinsic-social and extrinsic personal. Only the six intrinsic factor items (e.g. ‘I enjoy reading about my religion’) were taken into account to assess the level of religiosity of each participant during the pre-test. Participants were instructed to respond each item using a 3-point Likert scale where 1 = No, 2 = Not certain, and 3 = Yes. The scoring was tallied with the sum of the responses made separately in each factor. Higher scores equalled a greater degree of religiosity in each condition. All of its subscales presented reliability above .7, with expected correlations with other measures of religion demonstrating a proven validity.

The Self-Efficacy measure (translated to Spanish from Chen, Gully, & Eden, 2001; see Appendix 2.2.). It is an eight-item measure that evaluates belief overall across a variety of achievement situations. Some examples are: “In general, I think that I can obtain outcomes that are important to me,” and “Even when things are tough, I can perform quite well”. Responses were scored using a five-point scale where 1 = Strongly Disagree and 5 = Strongly Agree. Higher scores indicate a greater degree of generalized self-efficacy. Internal reliability estimates for these two scales ranged from .85 to .90 with evidence suggesting a uni-dimensional structure to the scale.

2.2.2.2. Behavioural measure (Anagram Task).

As administered by Damisch et al., (2010), an anagram task was used in the same way as the behavioural dependent measure of performance for the study, and consistent along the same instructions and procedure. The employment of a simple neutral task procedure such as this one

has also been present in other studies to easily measure goal accomplishment (Fitzsimons & Bargh, 2003; Shah, 2003; Chartrand, Dalton, & Fitzsimons, 2007; Crusius, & Mussweiler, 2012). Subjects were each tested individually in a same quiet class room of a local elementary school. Participants sat down on a chair, and were given a sheet on which was written a string of seven letters (A, A, B, L, O, R, and S). They were explicitly instructed to generate and write down as many solutions as they could on a separate sheet of paper, using anywhere from two to seven letters.

2.2.3. Procedure

The experiment required that all participants bring their religious amulets to the experiment session. 26 brought crosses on necklaces, and 14 brought a religious bracelet (four of them also had a scapular). The idiosyncratic procedure used in Damisch et al. (2010) was implemented in the two experimental conditions. All participants were initially given the same instructions, and were asked by a co-experimenter to remove their religious amulet(s), because a photo of it was needed, and it going to be taken outside the room to obtain natural light for the photograph. For the absence (of a religious amulet) condition (neutral group) the amulet was not returned before the experiment, whereas the participants whose amulets were returned (experimental group) formed the presence (of a religious amulet) condition. Participants were instructed to complete the anagram task first and afterwards the self-efficacy scale. Time taken to finish the anagram for each participant was recorded using a digital stopwatch.

The paradigm of this study might raise sensitive issues. It is based on a paradigm from an investigation (Damisch et al., 2010) whose research procedure demanded that researchers omit specific parts in the procedure in order to create a manipulated absence condition (e.g. telling the

participant that their particular amulet needed to be taken away for a few moments). Moreover the main purpose of the study was to test whether there was any advantage (or disadvantage) in performances dependent upon the aforementioned religious condition. In an attempt to avoid potential sensitive issues that both the research procedure and purpose might have raised, all participants participated in a full debriefing at the end of their participation, and were asked in the consent form whether they would like the researcher to conserve the data for analysis or discard it after debriefing. None of them refused and all the participants confirmed that they still wanted their data to be used. Additionally, another goal for the debriefing was to find out if participants were suspicious about the experiment's goals. Five participants in the experimental group were not considered for the data analysis to avoid any possible bias.

2.3. Results

2.3.1. *Independent-Sample t-tests*

An independent-samples t-test was performed to assess if there was any difference between the two different experimental conditions (presence and absence of the religious amulet), with regards to the number of identified words (dependent measure) in the anagram task. Participants in the presence of the religious amulet condition performed significantly better⁷, identifying more words in the anagram ($M = 34.25$, $SD = 5.82$) than the participants in the absence condition ($M = 27.99$, $SD = 6.21$), $t(38) = 3.85$, $p < .01$, Cohen's $d = 3.86$. However, a second independent-samples t-test showed there was no significant condition effect on Self-efficacy Scale scores; participants with their religious amulet reported the same scores during this scale

⁷ It is important to clarify that this observed effect might be caused after removing any personal object from the participant.

($M = 4.13$, $SD = .44$) than the participants without the amulet ($M = 4.17$, $SD = .34$), $t(38) = -.30$, $p = .77$ (*n.s.*).

Furthermore, two more independent-sample t-tests were performed to test the persistence (measured in ms from the time taken for the anagram completion), and self-set goals (assessed on % of words that the individuals thought were going to complete for the anagram). A near significant effect⁸ was found on the persistence variable; the presence condition group took more time to finish the anagram ($M = 817.75$, $SD = 176.19$) compared to the absence group ($M = 717.35$, $SD = 141.13$), $t(38) = 1.99$, $p = .054$ (*n.s.*), $d = 1.99$). Finally, no significant effect was found on the self-set goal performance variable; the absence group ($M = 59.75$, $SD = 14.91$) responded they were going to perform similarly as the presence group ($M = 53$, $SD = 12.18$), $t(38) = 1.57$, $p = .125$.

2.4. Discussion

The results of the present study revealed a significant difference in the performances of an anagram task between two separate groups. An interpretation of the results showed that the use of a religious amulet could have an effect on performance. Specifically, the findings suggest that when religious individuals carry a personal amulet, their performance in a simple anagram task is improved compared to that of a group that shares the same religious profile but is not carrying the personal amulet during such task. In sum, this finding - alongside those of Damisch's et al.(2010)- represents an important step forward in comprehending the psychological benefits from a particular ritualistic practice, namely, the use of a religious amulet. Unfortunately, unlike

⁸ It is possible that the performance enhancement may simply be due to improved persistence (see Discussion; section 4.2)

Damisch's et al. (2010) findings, where the performance-enhancement to a psychological-related mechanism was successfully linked to a heightened self-efficacy towards the subsequent task, the hypothesized underlying psychological mechanism for this performance boost effect was not reflected in the current study. Although there is a possibility that the results obtained might be explained by an effect of other item being removed, and not necessarily the religious amulet per se. In this case, a modification that would improve the paradigm would be the addition of a control condition (i.e. removing of a watch), which would allow testing whether this is in fact the cause of the effect. Furthermore, it is also viable that the observed performance effect may be linked to persistence, considering that a near significant effect was found on the persistence variable. It is possible thus that the performance enhancement may simply be due to improved persistence, although if this was the case, it would be necessary to analyse if the improved persistence is an effect of the use of the personal religious amulet (i.e. amulet provoking participants to be more persistent).

2.4.1. Future Research: An Experimental Condition of a Negative Psychological Placebo?

If we consider religion and superstition to be complex multifactorial phenomena in research paradigms, in the same way belief in luck is approached in the Belief in Luck Scale (Darke & Freedman, 1997; Maltby et al., 2008), there is an opportunity for future studies to include a “negative” belief (i.e. belief in being unlucky). It would be interesting to create a more complex balanced study design, by incorporating counterpart conditions, helping to examine the exhibited positive performance boost lead, and expand the theoretical framework with a possible reversed negative effect by adding a negative condition.

After all, it is known that health warnings (e.g. drugs side effects) in western societies (or black magic in esoteric believers) can have the opposite effect from a placebo, leading to negative physiological consequences such as making a person feel sick or experience pain (Benedeti, Lanotte, Lopiano, & Colloca, 2007). Due to this, there are obvious and imminent ethical restrictions rising from possible nocebo⁹ study designs, given that these likely involve manipulation that in some cases might harm individuals. On the other hand, it is known that certain social behaviours can act as triggers leading to physiological consequences, in a similar way as in the way placebo and nocebo phenomena operate, improving the clinical outcomes.

The proposition of a future study to consider the opposite phenomenon of the findings in this study, the psychological nocebo, for experimental design focusing on performances, instead of a clinical setting, could allow researchers to look at subtle psychological factors that work along both placebos and nocebos without the rise of a significant ethical concern. This will hopefully help clarify, revealing more about the effects behind these complementary phenomena. In sum, the idea is to create a reverse superstitious-activation condition (e.g. with the concept of bad luck, or a negative-related religious amulet), to investigate whether it can adversely affect performance on a neutral task, in opposition to these current findings.

2.4.1. Conclusion

The findings that this study provides act as a complement to the findings of Damisch et al., (2010), further establishing the link discussed since the first chapter of this thesis between religion and superstition. Both studies in conjunction can elucidate the view of religious practices

⁹ “A harmless substance that when taken by a patient is associated with harmful effects due to negative expectations or the psychological condition of the patient” (Merriam Webster Online Dictionary).

as homologues to superstitious rituals, by theorizing that religious and superstitious practices are a manifestation of basic human characteristics present in every culture, and most importantly, both function- and therefore can be understood - on a same magical thinking-level.

This experiment leaves the door open for a concrete continuance in this area of research, namely with regards to the construction of similar paradigms, for a further examination of religious and superstitious conditions; counterparts that work as hypothetical performance detriments, in circumstances fitting in the aforementioned psychological nocebo; or with the effects on specific tasks under conditions from essential practices of religion, such as praying. In doing so, it can help contribute even further to the literature upon body-mind effects.

After finding evidence for the impact of religious behaviour in this present study, the next chapter presents a research dedicated to examine whether religious related verbal items can cognitively interfere during a well-known cognitive task, the Stroop task, with the intention of finding more evidence that supports the significance of religion at a cognitive level.

CHAPTER 3: Religious Stroop: Assessing Inhibition and Attentional biases using Religious Stimuli in High Religious Believers

Abstract

Attentional Bias has inspired a great deal of cognitive research which explores potential biases in a variety of clinical, preclinical, and non-clinical groups towards a variety of verbal stimuli that represents specific relevant themes (MacLeod, 1986; MacKay et al., 2004). Religion is among the most powerful of all social forces, having had a strong influence on everyday life throughout human history, regardless of any time or place in human history. Based on this line of research, the present study aims to assess attentional biases toward this previously unexplored major psychological theme in religious believers. For this purpose, a modified version of the emotional Stroop task (Gotlib & McCann, 1984), which is an emotional analogue to the Stroop task (Stroop, 1935), was constructed using religious-related words (positive and negative valenced) and neutral words. A total of 30 individuals were selected based upon their intrinsic religious subscale scores (Gorsuch & Venable, 1983); two groups were formed, a 15 highly religious individuals and 15 low religious individuals group. Additionally, as an exploratory endeavour, paranormal, and spiritual factors were also measured using a variety of scales to explore whether any parallels could be found with religious beliefs. The results did not reveal any attentional effect, or interaction, in any of the task's variables with regards to religion, spirituality and paranormal beliefs, after performing a between-group (i.e. religious vs. low religious group) and a within-group (i.e. individual differences) statistical analysis. Some explanations for the lack of bias toward religious stimuli are discussed.

3.1. Introduction

There is a history of looking at individual differences in religion which started to substantiate and give insights to the underlying cognitive mechanisms of distinct groups of religious believers, in other words, treating religion in a non-reductionist manner. For instance, Sica et al. (2002) showed a correlation of higher scores on measures of OCD-related cognitions on Catholics with high or moderate degree of religiosity in relation to less religious Catholics; in

addition Abramowitz et al. (2004) corroborated the previous finding in a Protestants sample. Rassin and Koster (2003), revealed a stronger religiosity and a greater tendency to believe that their thoughts were morally equivalent to actions in Protestants when compared to Catholics, Atheists and members of other religions. Lastly, a design covering both within or between-religions samples comparison; Abramowitz et al. (2002), found a greater fear of God and sinful thoughts in highly religious Protestants when compared to Catholics, Jews and in less religious Protestants as well. All these results strongly suggest both the type of religious affiliation, and level of devotion (religiosity), can correlate to cognitive biases. These outcomes occurring in conjunction are highly significant; they lead to the premise that a given religious belief can have correlations with personality factors (see discussion section). However, this study aims to look at certain individual differences in biases.

The non-reductionist view encouraged in the first chapter of this thesis suggests that looking at the global demographic information, and the personality characteristics of religious adherents, would not be sufficient to back up a study design that aims to investigate correlations in religious features and cognition. In its place, specifying individuals' religious dimensions and their particular belief system will ideally be a mandatory factor in exploring possible cognitive differences in religious people. In this same vein, Rachman (1997, p.798) proposed that "people who are taught, or learn, that all their value-laden thoughts are significant will be more prone to obsessions – as in particular types of religious beliefs and instructions." Rachman's work led to several studies that successfully linked specific religious adherents and OCD-related cognitive biases. This present study supports this view and focuses on a specific group of believers, a group of Catholics from the same region and sharing a similar upbringing, with the intention of starting to integrate religious beliefs into cognitive paradigms.

3.1.1 Attentional Biases and Inhibition: A Framework for the current study

There is a continually evolving list containing a myriad of biases aiming to explain very specific occurrences around many areas of psychology. These are roughly categorized by a) social biases: most are labelled as attributional biases (e.g. egocentric and projection bias) b) memory biases (e.g. explicit memory bias: tendency to retrieve mostly the negative or unpleasant rather than the positive or neutral information) and c) cognitive biases (e.g. attentional bias: a selective attention to threat or significant-related stimuli when it is presented simultaneously to neutral stimuli). As defined by Kahneman and Tversky (1972) a cognitive bias “is a pattern of deviation in judgment that occurs in particular situations, which may sometimes lead to perceptual distortion, inaccurate judgment, illogical interpretation, or what is broadly called *irrationality*”. In other words, cognitive biases are effects of information-processing rules, called *heuristics*, which the brain uses to produce decisions or judgements. Cognitive patterns or psychological effects that produced a deviation in the processing of received information, leading to a distortion in specific cognitive areas (i.e. memory, attention). The attentional bias is an implicit tendency of relevant emotional stimuli in the environment to interfere or limit an individual’s attention in a preferential or selective way (Bar-Haim et al., 2007). It was well-established and implemented broadly in clinical studies, which focused on testing how selective information influenced attention processing with regards to distinct emotional disorders.

It is important to mention that in the area of information-processing biases it is widely suggested that inhibition (i.e. a cognitive process fundamental to EF) may play an important role in the Stroop interference (for a brief review of inhibition of response in Stroop tasks evidence see Smith & Waterman, 2005). This premise predicts delayed responses when presented with

words strongly relating to the clinical sample condition, a premise that this study adopts hypothesizing a significant delay to salient information (i.e. religious-related stimuli) in a group of Catholics.

3.1.1.1.. Beck's Cognitive Schema Theory

The attentional bias is described by Cha, Najmi, Park, Finn, & Nock (2010, p.2) as a cognitive process that “involves selective allocation of attentional resources toward specific aspects of stimuli”. Its theoretical basis has been explained within the framework of cognitive theories on emotional disorders, proposing that distinct attentional biases, in conjunction with general underlying ways that participate in virtually all information processing aspects (i.e. schemas), enhance vulnerability toward given disorders (Beck, 1976; Beck, Emery, & Greenberg, 2005). According to Beck's schema theory, individuals with a specific-related schema should present a cognitive bias greatly influenced by the mood or disorder that the individual possesses or prevails when processing information. In other words, its premise predicts that persons with depressed-related schemas should show a bias towards depressed-related stimuli; working under the same principle, persons with anxiety-related schemas should hold a bias towards threatening information, and so on. Inspired by Beck's schema theory, selective attentional biases studies have been widely successful and effective in a variety of selected populations including clinical (i.e. generalized anxiety disorder and depression; Mogg, Bradley, & Williams, 1995), preclinical (i.e. mild depression; Gotlib, MacLachlan, & Katz, 1988), and nonclinical groups (i.e. using taboo words; MacKay et al., 2004). Considering all this array of evidence, it is viable that attentional bias may be helpful in the understanding and prediction of religious attitudes.

3.1.1.2. Emotional Stroop Task

With the objective of understanding cognitive biases of attention, cognitive theories such as Beck's schema theory have relied on information processing paradigms such as the modification of a classical Stroop paradigm (Stroop, 1935), the Emotional Stroop (Williams, Matthews, & MacLeod, 1996), an emotional processing assessment, and other similar tests to gauge attentional bias such as the Dot Probe task (MacLeod, Matthews, & Tata, 1986). So far, the great majority of attentional interference effects have been predominantly assessed and documented via a variety of specially adapted modified Emotional Stroop tasks. This information-processing approach consists in presenting emotionally charged and neutral coloured words to examine if participants respond slower when naming the colour of the emotional words (i.e. 'SADNESS') in relation to the neutral stimuli (i.e. "CHAIR"), successfully confirming that depressive participants exhibited an attentional bias toward depressed-content words. Emotional Stroop tests can be categorized by two main versions depending on the stimuli in which these are composed: 1) disorder-specific highly emotional verbal items (i.e. a given phobia related words, or depressive related words) and 2) general highly emotional verbal items (i.e. taboo words or highly intense words). These combinations lead to a series of investigations that undertook the exploration of cognitive bias towards a variety of specific disorder-related stimuli in clinical populations. It is suggested that the provided empirical findings can help elucidate the underlying cognitive pathways of this effect, indicating immediate accessibility to the thoughts concerning the respective disorder, and ultimately helping to gain more information about a variety of psychological disorders and even the possibility to act as a predictor of possible risky events, for instance the identification of likely suicide attempters (Cha et al., 2010).

In terms of behavioural data the most significant cognitive bias effects were observed by giving several modified versions of the emotional Stroop task to clinical participants (mostly

with affective disorders), after comparing the RTs averages of the respective disorder-related words (in occasions also ‘positive’ words) vs. the neutral words. It was shown that depressive participants showed an attentional bias toward content with the requisite connotations, having significantly longer response latencies to negative rather than to positive or neutral items (Gotlib & McCann, 1984; Williams et al., 1996). Similarly, subjects suffering from PTSD also showed an attentional bias towards words with traumatic content (Foa, Feske, Murdock, Kozak, & McCarthy, 1991; McNally, Kaspi, Riemann, & Zeitlin, 1990); Anxious participants showed a response to anxiety-related words (Teachman, Smith-Janik, & Saporito, 2007); individuals who worried about physical harm to threatening words (Mathews and MacLeod, 1985; substance dependant users showed responses to words associated with the specific substance abused (i.e. alcohol), specifically in studies with heavy drinkers or smokers participating (Sharma, Albery, & Cook, 2001; Mogg et al., 2004; Cox, Fadardi, & Photos, 2006). Finally, participants with specific phobias also showed responses: those with phobias associated with snakes or spiders demonstrated longer response latencies to the respective words (Mathews & Sebastian 1993; Kindt & Brosschot, 1997). All of these findings represent highly specific effects.

In addition to this set of studies, Williams & Broadbent (1986) and Becker et al. (1999) demonstrated the earliest indications of response latencies through emotional stimuli in suicide attempters, demonstrating that they took significantly longer lengths of time to name the colours of words associated with suicide, when placed side by side with low believers. Building on these studies Cha et al. (2010) corroborated and expanded these findings by addressing several issues that arose as a result of their cross-sectional research methods. There were two main findings; the first was that subjects who had a history of suicide attempts showed an attentional bias towards words related to suicide, when compared to those who had never attempted suicide. Secondly,

they were able to give evidence bias as a behavioural marker for future suicide attempts, by studying the suicide attempts made by vulnerable participants in a follow-up 6-month period after the study.

It is generally held that emotional reactions to universal emotional stimuli (e.g. ‘fear’, ‘death’, ‘sickness’, ‘war’) may be too weak to cause the significant effects normally required in a computerized task, due to familiarization resulting from frequent repetition of these emotional stimuli (Williams et al., 1996). Another possible factor would be the lack of a match between the connotations associated with the word, and the specific concerns of the tested individual (Reiman & McNally, 1995). It is likely that a cognitive threshold exists that needs to be surpassed in order to attain a significant emotional Stroop effect. Nevertheless, there are a few selective attention investigations which resulted in significant RTs variation in non-clinical populations, using highly negative verbal stimuli versus neutral stimuli (or compared to positive stimuli). One lexical decision study involved highly intense words placed beside compliments and neutral words (Hinojosa, 2007) and another involved taboo words (MacKay et al., 2004). The results of both studies demonstrated that negative stimuli resulted in the longest RTs. An emotional Stroop study included positive and negative adjectives for personal traits (Pratto & John, 1991), and another used words implying threat, relative to the subclinical population containing individuals displaying high levels of self-reported anxiety (Williams, et al., 1996). Both studies revealed that colour naming (i.e., Stroop-like interference) took longer on words with negative connotations. All these findings share very similar results and the same interpretation – that negative information captures the attention of the participants on an automatic level, resulting in an increase in interference on the respective tasks, as seen in the longer overall RTs for the negative trials.

3.1.2. Study Aims

The widespread psychological and historical significance of religious beliefs and behaviour, whether manifesting itself in everyday life or over the course of human history, cannot be disregarded. Presently, according to the largest database of religious demographics, 85% of the populations worldwide are religious adherents (Adherents, 2003). Yet despite this overwhelming universal tendency to hold religious beliefs, there is little research in the psychological literature on cognitive bias or cognitive interference from using religious stimuli to test religious believers.

Research using schema theory and emotional processing paradigms revealed that attentional biases played an important role in the etiology and maintenance of emotional disorders (e.g. anxiety). There is a successful collection of findings obtained using a variety of emotionally related stimuli such as phobias, avoidance, substance abuse, and emotional words (i.e. spider, physical threat, alcohol, taboo, insults), but no sign of an Emotional Religious Stroop paradigm yet. Given this lack of focus to religion in this line of studies, this study aims to extend this widely used methodology to religious beliefs and investigate at which extent processed verbal stimuli related to religion is cognitively demanding and represent an attentional bias in a non-tested non-clinical population, a group of specific religious believers.

Despite effectively adapting the emotional Stroop task for a variety of specific disorders and verbal items that are considered to be highly emotional in most cases, a religious emotional Stroop based upon the same methodological approach has yet to be introduced in the literature on cognitive bias. Religion is an influential universal psychological construct that is intimately tied to everyday life. Many forms of intriguing behaviours ranging from subtle to extreme displays of faith are performed in its name (i.e. celibacy, wars, and sacrifices). Religion is

without a doubt a phenomenon deeply grounded in emotion. This study proposes that religion is a psychological phenomenon that would fit in easily within an emotional Stroop task, as a theme containing highly emotional verbal items (see Section 3.1.12). It was also hypothesized that religious verbal items had the potential to generate attentional effects (i.e. biases) in the same fashion as the previously mentioned documented studies, in a group of religious believers. To reach the study goal a modified version of the emotional Stroop task was constructed and relied to function as a selective attention measure allowing the testing and comparison of performances to see whether religious-related emotionally valenced words are able to significantly interfere at a cognitive level in a group of religious believers when compared to a low religious group.

Given the scarcity of cognitive research involving religious verbal stimuli, this study was envisioned as an exploratory investigation with the intention of promoting the integration of religious or religious-related beliefs to cognitive paradigms. The hypothesis proposed within this study was that the stimuli of religious-related set would be able to generate significant cognitive bias or attentional effects (predicting significant delays to this content) when compared to neutral stimuli in a group of religious believers. The premise behind this hypothesis comes from abundant research in the information-processing studies which indirectly suggest that religious stimuli would require greater levels of inhibition than standard colour words.. This study is motivated by the general and specific contributions the cognitive sciences have offered and reached practically all aspects in psychology. It represents thus a modest, yet innovative, effort to start exploring a universal multi-dimensional theme in psychology that had not been previously tested via a well-established cognitive task.

3.2. Methods

3.2.1. Participants

Participants from a town in Mexico (Xcunya, Yucatan) were recruited via flyers posted at a church and downtown to participate in the study. The study groups were based upon the results of the Religious Intrinsic 6-item subscale, from the Religious Orientation scale. Thirty right-handed religious believers (17 men, 13 women) were selected from an initial screening of 60 individuals. Participants ranged from 18 to 25 years of age ($M = 21.3$; $SD = 2.7$), and all of them had normal or corrected-to-normal visual acuity and had no history of any mental or neurological disorders. All participants were native Spanish speakers. Each participant was given a consent form and was paid \$12.00 USD. The University of Leicester granted Ethical approval to carry out the study overseas (Ethical Application Ref: jm420-acfe8). The selection was dependent upon the highest and the lowest scores on the intrinsic subscale. Two experimental groups were thus formed, composed of 15 participants who scored high on intrinsic religiosity and 15 who scored low. All participants were unaware of the main purposes of the study. All participants were right-handed as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971). A Mann-Whitney U (non-parametric test) for the two independent groups was performed to compare and demonstrate whether the two groups differed significantly in their Intrinsic subscale performance in order to profile the two groups around religion (high and low/non-believers). Results indicated that the 'Religious' group presented significantly higher scores ($M = 17.3$; $SD = 1.39$) than the low/non-believers ($M = 8.3$; $SD = .99$), $U = <0.001$, $p = <.001$.

3.2.1.1 Sample's Religious Demographics

Despite the gradual decline of religion in the population¹⁰, demographics of religion in Mexico depict it as a highly homogenous religious culture. Presently, the Mexico's General population census, carried out by the National Institute of Statistics and Geography (INEGI by its name in Spanish), showed it has a high percentage of Catholics or adherents to other Christian denominations, with over 91.5 % (INEGI, 2010), and even considerably higher just a decade ago with over 95.3% (Catholic Almanac, 1998). As for the specific demographics of the region in which the data was collected, the state of Yucatan, the demographic census indicated the percentage of catholic believers within this state surpassed the country's average (INEGI, 2005).

3.2.2 Stimuli and Apparatus

3.2.2.1. Psychological Scales

Spanish language versions of the following detailed Psychology Scales were administered to assess the level of religiosity, spirituality, paranormal belief and well-being of the participants. The selection and formation of the study groups depended on the religious and spiritual measures (Appendixes contain all the scales with their scoring instructions).

1. Religious Orientation Scale, the 'Age-Universal' I-E Scale version (Back-translated to Spanish from Gorsuch & Venable, 1983; Maltby, 1999). It is a revised and amended measure deriving from the Religious Orientation Scale (Allport & Ross, 1967). Changes in this version propose to consider the 'intrinsic' orientation towards religion a constant feature of religious orientation, while the 'extrinsic' orientation towards religion to be represented by two separate factors -- extrinsic-social and extrinsic personal. Thus, it is

¹⁰ At the dawn of the last century, Catholicism supposedly represented 99.5% of the population of Mexico, which was inhabited almost entirely by people settled in rural communities (González, 2009).

formed of 6 intrinsic items (e.g. 'I enjoy reading about my religion') and 6 extrinsic items formed by two divisions: three extrinsic-personal items (e.g. 'I pray mainly to gain relief and protection') and 3 extrinsic-social items ('I go to church mostly to spend time with my friends'). Participants are instructed to respond to each item using a 3-point Likert scale where 1 = No, 2 = Not certain, and 3 = Yes. The scoring is performed by a sum of the responses made separately in each factor. The higher scores equal the greater degree of religiosity in each condition. All of its subscales presented reliability above .7, with expected correlations with other measures of religion demonstrating a proven validity.

2. *Spiritual Meaning Scale* (back-translated to Spanish from Mascaro, Rosen, & Morey, 2004; see Appendix 3.3.). It is a 14-item inventory scale with a coefficient alpha reliability of 0.89 aiming to interpret the degree of spirituality. Ten of the items are positive statements (e.g. 'Life is inherently meaningful') and four are negative statements (e.g. 'there is no particular reason why I exist'). Participants are asked to respond all items on a 5-point Likert scale, where 1= I totally disagree, 2= I partially disagree, 3 = I'm in between, 4= I partially agree, and 5= I totally agree. The scoring is performed by the sum of responses; negative items are reverse-scored (1 = 5, 2 = 4 and 3 = 3). The higher scores equal the greater degree of Spirituality.

3. *Revised Paranormal Belief Scale* (adapted to Spanish by Diaz-Vilela & Alvarez-Gonzalez, 2005; R-PBS; Tobacyk, 2004; see Appendix 3.4.). It is revised and substantially reliable improved scale from the Paranormal Belief Scale (PBS), with 26-items used to provide a separate score on each of the seven factorially derived subscales of the major dimensions in the paranormal belief: Traditional Religious Belief, Psi,

Witchcraft, Superstition, Spiritualism, Extraordinary Life Forms and Precognition (e.g. of items: ‘the soul continues to exist though the body may die’, ‘some physics can accurately predict the future’, ‘it is possible to communicate with the dead’). Respondents are instructed to rate each answer by using a seven-point rating scale where 1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = uncertain, 5 = slightly agree, 6 = moderately agree, and 7 = strongly agree. The scoring is performed by the separately sum of the responses made in each sub-factor. The higher scores equal the greater degree of superstition in each paranormal belief dimension. Over a four-week test-retest sequence, the reliabilities for all the R-PBS subscales in a sample of forty university students were: Full Scale 0.92, Witchcraft .93, Extraordinary Life Forms .91, Traditional Religious Belief .95, Psi .71, Superstition .89, Precognition .81 and Spiritualism .91. Improvements on the R-PBS provide greater reliability and validity, less restriction of range, and greater cross-cultural validity than the original PBS (Tobacyk, 2004).

3.2.3. Computerized Religious Stroop (Attentional Measure Test)

Three main suggested cognitive threshold factors (Hinojosa, 2007; Reiman & McNally, 1995) were carefully followed as the guidelines for constructing the current study’s apparatus and methodology design. The first factor was the level of involvement in the on-going task (a modified version of the emotional Stroop task with religious items was constructed, a Religious Stroop). The second factor was the individual state and trait characteristics that were used to select participants (individuals scoring high on religiosity). The third and final factor was the nature and intensity of the emotional stimuli employed (choosing the participants’ most representative positive and negative religious words).

The instrument used to assess if there is any attentional bias was a modified version of the Emotional Stroop Task (Cha et al., 2010). More precisely, the goal of the task was to know whether religious-related words could capture significantly the attention of the religious participants by exhibiting slower response times due to the specific emotional relevance of the word.

The Religious Stroop was programmed and run on E-Prime 2.0 (Psychological Software Tools, Pittsburgh, PA). It was formed by eight positive religious-relevant words (e.g. ‘god’, ‘angel’, ‘miracle’), eight negative religious-relevant words (e.g. ‘hell’, ‘devil’, ‘sin’), and eight neutral household-item words (e.g. ‘chair’, ‘table’, ‘pen’). The word selection criteria process began using a preliminary group of 20 Spanish-speaking Catholics who were asked to write down as many positive and negative words related to their religion as they could. These words were then rated using a Likert-scale by other 20 individuals who possessed those characteristics. The most frequently used and highest rated words (in terms of relevance) were included within the task. The eight selected words were thus highly relevant to the religious believers. The neutral words consisted in eight noun house-related context words; they were matching in length to the religious words chosen (although not matched in word frequency; see Section 3.4.1). Words loosely related to religion (e.g. ‘good’, ‘evil’) that were highly ranked during the word screening selection were left aside, selecting only words strictly related to religion. The Spanish words used are three to eight letter-long words (See Table 3.1).

Table 3.1

Experimental stimulus words used in the modified Stroop task (English translation in parenthesis)

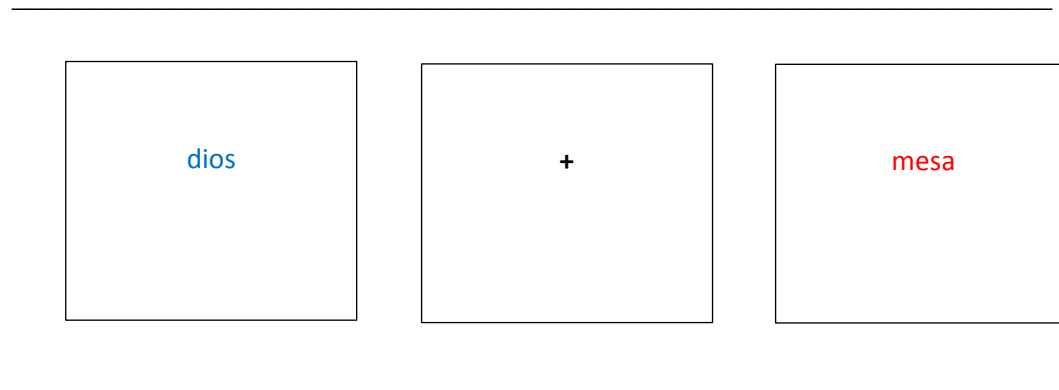
Positive Religious	Negative Religious	Neutral
dios (god)	satán (satan)	mesa (table)
alma (soul)	atóo (atheist)	vaso (glass)
angel (angel)	secta (sect)	silla (chair)
cielo (heaven)	pecado (sin)	trapo (cloth)
Moral (moral)	maldad (evil)	puerta (door)
biblia (bible)	diablo (devil)	librero (bookcase)
milagro (miracle)	demonio (demon)	cuchara (spoon)
oración (prayer)	infierno (hell)	escalera (ladder)

3.2.4. Procedure

The study was advertised with flyers in a Mexican community (Xcunya, Yucatan; see Section 3.2.1.1 for religious demographics), and aimed at individuals who were independent and not a part of any institution. Subjects were tested in a quiet, dimly lit room within a local elementary school (Colegio Primaria Comunitaria). They were seated in comfortable armchairs, their eyes were open, they faced a computer screen, and researchers made sure all the participants were seated at a reasonable distance (60 cm away) from the laptop monitor screen. They were instructed to indicate the colour of the word shown in the screen in a response button-box by pressing either the red or the blue button as quickly and accurate as possible.

Each trial started over a blank white screen with a fixation cross “+” in the centre of the screen for two seconds, followed by the replacement of the “+” with the stimulus word, pseudo-randomly printed in either red or blue to avoid bias related to the colour effect, since there is a likely higher emotional connotation for red (Demily, 2009). Before the experimental trials there was a 10-trial practice block. For the experimental block each word was presented twice and randomized for a total of 96 trials.

Figure 3.1

Example of a trial sequence of the Religious Stroop Task

A first trial (a religious condition trial in this example) followed by a fixation cross ('+') lasting two seconds, and a second trial (a neutral condition trial in this example).

3.3. Results

Overall, there was no significant difference in % of errors between both groups, therefore only correct trials were considered for the statistical analysis. Thus, a semiautomatic filtering operation of raw RT data was carried out on E-prime 2.0 to discard all incorrect trials.

Additionally, it was also used to filter excessive RTs, consistent with other studies in the area (Fuggetta, 2006). An absolute exclusion criterion of RTs of less than 150 ms and RTs greater than 3000 ms was used, removing thus extremely slow (retardations) and fast (anticipations) trial responses that might have unbalanced the data analysis.

The data analysis aimed to inspect the possible relationships in two separate ways. First approach looked to compare the religious versus low religious participants' data, the second approach, concerned on reviewing the individual differences in religiosity, religiosity-related

factors including: spirituality, paranormal beliefs, there was no significance effect. Both statistical analyses were performed using Statistical Package for Social Sciences (SPSS) program, version 18.

3.3.1. Mixed ANOVA for Between-group differences

An analysis of variance was performed to observe the experimental effects produced by the emotional content of the verbal stimuli. Mean RTs of positive, negative and neutral nouns were compared between the two main groups of study.

Table 3.2

Word Variables RT Means for the Two Groups

Group	Word Variable					
	Positive Religious		Negative Religious		Neutral	
	M	SD	M	SD	M	SD
High Religious	693.61	240.50	701.33	242.74	720.74	259.60
Low Religious	670.50	171.64	692.14	157.82	676.37	150.10

The ANOVA showed that neither the between-group factor of religiosity $F(1, 28) = .117$, $p = .735$, nor the within-participants factor of valence $F(2, 27) = .832$, $p = .446$ were significant.

Moreover, the interaction between the two factors was also not significant $F(2, 27) = 1.857$, $p = .175$.

3.3.2. Pearson's Correlation Analysis for Individual Differences

A within-group analysis was carried out. Results showed no relationships between any of the RT variables and the religion/spirituality and paranormal beliefs variables. Additionally, computed differences between the different RT conditions were performed to see if a change revealed anything. There were correlations of about .2 (which would be significant if the sample size was larger), the effect sizes would be all small ($<.26$) at best strongly suggesting that there is no significant relationship.

Table 3.3.

Pearson's Correlation for Mean Average of Words RTs and Religious/Superstitious Variables (N = 30).

	Intrinsic Religiousness	Extrinsic – Personal Religiousness	Extrinsic – Social Religiousness	Traditional Religious Beliefs	PSI	Witchcraft	Superstition	Spiritual	Extra-terrestrial Life Forms	Precognition	Spiritual Meaning
Negative Religious Words RTs	-.06	-.12	.10	-.01	.21	.07	-.21	-.02	-.12	-.17	-.05
Positive Religious Words RTs	-.25	-.20	.16	.11	.20	.13	-.10	.06	-.17	-.16	-.03
Neutral Words RTs	-.19	-.22	.11	.09	.26	.10	-.15	.07	-.13	-.15	-.03
Differences Between Positive & Negative Words RTs	.20	.02	-.18	-.08	.10	-.11	-.12	.00	.13	.04	.02

Note: Statistical significance: *p < .05; **p < .01; ***p < .001

3.4. Discussion

The present study was inspired by a line of cognitive studies which assessed attentional biases in a variety of clinical groups, via modified emotional Stroop tests composed of verbal stimuli based entirely on the respective group's disorder. This current study shares their same basic experimental paradigm/design with one main exception: the experimental group was a non-clinical group. It was hypothesized that the effect of a cognitive bias would be contingent upon the level of religiosity, considering the important role that religion is supposed to play in believers. Therefore, Religious Orientation scale scores were taken as the fundamental criteria of selection for the low believers group, oriented according to their level of religiosity. This allowed researchers to compare their behavioural results, obtained from the computerized tasks, to assess whether an attentional bias was exhibited.

In conclusion, the analysis of the behavioural results did not show any significant statistical differences in response times between groups, toward either valence or neutral words. Moreover, there were no statistically significant correlations between the type of stimuli and the variables associated with the beliefs (religiosity, spirituality, paranormal/superstitious beliefs), and attentional bias.

3.4.1. Exploring possible difficulties/limitations in the study

There is room for two main interpretations regarding the lack of any significant effects from cognitive bias. The first reason for this could be inefficiencies within the construction of the computerized task. There is a chance the number of trials were not sufficient enough, making the paradigm task too weak to attain statistical sustainability. Alternatively, another factor could be

cognitive in nature, a weak religious belief system, which, though practiced by the subjects, did not have a measurable psychological/cognitive impact, and was insufficient to force them to exhibit a cognitive bias. Lastly, it could be a combination of these two causes. These interpretations are further detailed below.

As for the possible limitations of the paradigm employed, the lack of any significant attentional bias in the study could be mainly due to two problems or inefficiencies within the paradigm. The first would be the sensitivity of the cognitive task paradigm (i.e. needing more trials). A second possible reason could be due to the set of verbal stimuli (i.e. a failure to adequately select highly relevant items for the specific group of participants). It is important to highlight that the selected words were not matched on word frequency given the lack of a verbal system classification for word frequency in Mexican Spanish. This obstacle could be treated hence as a lack of control implicated within the verbal stimuli set employed in the Religious Stroop. These likely limitations in conjunction might have impeded the construction of a powerful paradigm to allow a significant cognitive interference.

Hinojosa (2009) already pointed out the biological point of view of the words in his studies. He demonstrated that the processing of affective information captures attention only when biologically relevant stimuli is present, or when it is specifically important to the participant (e.g. in clinical cases studies using verbal stimuli related to the condition of the participant with emotionally charged words such as “war”, “kill” or “ambush” to a soldier exhibiting PTSD due to war combat). In any case, it was hypothesised that religious participants would respond to stimuli related to their faith. Although it did not happen in this case, the topic of religion is highly complex. Though it is a fundamental part of human culture with strong

biological and cultural implications, it is also problematic and hard to approach using Stroop task studies, given that it is an intertwined multidisciplinary domain that can be interpreted (and processed) in different ways depending on the believer. The lack of results of this experiment could provide indications that this specific religious group does not reflect any sort of deficit at a cognitive level, compared to other religious group that do, and is possibly reflected in their more extreme religious behaviour.

3.4.2. Conclusion

Despite the fact that the current study results did not support the hypothesis, not being able to demonstrate an attentional bias effect using religious stimuli in a group of individuals who supposedly possessed a high affinity towards them, it was an innovative and sustained proposition for a research paradigm. Religious beliefs had remained untested under the same type of theoretical framework methodology of successful attentional bias studies. The possibility that a specific religious belief (Catholicism in this case) simply does not have any impact in relation to an information processing bias in this task could be considered. Although, after including religious beliefs into this type of experimental design, this study could open a door for the possibility of integrating further attentional bias studies with other specific religious belief systems (e.g. Protestants, non-Judeo-Christian religions, and even religious extremists), to further analyse the level of involvement in the on-going task with similar or derived beliefs. It is also important to highlight that the two main possibilities for the lack of results were taken into account for the following studies within the thesis. Construction of the computerized task in the subsequent study (see next chapter) was revisited and drastically redefined by increasing significantly the number of experimental trials, with the intention of making it an adequate and

more sensitive cognitive task, able to surpass cognitive thresholds. In the following study carried out within this thesis, a big step is made forward, in terms of methodological procedures, with the use of the Event-related Potentials– an electro encephalogram-derived - technique. This was an attempt to continue further investigation of the underlying mechanisms of magical-religious beliefs, and the focus of exploring their connection to EF continues. The next study was based on a lead that revealed a significant effect between magical-religious related beliefs (i.e. beliefs in being unlucky) and EF deficits at a behavioural level. This finding formed the basis of what is known as the Dysexecutive Luck hypothesis. Specifically, the goal of the next study will be to provide initial electrophysiological evidence for this lead and to help to further establish this hypothesis.

PART III

EXECUTIVE FUNCTIONS RELATIONSHIP TO LUCK AND RELIGIOUS FACTORS

CHAPTER 4: Beliefs in being unlucky and deficits in executive functioning: An ERP Study.

Abstract

There has been initial evidence to support the Dysexecutive Luck hypothesis, which proposes that beliefs in being unlucky are associated with deficits in executive functioning (Maltby et al., 2013). The present study tested the Dysexecutive Luck hypothesis by examining whether deficits in the early stage of top down attentional control led to an increase of neural activity in later stages of response related selection process among those who thought themselves to be unlucky. Individuals with these beliefs were compared to a control group using an Event-Related Potential (ERP) measure assessing underlying neural activity of semantic inhibition while completing a Stroop test. Results showed stronger main interference effects in the former group, via greater reaction times and a more negative distributed scalp late ERP component during incongruent trials in the time window of 450 – 780 ms post stimulus onset. Further, less efficient maintenance of task set among the former group was associated with greater late ERP response-related activation to compensate for the lack of top-down attentional control. These findings provide initial electrophysiological evidence to support the Dysexecutive Luck hypothesis.

4.1. Introduction

Estimations of the prevalence of beliefs about luck in the general population are that 50% of the people consider themselves lucky, 36% consider themselves neither lucky nor unlucky, and the remaining 14% consider themselves to be unlucky (Wiseman, Harris & Middleton, 1994). The most prominent theory within the psychological literature on beliefs around luck is irrational belief theory, which forms part of Rational Emotive Behaviour Therapy (Ellis, 1994). According to this theory, the external, unpredictable, and uncontrollable influence upon the individuals that absolute beliefs concerning luck inflict upon individuals cause the basis of emotional distress (Ellis, 1994). A more recent distinction has been made between a perception of being lucky (belief in good luck) and the perception of being unlucky (belief in bad luck) (Darke & Freedman, 1997), with the latter being found to be associated with emotional distress, in terms of both hedonic and eudaimonic well-being (Maltby, Day, Gill, Colley & Wood, 2008).

Consequently there is literature that has focused on this distinction. One theory, the Dysexecutive Luck hypothesis (Maltby, Day, Pinto, Hogan, & Wood, 2013), focusing on beliefs in being unlucky. The Dysexecutive Luck hypothesis proposes that believing oneself unlucky is associated with lower levels of executive functioning. There are two possible causal directions underpinning the Dysexecutive Luck hypothesis. First, individuals' deficits in executive functioning may have a negative influence on their ability to successfully achieve goals, as a result they label themselves unlucky. Second, individuals, believing themselves to be unlucky fail to engage the executive functions required for successful completion of key goals. In other words, individuals that conceive themselves as unlucky may not effectively initiate, plan, devise alternate strategies, organize, and pay attention in relation to task or goal-orientated behaviour.

All these features are derived from executive functions, which may fail to be properly engaged in these persons, and consequently, failing at the goal¹¹.

Initial support for the Dysexecutive Luck hypothesis (Maltby et al. 2013) was found when it was reported that self-report dysexecutive symptoms accounted for unique variance in beliefs in being unlucky after controlling for established correlates of luck beliefs (personality, irrational beliefs, and self-efficacy). Moreover, experimental support for the hypothesis was offered when it was demonstrated via significant positive correlations between beliefs in being unlucky, two (shifting and inhibition) of the three components (inhibition) of Miyake et al.'s (2000) taxonomy of executive functions, and a significant negative correlation with decision-making ability using somatic markers was found (Somatic Marker hypothesis; Damasio, Everitt, & Bishop, 1996).

The Dysexecutive Luck hypothesis places a key emphasis on the role of executive functioning. Given the physiological basis of executive functioning (Jurado & Rosselli, 2007), the consideration of whether the Dysexecutive Luck hypothesis occurs at a physiological level is important, if only to elucidate the psychological nature of the hypothesis. Currently, there is vicarious physiological evidence for the hypothesis arrived at using measures (e.g. Switch cost task, Stroop test, and IOWA Gambling Task) that are well-established proxies for physiological functioning. For example, task-switching activates a common set of brain regions during diverse executive control operations, including medial prefrontal, superior and inferior parietal, medial parietal, and premotor cortices (Wager, Reading, & Jonides, 2004). Functional magnetic resonance imaging (fMRI) studies have shown that the *IOWA Gambling Task* is related to aspects of the prefrontal cortex (Li et al., 2010) and the color-word Stroop test is related to activation in

¹¹ In addition to the dysexecutive luck hypothesis it is useful to highlight that this reasoning does not suggest that individuals who consider themselves as lucky have improved EF than luck sceptics (Maltby et al., 2013).

the frontal lobe of structures such as the dorsolateral prefrontal cortex (DLPFC) and the anterior cingulate cortex (ACC) (Spreeen et al., 2006; Lansbergen, 2007; Siltan et al., 2010).

To begin this consideration, we addressed the Dysexecutive Luck hypothesis in terms of attentional control, because Maltby et al. (2013) found evidence for the hypothesis around key attentional processes. The cascade-of-control model proposes that during tasks that demand attention, DLPFC takes a leading role in implementing top-down attentional control, later ACC activity is thought to be involved in resolving response-related attentional processes (Banich, 2009; Milham & Banich, 2005; Siltan et al., 2010). Previous studies assessing attentional control of the aging brain in healthy participants have provided evidence that during colour-word Stroop test when early DLPFC activity is relatively low, late ACC activity increases (Milham et al., 2002; Siltan et al., 2010). The authors suggest that increased late response conflict is a consequence of the reduced maintenance of a task set, which causes a need for increased ACC activity in order to compensate for the lack of top-down attentional control required to maintain adequate task performance (Milham et al., 2002; Siltan et al., 2010).

The current study seeks to extend the Dysexecutive Luck hypothesis by providing initial electrophysiological evidence supporting it. For this goal, scalp recorded event-related potentials (ERPs) were recorded during the performance of a Stroop test.

4.2. Method

4.2.1. *Participants*

Initially, 217 undergraduate students (180 females; mean age = 20.34; $SD = 2.1$) completed the six-item Beliefs in Being Unlucky subscale from the Beliefs Around Luck scale (Darke &

Freedman, 1997; Maltby et al., 2008; see Appendix 4.2.). Responses are scored on a five-point scale (1="Strongly Disagree" to 5="Strongly Agree"). Internal reliability estimates for this subscale are $\alpha > .85$ and the measure demonstrates validity via acceptable correlations between both peer and family ratings and predicted correlates of beliefs in being unlucky (Maltby et al., 2008). Participants were recruited from a university experiment participation scheme. The study was advertised and completed online via an electronic survey system.

Twenty-five students were selected from the initial group, all of whom had the highest (item mean > 3.4) or lowest scores (item mean < 1.8) on the beliefs in being unlucky subscale. Five respondents' data was discarded and not considered in the statistical analysis due to either excessive eye-movement irregularities (i.e. artifacts) during the ERP recording and/or because of inconsistent scores in a re-test of the beliefs around luck scale. Thus 20 students (18 women; mean age = 22.7; $SD = 2.81$) were selected for the final study. Two final experimental groups were formed: the 10 participants with the highest scores on the Beliefs in Being Unlucky scale ('unlucky' group; $mean = 4.63$; $SD = .37$) and the 10 with the lowest scores on the beliefs in being unlucky scale (Control group; $mean = 1.43$; $SD = .47$). All participants had normal or corrected-to-normal vision, were unaware of the main purposes of the study, and had no history of any mental or neurological disorders. All participants, except one, were right-handed as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971).

To establish further validity for the experimental groups we administered measures of dysexecutive symptoms (Wilson, Alderman, Burgess, Emslie, & Evans, 1996; DEX-Q; see Section 5.2.2.4. and Appendix 5.4.), neuroticism (Gosling, Rentfrow, & Swann, 2003) and self-efficacy (Chen, Gully, & Eden, 2001). This was to profile both experimental groups in terms of those characteristics found within the wider luck literature, namely that the belief in being

unlucky is positively associated with neuroticism and dysexecutive symptoms, and negatively associated with self-efficacy (Maltby et al., 2008; 2013). A series of Mann-Whitney U comparisons demonstrated that 'unlucky' individuals scored significantly higher on dysexecutive symptoms ($U = 3.88$ $p < .001$), neuroticism ($U = 18.80$, $p = .016$), and significantly lower on self-efficacy ($U = 4.00$, $p < .001$) than the control group¹².

For this experimental study, participants were paid 12.00 GBP. The University of Leicester granted Ethical approval to carry out the study within its facilities (Ethical Application Ref: jm420-c5a3d).

4.2.2. Experimental Measures

The aim of the experimental measures was to record Event Related Potentials (ERPs) during a manual colour-word Stroop test, based on previous Stroop ERP investigations (West & Alain, 1999; Badzakova-Trajkov, Barnett, Waldie & Kirk, 2009), with modifications on the number of control stimuli.

4.2.2.1. Event-related Potentials Technique

The ERPs is a non-invasive measured brain response technique derivative of the EEG. It has provided important information about how the human brain normally processes information, so as the abnormality of this processing when it may be significantly altered mainly due cognitive deficits in psychiatric or neurological disorders. Among the most representative ERPs studies centred on clinical populations are: the ERPs correlates of schizophrenia and schizophrenic-related disorders (Pritchard, 1986; Egan et al, 1994; Gruzelier, 2003; Mannan et al., 2001); of

¹² Please be noted that a multiple regression or covariance analysis would be necessary to further examine if the belief in being unlucky factor is a significant predictor of the dependent variable (i.e. Stroop test effects) over and above any effect potentially related to the other independent variables (i.e. neuroticism, dysexecutive symptoms and self-esteem). Because of this, the interpretation of the results and findings found in the present study (see Section 4.3 and 4.4) should be taken cautiously.

hyperactive children (Callaway, 1983); of major depression (Giese-Davis et al., 1993; Ogura et al., 1991; Miller, 1986; Simons, 1982); and other psychiatric disorders such as Alzheimer and substance abuse (Phillips et al., 2004; Iacono et al., 2002, 1996). ERPs allow precise analysis of the time course of neural events since they provide a real-time temporal resolution of neural processes by reflecting event-locked electrical activity produced by neural ensembles (West & Klein, 1999). The ERP nomenclature refers to the term ‘waveforms’ that consist on a series of positive and negative deflections related to a set of underlying cognitive components. These deflections, or waveforms, occur above a pre-stimulus baseline level of activity which peaks at specific intervals following the stimulus onset and are indicated by a letter that indicates the polarity of the component (i.e. ‘N’ for negative and ‘P’ for positive) followed by a number that refers to the specific latency in ms (i.e. ‘P100’ for a positive latency of 100 ms after the stimulus; for a full introduction of the different ERP waveforms see Luck & Kappenman, 2011). This electroencephalogram-derived technique was used thus to explore whether deficits in executive functions in ‘unlucky’ individuals are associated with elongated (slow) reaction time, and whether larger (more negative) late ERP waveforms underpinning response-related selection processes are specifically associated with the interference effect (in order to compensate for the lack of top-down control).

4.2.2.2. *Stroop Task*

The Stroop test was selected as the executive measure over other physiological assessments (i.e. task switch) since it is widely regarded as a prototypical inhibition task (a main function of attention control) (Miyake et al., 2000), a paradigmatic measure of selective attention (Carter, Mintum & Cohen, 1995), and a well-established proxy for physiological functioning. Its main effect (i.e. Stroop effect) is widely used in clinical practice and is the most extensively studied

phenomena in experimental psychology (MacLeod, 1991). Most importantly, the Stroop test was utilized to test the Dysexecutive hypothesis for the first time in the study on which this study is based (Maltby et al., 2013) and aims to further develop.

The Stroop task employed for the present study was based on both West (1999) and Badzakova (2009) classic Stroop tasks used also in ERP studies, except for two significant variations made. Given that in these Stroop paradigms the stimuli words used as controls were not fully balanced to the ones used in the Congruent and Incongruent conditions in terms of quantity and neither as in condition (two experimental conditions against one neutral condition), the paradigm exhibits a condition comparison and stimuli presentation mismatch, since every word used in control stimuli appeared only once during experiment for a total of 104 different neutral non-colour words ($52 \times 2 = 104$), while in the other hand, experimental stimuli used only four colour-words ('Yellow', 'Green', 'Red' and 'Blue').

The first modification was the addition of one neutral condition to the paradigm in order to fully match the stimuli conditions which now each respectively and separately holds a baseline comparison (two experimental conditions and two control conditions), allowing more flexibility and a more adequate statistical analysis (fully explained in the Section 4.4). These two control conditions were required to be also balanced to the main conditions in perceptual difficulty/conflict, so that they correspondingly represent either one perceptive congruency or one perceptive incongruence only between them (See Table '4.1'). Therefore, control incongruent trials provided one cognitive incompatibility: a grapheme-length mismatch; and control congruent trials delivered also a single cognitive compatibility: a grapheme-length match; whereas the incongruent and congruent conditions respectively possess either two

incompatibilities (one grapheme-length and one semantic content mismatch) or two compatibilities (one grapheme-length and one semantic content match).

The second variance was the number of stimuli words matching for all conditions, by having the same number of control non-colour words as the colour words in the Experimental conditions (4), for a fully matched balanced design. Control non-colour words were chosen carefully from the HAL online database; were all stimuli matched in similar HAL frequency, same number of syllabus and same part of speech (all stimuli were adjectives/ nouns). Furthermore, two parallel versions of the Stroop were (still fully-matched) created differing only in the control non-colour words, with the intention of avoiding any possible attentional bias due to a more distracting word.

Table 4.1

Table composition of all the stimuli used during the Experimental Phase of the Stroop task

Stimulus Condition	Word Stimuli Examples	# of Trials	Description
Congruent	‘red’ (in colour red)	144	Word-Colour: matched Word-Colour grapheme length: matched
Incongruent	‘red’ (in colour blue)	144	Word-Colour: mismatched Word-Colour grapheme-length: mismatched
Control Congruent	‘dog’ (in colour red), ‘jump’ in colour (blue)	144	Word-Colour: neutral Word-Colour grapheme-length: matched
Control Incongruent	‘north’ (in colour red), ‘deep’ (in colour yellow)	144	Word-Colour: neutral Word-Colour grapheme-length: mismatched

Verbal stimuli for the Stroop test consisted of four colour-words and four control non-colour words. To reduce potential cognitive confound and bias among the verbal stimuli, the selection criterion for the control words was based and balanced on the following linguistic characteristics from the English Lexicon Project website (Balota, et al., 2007): (1) HAL Word Frequency, i.e., selecting words with similar frequency values from the Hyperspace Analogue to Language frequency forms corpus (Lund & Burgess, 1996); (2) Parts of Speech, i.e., selecting only adjectives and nouns; (3) Lexical Decision Task Behavioural Results, i.e. similar mean RTs (ms); (4) Grapheme-length, words that are matched by the same number of letters to their respective colour-word; and (5) Syllables, all of the control words matched the number of syllables of their respective colour-word.¹³

4.2.3. Procedure

Participants were instructed that it was highly important during the recording to remain still, avoiding as much body movement as possible, to keep their eyes fixated at the centre of the screen, and to blink only when necessary and preferably between-trials when stimuli disappeared.

Subjects sat 57 cm from a computer screen, and were restricted by a head and chin rest installed between the chair and the screen to minimize head movements. Stimuli were presented at a resolution of 1,024 x 768 pixels on a 21-inch monitor with a vertical refresh rate of 100 Hz. The task and EEG triggering was constructed and generated by E-Prime 2.0 software

¹³ In the interests of full disclosure respondents completed the Trail-Making Task (Reitan, 1958). However no difference was found for this scale, since it measures executive function among a clinical population thought to have substantial clinical deficits and therefore all respondents performed well at this task.

(Psychological Software Tools, Pittsburgh, PA), running on a PC Pentium IV desktop computer. Responses were recorded using a serial response box that featured a 0 millisecond debounce period, which allows for a high precision on answer recording. Each trial started with 1000 ms. of a white fixation cross (“+”) which was presented over a black background at the centre of the screen. This was replaced with the target stimulus item shown for 1000 ms. A blank screen followed lasting 700 ms. Written feedback with a duration of 300 ms appeared at the centre of the screen after incorrect (‘wrong’) and missing (‘missing’) responses. The speed of response timeframe remained unaltered for all trials; with a total duration for each trial being 3000 ms.

Participants were required to indicate the colour of the font (red, blue, yellow or green) of the stimuli shown at the centre of the screen. They did this by pressing one of the four corresponding buttons on a button box using the index and middle fingers of the right and left hands. All target stimuli were presented in a random order, though all were presented in the font style Courier New , with a font size of 25 and a bold font style. At the beginning of the acquisition and practice phases, and before the start of each test block, a message appeared on the screen instructing the participants to press the space bar to begin the block of trials. After the space bar was pressed, the screen was blank for 2000 ms.

The total duration of each Stroop experimental session recording was 30 minutes, and consisted of three sequential phases:

- a) A colour-to-key acquisition phase designed to establish a strong mapping between the stimulus colours and the correct response keys. This phase was presented in a single block of 96 trials with each of the four colours represented 24 times in a series of ‘X’s, equal in grapheme-length to the colour’s name (‘xxx’ in red font, ‘xxxx’ in blue font, ‘xxxxx’ in green font, and ‘xxxxxx’ in yellow font).

- b) A practice phase consisting of 48 trials with the four types of stimuli conditions (congruent, incongruent, control congruent, and control incongruent) also used in the upcoming phase. Stimuli in the congruent condition were coloured-words that were presented in the colour congruent to their meaning (e.g. 'RED' in red font). Stimuli in the incongruent condition were coloured words presented in any of the three colours that did not match their meaning (e.g. 'RED' in blue font). Stimuli in the control congruent condition were coloured words that were matched for their grapheme length with the colour words (e.g. 'DOG' in red font). Finally, stimuli in the control incongruent condition were coloured words that were mismatched for grapheme-length with the colour words (e.g. 'NORTH' in red font). Each of these four conditions had 12 trials.
- c) A test phase (EEG recorded) that had the four condition trials balanced, with each presented 24 times in a single block, for a total of 96 trials per block. A brief break occurred in between blocks. Six blocks with a grand total of 576 trials were run in this phase. Stimuli in all phases were presented in a random order.

4.2.4. ERP Recording and analysis

Continuous EEG signals were recorded by a DC 32-channel amplifier (1-kHz sampling rate, 250 Hz high cut-off frequency; Brain Products Inc., Germany). The EEG activity was recorded via a Waveguard elastic cap, containing 64 unshielded and sintered Ag-AgCl electrodes (CAP-ANTWG64; ANT, Netherlands), with an electrode layout according to the international 10–5 electrode system. The following electrodes were used during the recording FP2, F3, FZ, F4, FC5, FC1, FCZ, FC2, FC6, C3, CZ, C4, CP5, CP1, CP2, CP6, P7, P3, PZ, P4, P8, PO7, PO3, PO4, PO8, O1, OZ, and O2. The electrode on the right-earlobe served as on-line reference. EEG waveforms were re-referenced off-line to the average of both electrodes. Two electrodes served

to record the horizontal electrooculogram (HEOG) positioned in a bipolar montage at approximately 1 cm from the outer canthus of each eye. The vertical electrooculogram (VEOG) and blinks were recorded using an electrode placed below the right eye and Fp2 referenced to the right earlobe. Electro impedance was kept below 5 K Ω . EEGs were epoched from 200 ms pre-stimulus-onset to 1000 ms post-stimulus-onset. Each EEG epoch was inspected off-line, and those with ocular artifacts (as indicated by HEOG activity exceeding ± 30 μ V and VEOG activity exceeding ± 80 μ V) were excluded from statistical analyses. Only ERP data for trials with correct responses were analysed, therefore artifacts from eye movements and excessive noise were marked bad and discarded after a selective individual trial review of each participant's data. To help remove slow and sustained shifts in voltage (from non-neural origin) during data acquisition and reduce high-frequency noise, averaged ERPs were filtered using 0.05 Hz high-pass, 30 Hz low-pass and 50 Hz notch filters.

Mean amplitudes of ERP waveforms in the time window of 450 – 780 ms relative to a 200 ms pre-stimulus baseline were obtained for each subject under each of the four conditions. This late ERP time window was chosen based on visual inspection and on relevant source-ERP colour-word Stroop research. In particular, a recent study (Silton et al., 2010) supported a role only for late ACC activity (520-680 ms), which is related to later aspects of response selection, in differentiating Stroop conditions (Silton et al., 2010). ERP mean amplitudes were measured for a selected group of four electrodes in the fronto-central scalp region (Fz, FC1, FCz, FC2). This region was chosen because it was likely to reveal the brain processing associated with cognitive control, in a situation requiring effective inhibition of distracting task-irrelevant information (Badzakova-Trajkov, Barnett, Waldie, & Kirk, 2009).

4.2.5. Variable creation and statistical analyses

A semiautomatic filtering operation of raw RT data was carried out by E-prime 2.0 in order to remove extremely slow (retardation) and extremely fast (anticipation) responses. Consistent with other studies in the area (Fuggetta, 2006), an absolute exclusion criterion excluded RTs less than 150 ms and greater than 3000 ms. The magnitudes of a variety of effects were computed and analysed for analysis. These effects were obtained after computing three different combinations of conditions and mean averages in the Stroop test, such as the facilitation effect (control congruent condition minus congruent condition), interference effect (incongruent condition minus control incongruent condition), and Stroop effect (incongruent condition minus congruent condition). Mean error (%), and Stroop condition effects (ms) for the correct trials were only used in the reported analysis of variance (ANOVA). Three differential effects of the factor condition on the two groups of participants were quantified on the basis of ERP mean amplitudes from a particular region of interest (fronto-central area) using four electrodes' activity (Fz, FC1, FCz, and FC2) during the time window of 450 – 780 ms post stimulus onset and reading that were used in the report ANOVA. For each ANOVA, the sphericity assumption was assessed using Mauchly's test. Greenhouse-Geisser epsilon adjustments for non-sphericity were applied where appropriate. Post-hoc paired t-test were Bonferroni corrected for multiple comparisons. For statistical testing, $p < .05$ was considered significant.

4.3. Results

Both behavioural and physiological data was also performed using the IBM Statistical Package for Social Sciences (SPSS) program version 20.0. The mean percentage of errors in the Stroop test was 2.572 ± 0.574 % with the mean percentage of errors for the facilitation effect $M = 0.31$ ($SD = .62$), interference effect $M = 3.17$ ($SD = 0.8$) and Stroop effect $M = 4.24$ ($SD = 1.5$). An

ANOVA showed a significant effect for the conditions ($F_{(1.2, 21.6)} = 7.24, p = .002, \eta^2 = .29$), with post-hoc comparisons showing a significant difference between facilitation effect compared to the interference effect (.308% vs. 3.167%, $p = .033$), and the Stroop effect (.308% vs. 4.242%, $p = .037$). This means that participants in both groups had significantly more errors in the interference and Stroop conditions than in the facilitation condition (Stroop and interference conditions represent the conflict). These effects are expected for each Stroop test. There was no significant main effect for group ($F_{(1, 18)} = 1.24, p = .280$), meaning both groups performed in a similar fashion across the conditions.

In terms of the experimental groups' performance on the Stroop test, descriptive statistics (mean, accuracy, and reaction times) for the three Stroop condition effects in the two groups are shown in Table 4.2. Mean RTs for the magnitudes of the three condition effects on the Stroop test for both groups were 78.15 ± 9.39 ms. An ANOVA for the mean RTs showed a main effect of 'Group' ($F_{(1, 18)} = 6.30, p = .022, \eta^2 = .26$). There was also a significant main factor "condition effect" ($F_{(1.2, 21.2)} = 55.9, p < .001, \eta^2 = .76$). Furthermore, there was a two-way interaction "condition effect by group" with $F_{(1.2, 21.2)} = 5.3, p = .027, \eta^2 = .23$. Post-hoc comparisons showed a significant difference between the 'unlucky' and control group for interference effect (68 vs. 132 ms, $p = .027$), and Stroop effect (90 vs. 163 ms, $p = .017$), but not in the facilitation effect (6 vs. 9 ms, $p = .766$). Means for each experimental group's RTs and accuracy are provided in Table 4.2.

Table 4.2

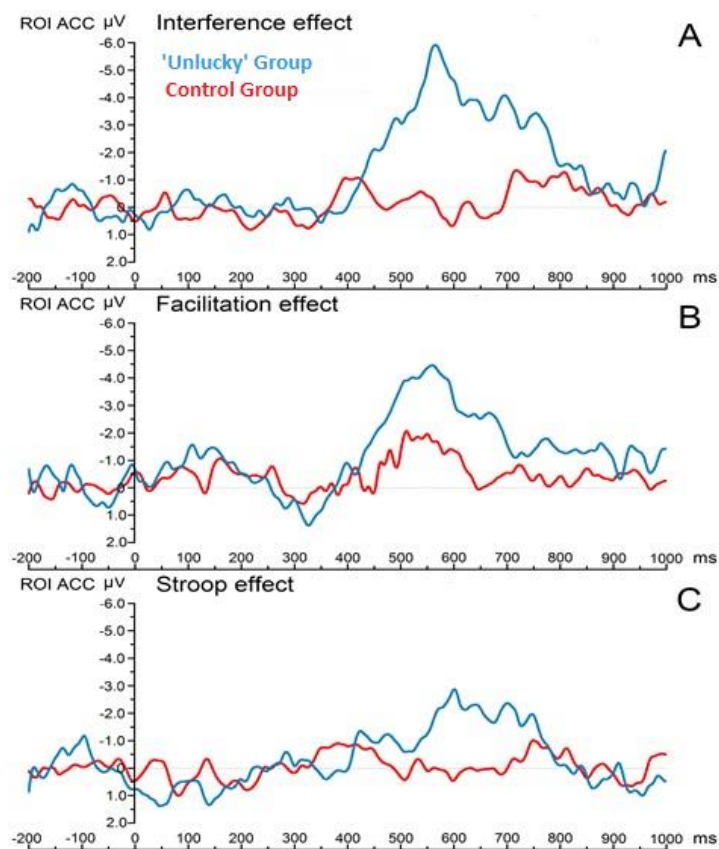
Mean reaction times in milliseconds and Mean accuracy (%) for both experimental groups.

	Main Condition Effects		
	Interference (incongruent condition - control incongruent condition)	Facilitation (control congruent condition - congruent condition)	Stroop (incongruent condition - congruent condition)
Control Group			
Reaction Time [ms] (SD)	67.77 (48.78)	6.00 (16.80)	90.01 (56.87)
Errors % (SD)	6.10 (1.13)	- 1.33 (0.88)	5.5 (1.48)
'Unlucky' Group			
Reaction Times (ms)	132.47(69.90)	9.14 (28.40)	163.50 (67.66)
Errors %	3.92 (4.55)	.77 (2.27)	4.70 (5.36)

Figure 4.1 shows the grand average ERP's of the three main condition effects for both experimental groups. The time-window where the greatest ERP activity occurred was the late time window, 450 – 780 ms which showed a statistically significant main effect of 'group', with $F_{(1,18)} = 7.17$, $p = .022$, $\eta^2 = .285$. There was an overall effects significant difference with decreased ERP amplitudes for the control group compared with the 'unlucky' group (0.169 vs. - 2.674 μV). More importantly, a significant three-way interaction 'Electrode * Condition effect * Group' was also found ($F_{(6,108)} = 2.21$, $p = .028$ $\eta^2 = .109$). Post-hoc comparisons of the significant three-way interaction revealed a significant difference in the amplitude of the late

ERPs between the 'unlucky' group and the control group. Notably, there was a significant difference in the magnitude of interference effect for electrodes Fz (0.202 vs. -3.788 μ V), FC1 (-0.335 vs. -3.638 μ V), FCZ (-0.078 vs. -3.663 μ V), and FC2 (-0.324 vs. -3.752 μ V), respectively (the study's region of interest). Moreover, there was a significant difference in the magnitude of the facilitation effect between individuals with no beliefs in being unlucky and individuals with beliefs in being unlucky for electrode Fz (0.608 vs. -2.951 μ V) and FC1 (0.753 vs. -2.821 μ V).

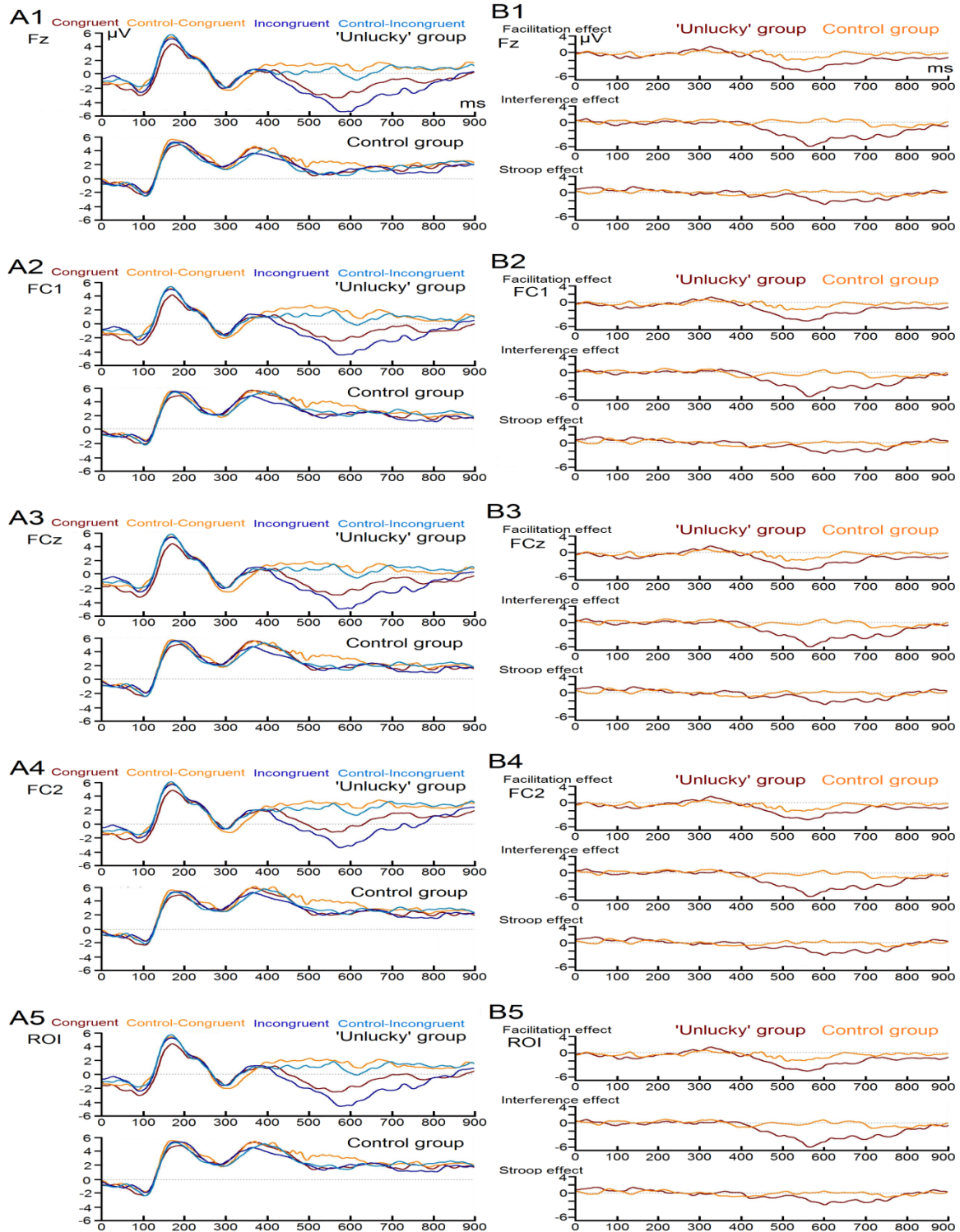
Figure 4.1. *Grand Average ERP's of the three main condition effects for both study groups*



Notes: All the effects were obtained from the combination of four fronto-central electrodes, or region of interest (Fz, FC1, FCz, and FC2) during the time window of 450 – 780 ms. The greatest effect was found

on the interference effect (A). The next figure (see Figure 4.2) shows individual ERP's of each of these four main electrodes.

Figure 4.2 Four main individual electrodes' ERP's of each Stroop test condition (A1, A2, A3, and A4) and of the three main condition effects (B1, B2, B3, and B4) for both study groups.



4.4. Discussion

Maltby et al. (2013) proposed the Dysexecutive luck hypothesis; its premise indicates that beliefs in being unlucky are correlated to a range of EF. Within this study, they provided initial support to this hypothesis via a self-report of dysexecutive symptoms, assessments of EF assessment (inhibition and shifting), emotional processing related to EF, and higher EFs examined via divergent thinking. All these array of evidence resulted in important behavioural support to this theory. The current study aimed to provide the first physiological lead to the dysexecutive luck hypothesis.

The first finding, consistent with Maltby et al. (2013), was that 'unlucky' individuals performed poorly on the Stroop test and interference main effects when compared to the control group. The interference effect differences between groups are of great importance since it has been emphasised that the overall Stroop effect is not enough for an accurate conflict measure, it is necessary to have a comparison to a baseline neutral condition. The interference effect, which measures an interference or “cost” relative to a neutral condition, is the most reliable and robust component within the Stroop test (Henik & Salo 2004; Macleod, 1991). Electrophysiological results supported the role of late negative ERPs amplitude due to incongruent trials in differentiating 'unlucky' individuals from the control group in the magnitude of the interference effect.

In the current study, as in previous ERP studies, we used a difference waveform (incongruent condition - control incongruent condition waveforms) in an attempt to isolate the processes specifically associated with the interference effect (Badzakova-Trajkov et al., 2009; Markela-Lerenc et al., 2004). Although the late time window chosen in the current investigation between 450 and 780 ms is an unusual epoch for Stroop-related effects, we were particularly

interested in assessing late-stage response-related processing, which we hypothesised would be enhanced in the group of 'unlucky' individuals to compensate for their impairment in high-order attentional control processes. A recent study employed the source-waveform ERP mediation analysis (Hayes, 2013) and found that only late ACC activity (520-680 ms) was correlated with the interference effect, distinguishing the waveforms between incongruent/congruent conditions (Silton et al., 2010). Thus the findings demonstrated as did previous studies, that late-stage response-selection processes are specifically associated with ACC function (Milham et al., 2003; Silton et al., 2010). Furthermore, an ERP study on the colour-word Stroop test (Liotti, Perez, Woldorf, & Mayber, 2000) found a significant difference in the incongruent relative to the congruent trials on a left temporoparietal cortex scalp region during a late time window of 600 – 700 ms, supporting the role of late-stage response-selection processes in the interference effect.

Overall, both the indirect behavioural and direct electrophysiological significant interference effects of the present study can be interpreted with Silton et al. study (2010), which integrated fMRI and ERP data to identify the time course of regional brain activity associated with top-down attentional control during the execution of a colour-word Stroop test. Silton et al. demonstrated that the degree to which ACC influenced Stroop performance depended on the level of earlier DLPFC activity. When DLPFC activity levels were high, there was little ACC impact on activity on Stroop performance. This suggests that, when DLPFC provides sufficient attentional control, ACC has a smaller role in affecting overt performance. The finding that ACC activity was not critical for performance when DLPFC activity was high is also consistent with a prior study (Milham et al., 2003). A similar pattern of neurophysiological activity has been found in the current study in the individuals of the control group. This group's minimal level of late

ERP interference effect and adequate level of behavioural performance are direct evidence for this interpretation.

Furthermore, Siltan et al., (2010) demonstrated that in the case of low DLPFC activity, there was a relatively high late ACC activity, which affected Stroop performance with a response pattern that involved slow RT responses. These results were consistent with the idea that ACC was compensating for the lack of top-down DLPFC control (Siltan et al., 2010). The pattern of results for 'unlucky' individuals in the current ERP study echoes these previous results; the individuals exhibited a significantly increased response conflict with greater RTs and larger late negative response-related ERPs during incongruent trials, compared to the control group.

The increased facilitation effect exhibited only in ERPs, could be the result of an early, non-strategic priming effect (word 'red' in red font), or a deficiency in the strategic allocation of attention that may result in word-reading errors (participants read the word rather than name the colour). In terms of the interference effect, both the RTs and ERP results complement each other quite well, given that it is the only one of the three main condition effects revealing significant differences between groups. A global interpretation of these results suggests that 'unlucky' individuals had a slower processing of the interference or "cost" relative to a baseline condition in the interference effect, translating to slower RTs and greater ERP magnitudes in this condition effect when compared to the control group. Furthermore, the control group had adequate attentional resources available to perform the task and quickly resolved the 'conflict condition,' and did not manifest a strong interference effect in the late ERPs. This suggests that the conflict resolutions of the Stroop test occurred earlier in the control group than in the group of 'unlucky' individuals.

The present study is observational and cross-sectional in nature (since no conditions were experimentally manipulated), therefore it is important to highlight that the findings cannot establish that neural dysfunction in the executive network caused participants' beliefs in being unlucky. Neither confirm, at a highly specific localization level, which specific structures of the brain were responsible for the different main effects found in this investigation [mainly due to the limited number of channels (24) used in the electrophysiological data recording]. However, these effects do show an association between self-reported beliefs and neural dysfunction, and also suggest an anatomical basis. The electrodes' region of interest in the current findings (fronto-central scalp) is in agreement with other ERP investigations that reveal a consistent neuroanatomical basis, correlating the Stroop effect with strong activation in the DLPFC and especially the ACC (e.g. Carter & Van Veen, 2007; Botvinick et al., 1999). Taken together, these studies strongly support a conflict-monitoring hypothesis (Bush et al., 2000), whose main premise identifies the ACC as the structure of the brain responsible for signalling the occurrence of conflicts in information processing, triggering compensatory adjustments in cognitive control. In a Stroop test this event can be specifically identified in the semantic conflict generated by the incongruent stimuli.

With respect to future research related to the current thesis work, there is an opportunity to further examine some of the findings presented. For instance, a possible study based on two pending ideas would consist on first seeing if the electrophysiological lead supporting the dysexecutive luck with belief in bad luck in UK can be replicated in another country, and/or the potential to extend the number of luck factors employed in that study and work with all four beliefs around luck factors. This would signal if there were cross-cultural potential to the earlier work and something that could be pursued, as a continuation of this thesis work. Additionally, it

would be also interesting to examine how the dysexecutive hypothesis might behave when applied to other related and common beliefs, such as hope.

4.4.1. Conclusions

In summary, the findings provide physiological data that is consistent with the Dysexecutive Luck hypothesis. They suggest that increased response conflict in the context of deficits executive functions of 'unlucky' individuals have probably caused a need for increased late ACC activity, which in turn translated to lengthened RTs and increased magnitude of late ERPs primarily involved in response-related processes. This alteration of regional neural activity also supports the concept introduced in previous studies that ACC was compensating for the lack of DLPFC attentional control in the attempt to maintain adequate task performance.

This chapter provided electrophysiological evidence for a significant effect of EFs and a specific superstitious belief (belief in being unlucky), supporting in turn the recent EF-superstitious belief correlation hypothesis, the Dysexecutive hypothesis. The following chapter presents an exploratory study which aims to continue this lead. Widening the object of study, and focusing on several religious, religious-related and superstitious factors to further investigate psychological relationships between magical-religious beliefs and examine whether another correlation effect to EFs can be evidenced.

CHAPTER 5: Examining the Relationship of Luck, Religious and Religious-related Factors to Executive Functions and Extended Factors

Abstract

The present chapter covers a final study which shifts its emphasis into an exploratory study. It is based on the dysexecutive symptom and beliefs in being unlucky significant effect lead found in the previous study (chapter 4) and Maltby et al. (2013). This last study within this thesis work intends to explore whether there is any evidence of an executive function (EF) deficit (via the DEX and its extended EF measure based on attentional control in the presence of emotions; eACS) correlation to religious attitudes, religious, and luck dimensions. Therefore, a sample of 192 participants was tested with a questionnaire battery formed by measures correspondent to these factors. Moreover, the addition of the belief around luck measure also permitted testing the relationship between these two beliefs within a single sample. Results from Pearson's correlation showed significant interactions between the beliefs and the EF measures, although this interaction seems to be especially dependent of the belief valence; for instance, it was found that negative oriented beliefs (i.e. negative religious coping; belief in being unlucky) were significant related to virtually all DEX factors. Furthermore, multiple regression analyses confirmed the interaction between negative oriented religious factor (i.e. negative religious coping) and EF (DEX total). These findings are consistent to the thesis' non-reductionist approach to beliefs, which hypothesized that religion and superstition are not a substitute for each other, nor the same exact phenomenon, but rather similar and peripheral phenomena.

5.1. Introduction

Terms like religion or superstition are omnibus terms that are difficult to pin down to prescribed definitions. Given their ambiguity, these terms can imply numerous meanings formed by multiple dimensions, and therefore, be directly and indirectly involved to a diversity of psychological-related effects. Needless to say, these are not simple phenomena, and therefore should not be reduced and considered as the same, despite the relation. Nevertheless, an

important limitation that religion and superstition face is the relatively simplistic and reductionist approach taken toward their measurement (Hill, 1999). Albert E. Ellis (2000), an authoritative emotion researcher highlighted how the loose use of these terms in literature raises significant concerns, leading him to admit that even himself has previously used the religion term in psychology inappropriately, in cases where he should have defined both terms clearly (i.e. investigating the compatibility of mental health with religion). Ellis (2000) rectified his previous ideas and encouraged thus a more consistent effort for the defining of these ambiguous terms, in order to avoid definitional trouble. Specific distinctions for these phenomena followed, with the identification of multiple subfactors of religion (i.e. intrinsic, extrinsic religiousness).

In an attempt of clarifying the number of meaningful religiosity dimensions, and in turn demonstrate the complexity of religion in research, Kendler's et al., (2003) study revealed dynamic and abundant significant associations between a diversity of religious dimensions and lifetime psychopathology. Kendler's et al. approach to the religiosity construct in research supports a multidimensionality approach of religion (Abeles et al., 1999). Results showed a significant correlation of seven religiosity dimensions/factors to several emotional-related ("internalizing") disorders including major depression, generalized anxiety disorder, phobia, panic disorder; and substance abuse ("externalizing") disorders including nicotine dependence, alcohol dependence, drug abuse or dependence, and adult antisocial behaviour. Social religiosity and thankfulness were associated with reduced risk for both internalizing and externalizing disorders; four factors, general religiosity, involved god, forgiveness, and god as judge, with reduced risk for externalizing disorders only; and one factor, unvengefulness, with reduced risk for internalizing disorders only (Kendler et al, 2013).

As it has been detailed throughout the length of this thesis, there is a well-established correlation of psychopathology (i.e. emotional related disorders) and executive functions (EF) deficits (see Chapter 3). For example, relative to non-anxious controls, anxious people have shown heightened activation of the brain's fronto-parietal attentional system in tasks such as the Stroop (Eysenck et al., 2007). When resources are further constrained, as in stressful or emotionally provocative situations, some trait-anxious people may have difficulty controlling their attention and preventing distraction. Performance in a demanding, emotional task such as the emotional Stroop task may then reflect that of someone low in attentional control (AC) even if they have a high score on the affectively-neutral attentional control scale (ACS) (Reinholdt-Dunne, Mogg, & Bradley, 2009).

The emotional attentional control scale (eACS); Barry, Hermans, Lennaert, Debeer, & Griffin, 2013) is a recent measure adapted from the widely-used measure for Attentional Control Scale (ACS; Derryberry & Reed, 2002). The original ACS was concerned with the assessment of voluntary attentional processes in neutral situations, that is, affectively-less stimuli, whereas the eACS is focused with attention in the presence of emotion, or emotionally provocative items. It functions as a specific emotional-centred extension/complement to dysexecutive function measures. Since along this thesis the emotional-laden nature of beliefs such as religion and luck has been continuously stressed, the inclusion of an wider EF, that was emotional-oriented, resulted an interesting and suitable measure option to expand further the comparisons between religion and luck, and thus the eACS was then incorporated as part of the questionnaire battery.

5.1.1 Study Aims

So far all three of the studies that have been included within this thesis have revolved around examining EF or performance effects in a specific sample of interest (i.e. religious believers, unlucky believers); these three study designs can be summarized so far as a) performance assessment in a simple test (anagram task) on a group of religious believers under a manipulated religious condition (Chapter 2); b) assessing of any possible emotional attentional biases using a Religious Stroop in religious believers (Chapter 3); c) physiologically inspection of semantic inhibition using a classic Stroop in participants with high levels of beliefs in being unlucky (Chapter 4). Based on Maltby et al. (2013), this specific investigation corroborated at an electrophysiological level an association of an executive function deficit to a negative-oriented superstitious belief (i.e. belief in being unlucky). Similarly, this current chapter presents an investigation that seeks to determine whether a religious factor/dimension can be also correlated to dysexecutive symptoms (i.e. EF deficits). Thus, for the current and final study, it is hypothesized that religious and luck factors would interact with EF factors when comparing several of their valence oriented subfactors.

5.1.11. Selection of Religious/Luck-Derived Factors

A variety of belief around luck and religious derived factors were selected. Each of these factors will be explained as to why they were particularly chosen, with the aim of examining their interactions to EF. Two major models encompassing greatly contrasting religious views about god and the belonging religious group were identified to be embraced by religious believers during a study that aimed to examine the use of religion at coping with major life stressors (Pargament, 2001). “The-sinners-in the-hand-of-an-angry-god” model consisting of people that feels angry towards god and believe they are being punished for their sins or lack a strong

emotional support from their church or synagogue are linked to poorer mental outcomes (i.e. an increase of distress, anxiety and depression). Whereas the contrasting “loving god” model, referring to believers which see a god that acts as a partner (instead of a punisher) who is supportive with their problems, with a resilient approach to life that considers difficult situations as opportunities for spiritual growth and believe they are being fully supported by their respective religious leaders and fellow members are associated to more positive mental health outcomes.

In summary, with the two-model religious adherent Pargament (2001) successfully differentiated two major classes of believers. By basing on a collection of polarized (i.e. positive and negative) attributes, attitudes, emotions and experiences representing two opposite sides of the spectrum of the believer integrative experience towards their religion and god. But the need for distinction of believers was already addressed earlier (Kirkpatrick, 1997; Gorsuch, 1988), rapidly obtaining an empirical support. A group of clinical findings strongly suggest that the same optimistic beliefs on religion which later formed the basis of the “loving god” model help to avoid substance abuse disorders, when compared to negative views on god (for a full research review see: Hood, Spilka, Hunserberg & Gorsuch, 1996; Batson, Schoenrade & Ventis, 2003, pp. 437- 438).

5.2. Methodology

5.2.1. *Participants*

The University of Leicester granted Ethical approval to carry out the study overseas (Ethical Application Ref: jm420-cce3), in addition to permission from the Universidad Autonoma de

Aguascalientes (Autonomous University of Aguascalientes; Mexico) to perform data collection with students from that institution. Two hundred and twenty Mexican Spanish speaking undergraduate psychology students (different academic years) from the aforementioned university, ranging from an age of 18 to 27 years, were given a consent form and agreed to participate in a screening which was divided in two sessions, consisting of back-translated versions (Spanish language) of three scales. Each of the sessions lasted 40 minutes. Data for 28 participants had to be discarded due the incomplete items in the collection of measures. A total of 192 participant's data (70 males, 122 females), with an age average of 20.6 ($SD = 2.1$), was used to run the statistical analysis. Participants were not paid.

5.2.2 Measures:

The study centred on a range of religious factors which are based upon the 17 major clusters classification of religion , categorized and found in an authoritative reference volume of religious measures (Hill & Hood, 1999). Participants responded to a battery of questionnaires consisting of back-translated (Spanish) versions of a luck-based scale (Belief around Luck Scale; Darke and Freedman , 1997; Maltby, Day, Gill, Colley & Wood, 2008); three religious scales including the “Age Universal” I-E Scale (Gorsuch & Vebale, 1983; Maltby, 1999), the Religious Coping Scale (RCOPE; Pargament et al., 1998) and a questionnaire comprising several religious dimensions (Kendler, 2003); two EF-related scales, the Dysexecutive Questionnaire (DEX-Q; Wilson et al., 1996), and a recently developed emotional-oriented EF scale, the Emotional Attentional Control Scale (eACS; Barry et al., 2013). All of the factors belonging on these scales are covered in the following sub-sections.

5.2.2.1. Religiosity-related Attitudes

The following factors are based upon a study that identified seven different religious-related attitudes factors with the aim of investigating their relationship to several emotional related disorders, including major depression, generalized anxiety disorder, phobia, panic disorder among others (Kendler et al., 2003; see Appendix 5.3 for all the items). Such factors were created after selecting, and grouping, a total of 30 items from a range of sources such as official religious scales, and self-developed, since not being able to find satisfactory items. A cluster made of three factors reflecting specific religious-related attitudes, including forgiveness and gratitude (Forgiveness/Love, Unvengefulness, and Thankfulness), and an individual factor involving the judgmental and punitive nature of god (God as Judge). It is important to highlight that these factors are not all necessarily entirely religious per se, but rather religiosity-related attitudes, for instance in some of the factors the terms ‘god/religion’ does not even appear. These dimensions appear to have limitations since they ignore standard validity issues. Although Kendler and colleagues (2003) argue that the distinctive relationships observed between the identified dimensions and psychopathology do represent a strong sign for their validity.

a) *Forgiveness and Gratitude*. The first factor is termed Forgiveness/Love, it consists of seven items concerning love, caring and forgiving (e.g. ‘I feel deep love for the world and all the creatures in it’; ‘I believe that you have to care about people regardless of how they treat you’; ‘I try to be forgiving toward other people’). The original source for the selection of these items: four items from ‘Love and caring’ (see Kendler, et al., 2003) and 3 items from ‘Forgiveness versus revenge’, a scale that partially modified (see Kendler et al., 2003; Mauger et al., 1992). None of the items in this factor mentions the term ‘God’. There are a handful of studies that have examined emotion and religion, and have successfully identified emotions such as love and gratitude as the most frequently emotions experienced towards god (Samuels & Lester, 1985;

McCullough et al., 2002). Example items are: “I can forgive even if someone hurts me on purpose” [Item 2] and “I feel deep love for the world and all the creatures in it” [Item 7].

b) Unvengefulness. Consisted of eight items; four items of ‘Forgiveness versus revenge’, one item from a subscale of the ‘Parental influence on God images’ (‘God as Love’) (Hertel & Donahue, 1995), and 3 items from ‘Gratitude versus ingratitude’ (Kendler et al., 2003). Such factor should be originally termed as ‘vengefulness’, but given its items scoring switch to positive direction, with the purpose of consistency, the term was thus modified. In the same fashion as Kendler et al., 2013, these two factors (e.g. forgiveness and gratitude) were essentially treated as religious factors, although it is important to emphasize that they do represent attitudes that are often, but not always, associated with religiosity (e.g., forgiveness, gratitude, and love). These could therefore be separated from more formal religious and spiritual beliefs (Hill, 1997; Abeles et al., 1999). Example items are: “It is all right to get back at someone who hurts or offends you (scored negatively)” [Item 1] and “If people are not kind to me, I am not going to be kind to them (scored negatively)” [Item 5].

c) Thankfulness. Contained four items reflecting feelings of thankfulness versus anger toward life and God; two items came from ‘Gratitude versus ingratitude’ (Kendler et al., 2003) and 2 items from a subscale of the Multidimensional Measurement of Religiousness/Spirituality (Religious coping) (Traphagan, 2005). Example items are: “I feel thankful for what I have received in life” [Item 1] and “I wonder whether God has abandoned me (scored negatively)” [Item 4].

d) Judgmental Nature and God. A standalone factor also selected from Kendler’s et al. (2003) was God as Judge. Originally termed “religious conservatism” (Kendler, Gardner, &

Prescott, 1997), because it reflected beliefs about the nature of God most prominently seen in fundamentalist American Protestants. This factor differs from the three factors that encompass the previous cluster in the sense that all of its seven items are directly related to god (the term ‘God’ appears in each of its items), and deal specifically with the judgmental and punitive nature of God. It is encompassed of all the 3 items from the Parental influences on God images subscale (God as authority) (Hertel & Donahue, 1995), two items used in a female-female twins study (Kendler, Gardner & Prescott, 1997), one from the Multidimensional Measurement of Religiousness/Spirituality subscale (religious coping), and one item from Nature of God scale, which purpose is to measure the level of perceived involvement of God in his creation (Kendler, 2003). This particular factor was selected to examine its particular interaction to ‘unlucky beliefs’ and other factors involving absolutistic views. Example items are: “I believe God will punish me if I do something wrong” [Item 4] and “I feel that stressful situations are God’s way of punishing me for my sins or lack of spirituality” [Item 6].

5.2.2.2. *Religious Factors*

Religious Orientation Scale: The ‘Age-Universal’ I-E Scale-12 (Gorsuch & Venable, 1983; Matby, 1999). Intrinsic and Extrinsic religion orientation are two well-defined and familiar religious dimensions recurrently employed in scientific religious research. The original “Religious Orientation” Scale (Allport & Ross, 1967) measures Allport’s Intrinsic (I) and Extrinsic (E) religious orientations. It continued being developed and refined. One of the most significant changes was the type of language it was written. Since it was originally designed to test adults it had a refined language, but the scale was later adapted to a simpler language for general public. It was also divided into two separate factors; extrinsic-social and extrinsic

personal and named “Age Universal” I-E Scale (Gorsuch & Venable, 1983). It became revisited and amended once again, resulting in a shortened 12-items scale (Maltby, 1999) and referred as The 'Age-Universal' I-E Scale-12. This latest version consists of six intrinsic items (e.g. ‘I enjoy reading about my religion’) and six extrinsic items formed by two divisions: 3 extrinsic-personal items (e.g. ‘I pray mainly to gain relief and protection’) and three extrinsic-social items (‘I go to church mostly to spend time with my friends’); for a total of 12 items. Participants are instructed to respond each item using a three-point Likert scale where 1 = No, 2 = Not certain, and 3 = Yes. The scoring is performed by a sum of the responses made separately in each factor. The higher scores equal the greater degree of religiosity in each condition. Since the beginning of the Religious Orientation Scale, some suggestions have been made to improve psychometric confidence in the measurement of the intrinsic and extrinsic religious constructs. The main change to take consideration suggest that religious orientation constantly features the intrinsic orientation towards religion , while an extrinsic orientation towards religion represents two separate factors; extrinsic-social and extrinsic personal. Maltby (1999) examined the internal structure of a measurement of intrinsic–extrinsic religiosity among both adults and school children. Findings obtained confirm that the scale provides a psychometrically reliable measure for these dimensions, and suggesting a 12-item measure of intrinsic and extrinsic dimensions to religiosity which can be used among a number of Western samples, among adults and school children, and among religious and non-religious individuals.

Brief Religious Coping Scale (RCOPE; Pargament et al., 1998; see Appendix 5.2.). This religious coping measure is a 14-item indicator of a two-factor model (comprising seven items) of Positive (e.g. (‘I looked for a stronger connection with God’, and ‘Focused on religion to stop worrying about my problems’) and Negative Religious Coping (e.g. ‘Wondered whether God

had abandoned me’ and ‘Questioned the power of God’). Adequate reliability and validity is demonstrated within the scale (Pargament, 1997; Pargament et al., 1998). Items responses are scored on a five-point Likert-type scale (1=strongly disagree to 5=strongly agree). On both scales, scores range from seven to 35 with a higher level of each religious coping style indicated by higher scores..

5.2.2.3. *Belief around Luck Factors*

Belief around Luck Scale (Darke & Freedman, 1997a; Maltby et al., 2008; see Appendix 4.2.). The twenty-two items Belief around Luck Scale (Maltby et al., 2008) is adapted from items of the twelve-item Belief in Good Luck scale (Darke & Freedman, 1997). Unlike Darke & Freedman’s six-component uni-dimensional version centred on good luck, Maltby’s et al. Belief Around luck scale is a multi-dimensional measure of beliefs around luck. It consists of a four-component model that comprises the Belief in being unlucky, Belief in being lucky, Rejection of belief of luck and the General belief in luck subscales. Item responses are scored on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), with a greater degree of belief in being unlucky indicated by high scores. Internal reliability estimates for this scale range from a = .85 to .88 and test–retest reliability estimates range from .52 to .80 for two and four-week time periods (Maltby et al., 2008). Scores on the scale also show validity by acceptable correlations between both peer and family ratings and other established measures of the individual’s beliefs around luck (Maltby et al., 2008).

5.2.2.4. *Executive Functions Measures*

Working as a cornerstone in the thesis, two of the past three studies revolved around EF. Aside from the recently developed Dysexecutive Luck hypothesis (Maltby et al., 2013) the connection of EF and beliefs is rather inexistent in research.

Dysexecutive Questionnaire (DEX-Q; Wilson et al., 1996; see Appendix 5.4.). It is a 20-item standardized self-report assessment of EF originally designed to measure the severity of dysexecutive symptoms shown by patients with frontal lobe damage. Items refer to self-reports of behavioural difficulties commonly associated with dysexecutive syndrome across four categories: a) emotional or personality problems (e.g. “I have difficulty showing emotion” [item 11]); b) motivational problems (e.g. “I find it difficult to keep my mind on something and am easily distracted” [item 18]); c) behavioural problems (e.g. “I do or say embarrassing things when in company of others” [item 9]); and d) cognitive problems (e.g. “I have difficulty thinking ahead or planning for the future” [item 4]). Responses are scored using a five-point Likert scale (0 = Never to 4 = Very Often), with responses computed to a total score, and higher scores indicating a greater degree of deficits in EF. The self-report scale confirms validity as a measure of behavioural symptoms representing types of deficits in EF, for example, its relationship with other EF measures (Burgess, Alderman, Evans, Emslie, & Wilson, 1998), and also that the cognitively less fit elderly reported substantially more deficits in EF on the DEX compared to cognitively fit elderly (Gerstorf, Siedlecki, Tucker-Drob, & Salthouse, 2008).

Emotional Attentional Control (eACS; Barry, Hermans, Lennaert, Debeer, & Griffin, 2013; see Appendix 5.4.). It is a 14-item questionnaire, composing one general factor, with responses scored using a four-point Likert-scale from 0 (almost never) to 4 (always). Item examples are “When I am emotional, it is hard for me to stay focused” [item 1], “When I am in

an unpleasant situation, I am still able to concentrate” [item 11], “upsetting information captures my attention” [item 14]. The original source of the eACS, the Attentional Control Scale (ACS; Derryberry & Reed, 2002) measured voluntary attentional processes in neutral situations (i.e. attentional control), a process that is officially regarded/recognized as an executive function (EF) (Posner & Petersen, 1990), and thus primary mediated by the prefrontal regions of the frontal lobes, including pre-frontal cortex and the anterior cingulate cortex. In the other hand, the eACS was an adaptation of the ACS which aimed to extend this theoretical construct centring on emotional attention control. The eACS focuses thus on the internal and external modulation of attentional control by emotions.

5.3. Results

5.3.1. Pearson’s Correlation Analysis for Individual Differences

A within-group Pearson’s Correlation analysis (see Appendix 5.6. for the Table containing all results) was carried out showing positive and negative significant correlations between various religion/luck and dysexecutive functions variables. Descriptive statistics with Means and Standard Deviations for all variables were also obtained (see Table 5.1). Analysis was performed using IBM SPSS Statistics 21 software package.

Table 5.1.

Means and SD for the EFs, Religious-related, Religious, and Luck Variables (N = 192)

	<i>M</i>	<i>SD</i>
<i>DEX Total</i>	28.41	9.45
<i>eACS</i>	31.23	4.56
<i>Forgiveness/Love</i>	23.75	4.43
<i>God as Judge</i>	15.89	5.09
<i>Unvengefulness</i>	32.01	4.87
<i>Thankfulness</i>	16.51	2.62
<i>Positive Religious Coping</i>	21.90	7.05
<i>Negative Religious Coping</i>	13.63	5.05
<i>Intrinsic Religiousness</i>	27.82	5.41
<i>Extrinsic – Personal</i>	6.16	2.21
<i>Religiousness</i>		
<i>Extrinsic – Social</i>	8.68	1.01
<i>Religiousness</i>		
<i>Belief in Being Unlucky</i>	10.17	5.10
<i>Belief in Being Lucky</i>	19.01	8.16
<i>Rejection of Belief in Luck</i>	18.18	5.42
<i>General Belief in Luck</i>	15.90	7.87

The religious and Dysexecutive symptoms interaction presented several significant correlations; within the Religious Coping factors, “Negative Religious Coping” was positively correlated to each of the four DEX subscales, showing a Pearson’s r for “Inhibition” of $r = .24, p < .001$; for “Intention”, $r = .30, p < .001$, for “Social Regulation”, $r = .26, p < .001$, and finally, for “Abstract Problem Solving”, $r = .23, p < .001$, thus, “Negative Religious Coping” and “DEX Total” were also positively correlated, $r = .32, p < .001$; furthermore, “Negative Religious

Coping” was also positively correlated, in a slightly lesser extent, to the “Emotional Attentional Control” general factor, $r = .24, p < .001$. Whereas the “Positive Religious Coping” was only positively correlated to the single DEX factor of “Intention”, $r = .17, p < .05$. Two of the four religious-related attitudes (see Section 5.2.2.; Kendler et al., 2003), “Unvengefulness” and “Thankfulness”, were both negatively correlated to several DEX factors. “Unvengefulness” showed a negative correlation for all four DEX factors; Pearson’s for “Inhibition” was $r = -.25, p < .001$, for “Intention”, $r = -.16, p < .05$, for “Social Regulation”, $r = -.24, p < .001$, and for “Abstract Problem Solving”, $r = -.20, p < .01$. Lastly, “Unvengefulness” was also negatively correlated to DEX Total, reporting a Person’s of $r = -.28, p < .001$. Furthermore, in a slightly lesser extent, it was negatively correlated to the “Emotional Attentional Control”, $r = -.15, p < .05$, whereas “Thankfulness”, it was only negatively correlated to just one DEX factor, “Social Regulation”, reporting a Pearson’s of $r = .19, p < .05$. Furthermore, “Thankfulness” was also negatively correlated to “Emotional Attentional Control” $r = -.18, p < .05$. Additionally, for the Religious Orientation factors, “Extrinsic-Social Religiousness” was negatively correlated to DEX’s “Abstract Problem Solving”, $r = -.14, p < .05$.

Luck and Dysexecutive Symptoms factors correlations: results corresponding to the Belief around Luck Scale showed only one of their four subscale factor significantly involved to DEX. “Belief in Being Unlucky” was positively correlated to three DEX factors: for “Intention”, $r = .20, p < .01$; for “Social Regulation”, $r = .21, p < .01$; and for “Abstract Problem Solving”, $r = .17, p < .05$. Moreover, a positively correlation of “Belief in being unlucky” and “DEX total”, $r = .18, p < .01$. Unlike previous ‘negative valenced/oriented’ religious factor (e.g. “Negative Religious Coping”), “Belief in being unlucky” was not significantly correlated to the Emotional Attentional Control factor $r = .1, p > .05$ (ns).

As for the luck and religious factors interactions, three of the four subscales from the Belief around Luck Scale were significantly correlated to a variety of religious factors. For instance, “Belief in Being Unlucky” was significantly positively correlated to “Negative Religious Coping”, and negatively correlated to both “Unvengefulness” and “Thankfulness”, $r = -.23, p < .01$; and $r = -.26, p < .001$. “Belief in Being Lucky” was positively correlated to “Positive Religious Coping”, $r = .21, p < .005$; and also to “God as Judge”, $r = .14, p < .05$; whereas it was negatively correlated to “Intrinsic Religiousness”, $r = -.2, p < .005$, and “Extrinsic-Personal Religiousness”, $r = -.27, p < .001$. Finally, “General Belief in Luck” turned out to be positively correlated to both “Positive Religious Coping”, $r = .23, p < .001$ and “Negative Religious Coping”, $r = .17, p < .05$; to “Forgiveness/Love”, $r = .15, p < .05$ and to “God as Judge”, $r = .3, p < .001$; moreover, it was negatively correlated to “Intrinsic Religiousness”, $r = -.22, p < .005$ and to “Extrinsic-Personal Religiousness”, $r = -.28, p < .001$.

For the DEX and eACS factors interactions it is important to mention that the results of the DEX scale were consistent with its ‘extended’ emotional-centred counterpart Dysexecutive scale, the eACS. All of the DEX factors, and hence the DEX Total, were significantly correlated to eACS. Other noteworthy correlation is that “Rejection of Luck” (e.g. scepticism) was the single factor from both of the religious and luck factors that was not significantly correlated to any single factor at all, not even to any DEX or the eACS general factor.

5.3.2. Multiple Regression Analysis for Religious Attitudes, Religious, Luck and EFs variables

To avoid reliance on the simple correlation analysis findings and to examine overlapping variance between the two domains (DEX/eACS and religion/superstition) two hierarchical multiple regression analysis were performed to investigate if several participant’s belief traits

such as religious-related attitudes (i.e. thankfulness, forgiveness/love), religious factors (i.e. negative religious coping, positive religious coping), and belief around luck factors (i.e. belief in being lucky, belief in being unlucky) (independent variables) (IVs) predicted participant's global factors of EF (dysexecutive syndrome total; DEX, and emotional attentional control global factor; eACS) (dependent variables) (DVs). All analyses were performed using IBM SPSS Statistics 21 software package.

The first hierarchical multiple regression (see Table 5.2) used the DEX total factor as the DV. In the first step of this analysis four variable predictors (IVs) were entered: forgiveness/love, god as judge, unvengefulness, and thankfulness. The first model was statistically significant $F(4, 187) = 4.43; p < .01$ and explained 9% of variance in DEX total; the introduction of the rest of the variable predictors (IVs) in the second step model (positive religious coping, negative religious coping, intrinsic religiousness, extrinsic personal religiousness, extrinsic social religiousness, belief in being lucky, belief in being unlucky, rejection of luck, and general belief in luck) was nearly significant and explained an additional 8% variance in DEX, after controlling for forgiveness/love, god as judge, unvengefulness, and thankfulness ($R^2 \text{ Change} = .08; F(9, 178) = 1.86; p = .06$). In the first step the unvengefulness factor was the only predictor variable statistically significant (negative correlated to DEX) ($\beta = -.30, p < .001$); in the second step two predictor variables were statistically significant; unvengefulness ($\beta = -.24, p < .01$) and negative religious coping (positive correlated) ($\beta = .27, p < .01$).

A second hierarchical regression analysis was performed (see Table 5.3) using the eACS global factor as the DV and the same IVs were used as in the preceding multiple regression analysis. The first step model was also statistically significant in this analysis $F(4, 187) = 3.43; p$

< .05 and explained 7% of variance in eACS (global factor); as for the second step model, the introduction of the IVs explained only an additional 5% variance in eACS (R^2 Change = .05; $F(9, 178) = .05$; $p = .42$ (*n.s.*). In the first step only the forgiveness/love factor was statistically significant (positive correlated to eACS) ($\beta = .16$, $p < .05$) and unvengefulness was nearly (negative correlated to eACS) significant ($\beta = -.16$, $p = .06$); none were significant in the second step model.

In sum, the multiple regression analyses results suggest that unvengeful traits (unvengefulness factor; e.g. “It is not right to get back at someone who hurts or offends you”¹⁴) and negative religious coping (“Wondered whether God has abandoned me) in individuals are likely to predict EF deficits (Dysexecutive symptoms; e.g. “I have difficulty thinking ahead or planning for the future”). Moreover, the analyses also suggest that individuals with love, caring and forgiving traits (Forgiveness/love factor; e.g. “I try to live by the saying “love thy neighbor as thyself”) and possibly (near significant) also unvengefulness individuals are likely to predict emotional attentional control deficits (deficits in the modification of AC by emotions as well as attention towards affective stimuli; eACS global factor; e.g. “I get distracted by my feelings”).

The Negative Religious Coping factor was expected to be correlated to EF given its conflictive attitude, and it indeed exhibited a significant correlation to both Pearson’s and regression analyses. As for the Unvengefulness, it was also expected to be related to EF because it shows an ability to control impulses (i.e. think through an issue, not act on impulse) which essentially demonstrates a basis of inhibition, an essential aspect of high EF (i.e. “inhibition”

¹⁴ Original item in the unvengefulness factor of the religious-related attitude questionnaire is “It is all right to get back at someone who hurts or offends you” [item 8], although it is reverse-scored (scored negatively).

DEX's subscale). Hence it was likely to be negatively correlated with higher scores on a poorer EF (dysexecutive thinking), as it occurred.

Table 5.2. *Multiple Regression Analysis for variables predicting Dysexecutive Syndrome (DEX)*
(*N* = 192)

	R	R ²	R ² Change	B	SE	β	<i>t</i>
Step 1	.29	.09**					
Forgiveness/Love				.18	.16	.08	1.09
God as Judge				.11	.13	.06	.82
Unvengefulness				.59	.16	-.30***	-.36
Thankfulness				-.03	.29	-.01	-.12
Step 2	.40	.16	.10				
Forgiveness/Love				.14	.16	.06	.82
God as Judge				-.01	.015	-.01	-.07
Unvengefulness				-.47	.17	-.24**	-2.80
Thankfulness				.274	.30	.77	.92
Positive Religious Coping				.01	.14	.00	.04
Negative Religious Coping				.50	.16	.27**	3.19
ROS Intrinsic				-.07	.27	-.04	-.27
ROS Extrinsic Personal				.11	.52	.02	.21
ROS Extrinsic Social				-.72	.75	-.08	-.97
Belief in Being Unlucky				.18	.14	.10	1.25
Belief in Being Lucky				.01	.09	.01	.12
Rejection of Belief in Luck				.09	.12	.05	.72
General Belief in Luck				-.04	.10	-.03	-.38

Note: Statistical significance: **p* < .05; ***p* < .01; ****p* < .001

Table 5.3.

Multiple Regression Analysis for variables predicting Emotional Attentional Control (N = 192)

	R	R ²	R ² Change	B	SE	β	T
Step 1	.26	.07*					
Forgiveness/Love				.16	.08	.16*	2.01
God as Judge				.08	.06	.09	1.29
Unvengefulness				-.15	.08	-.16	-1.88
Thankfulness				-.20	.14	-.12	-1.46
Step 2	.34	.11	.05				
Forgiveness/Love				.15	.08	.14	1.79
God as Judge				.03	.08	.03	.38
Unvengefulness				-.14	.08	-.15	-1.70
Thankfulness				-.14	.15	-.08	.76
Positive Religious				.05	.07	.08	.76
Coping							
Negative Religious Coping				.13	.08	.14	1.61
ROS Intrinsic				.01	.13	.01	.11
ROS Extrinsic Personal				.01	.26	.01	.05
ROS Extrinsic Social				-.34	.37	-.07	-.92
Belief in Being Unlucky				-.01	.07	-.01	-.08
Belief in Being Lucky				-.05	.04	-.10	-1.12
Rejection of Belief in				-.06	.06	-.07	-.91
Luck							
General Belief in Luck				.05	.05	.08	.88

Note: Statistical significance: *p < .05; **p < .01; ***p < .001

5.4. Discussion

So far, the thesis work had dwelled around two complex multidimensional constructs, religiosity and superstition, but had not specifically worked on testing any possible direct relationship in between them. This particular investigation sought to examine the relationship these two psychological constructs have in common with two EF measures; DEX and its extended emotional-based measure, the eACS. Result of this study indicates an interaction between some of the religious-related and religious factors based in self-regulation/inhibition (unvengefulness) and distress (negative religious coping) to EF, the well-recognized term that covers management of cognitive process (regulation and control) (Elliot, 2003), consistent with the idea of emotion as one of the main basis of religious and luck beliefs (Watts, 1996; McCauley, 2001). Findings also point out to not consider luck and religious beliefs as either complementary or substitutes beliefs of each other, as it was previously suggested in literature on the matter (Persinger, 1990; 1993). Instead, the observed results indicate that these two psychological constructs rather act as parallel belief systems that go hand in hand. Both negative subfactors of religion and luck (i.e. negative religious coping and belief in being unlucky) shared a strong correlation to all of the four dysexecutive subscales. And conversely, positive factors of religious-related attitudes (i.e. “Unvengefulness” and “Thankfulness”) were negatively correlated to the dysexecutive subscales, indicating a reverted effect. Also of relevance are the interactions between both positive factors of religion and positive factors of luck (i.e. ‘being in being lucky’ and ‘positive religious coping’), also strongly significant. In sum, it can be observed in this finding that both religious and luck factors behave similarly between them and also when compared to EF. It can be seen there is a significant interaction between religious and superstitious factors, although this interaction appears to be strictly dependant to the valence orientation of the respective factors

(positive oriented religious factors correlated to positive oriented luck factors and negative to negative).

5.4.1. Conclusions: Importance of a Non-reductionist View of Beliefs

Previous chapters have revolved around a central idea that suggests that the phenomena of religion and superstition, given their complex and multidimensional nature, should not be simply approached straightforward or in a deterministic way. An example for their complexity is the relationship of many of its derived factors and other psychological aspects including psychopathology (e.g. emotional related disorders), cognitive processes (i.e. EF), and personality. In summary, religious and superstitious factors have been correlated (or at least been involved) to a variety of advantages and disadvantages effects at both cognitive and behavioural levels. An essential fact for this complex of these constructs in research that should not be overlooked in research is that beliefs can be heavily dependent on a polarity/valence aspect, or orientation of the belief (Frijda, 1986), this is why an emphasis on the valence of beliefs should be made. Superstitious or religious believers vary from each other, possessing significant differences in between them. Take for example someone who devoutly believes that luck consistently works against his/her, and therefore cannot leave things to chance; while in the other side of the belief around luck continuum, you may have an individual who firmly believes that is a lucky person, often feeling that luck works on his/her favour, not minding to leave things to chance because of this. It is easy to differentiate these two examples are two totally opposite superstitious attitudes. Consequently, religion, superstition, and their parallel/neighbour beliefs cannot be considered as absolute uni-dimensional constructs/traits in research (nor in theory for that matter). This take on beliefs can also be applied in other schools of psychology. For

instance, within the evolutionary psychology paradigm beliefs should not be simply labelled generally, neither as maladaptations or adaptations.

PART IV

CONCLUSIONS

CHAPTER 6: Thesis Conclusions

6.1. Thesis Review

The current thesis' main themes represent a systematic effort routed towards 1) encouraging the view of religion and superstition as independent (although related) multidimensional constructs in research (and therefore, to be cautious against reductive assumptions concerning the reach and impact that these two psychological constructs have in psychology, and more specifically, on cognitive psychology); 2) avoiding the tendency to focus on the negative outcomes from religious and superstitious behaviour to help establish a more equilibrated and unbiased view of their behaviour. In other words, recognize that religious and superstitious practices and/or beliefs can be associated to both positive (i.e. improvement on performances) and negative outcomes (i.e. deficits in cognitive functions); and 3) the integration of magical-religious beliefs into well-established and recent research paradigms. To achieve these goals, both religion and superstition were dissected into several components' whose relationship to important cognitive and psychological functions was explored in both experimental and exploratory study designs.

The main goal of the introductory chapter was to provide a brief framework of the scientific study of religion and superstition. Definitions and relationship of both phenomena is

presented, with a specific emphasis on their relation to cognitive functions (i.e. executive functions, attentional bias) and assessments (i.e. emotional Stroop and Stroop tests), which are key aspects to the thesis's purpose and to each of the investigations.

Chapter 2 was fully dedicated to the first investigation conducted. Even though this study did not utilize an elaborated methodology, its findings can elucidate considerable implications to the literature of magical/religious beliefs (and mind/body effects), and to further develop on the link between superstition and religion. The conducted experiment was designed to approach a particular religious behaviour (i.e. the use of religious amulets) in a route that allowed exploring the possibility of a causal effect involving religious practices and performance. A religious-related condition was created to test whether it enhanced performances via a boosted psychological mechanism. Such experimental condition consisted in manipulating a variable and was based on the Damisch et al. experiment (2011), wherein good luck-related superstitious conditions were created as experimental conditions via a variety of idiosyncratic procedures. Having obvious similarities, this study hoped to act as a religious homologue version of Damisch's et al. superstitious-activated condition experiment. Given the research method and the type of implemented task employed, this particular study was markedly different from all foregoing studies conducted within this thesis. Instead of focusing on the use of computerized tasks, this research relied on an anagram task as the main task. Furthermore, whereas data collection occurred indirectly during the first three studies, it could never be determined whether the significant results were a causal effect or just a correlated trait. On the other hand, this study's methodology let us directly examine whether or not there was an effect on performance given that the research method consisted of manipulating a condition to create an experimental variable (i.e., absence vs. presence of religious amulet) which allowed testing possible direct

effects. Results revealed a significant effect in the presence condition, which translated in an improvement of performance, nonetheless, is feasible that this effect could be due to the removal of any item taken away. This idiosyncratic research paradigm enabled the thesis to use a dynamic approach to magical-religious beliefs. Lastly, the implications to beliefs literature as well as clinical settings are briefly discussed (i.e. sports science, placebo effect and health implications).

Chapter 3 presented the second study of this thesis. The conducted experiment was an exploratory research which main purpose was to examine a cognitive bias effect in a group of religious participants under a religious Stroop, a religiously adapted version of the emotional Stroop task; while the secondary goal was to examine whether they exhibit correlations of personality, or religious belief-related variables (such as paranormal beliefs) to religiosity. Based on Beck's and Clark's (1998) premise that predicts an attentional bias towards disorder-related stimuli, substantiated with plenty of behavioural evidence on a wide variety of pre-clinical and clinical groups (mostly in participants with specific affective disorders), and resulting in significant reaction times delays while compared to neutral stimuli. As for non-clinical populations, these types of findings are also present, but reduced to extremely negative verbal stimuli (e.g. taboo and insult words). Before this study was conducted, attentional bias task studies focusing on religiosity were non-existent, furthermore no piece of significant evidence relying on religious beliefs-related stimuli had ever been found in a cognitive study before. Therefore, a task adaptation to such an important, yet overlooked psychological domain was an attractive starting point for research. Hence, highly religious and low-religious participants were tested with the religious Stroop and were administered the scales. Results did not show any significant statistical differences within and between groups in their response times toward emotionally charged words stimuli. Also, there were no significant statistical correlations

between type of stimulus and any beliefs variables (i.e. Religious Orientation Scale, Spiritual Meaning Scale and Paranormal Belief Scale). In conclusion, participants scoring high on religiosity showed the same response times (RTs) on average for emotional and neutral stimuli when compared with participants who scored low on religiosity. Also the study's task weaknesses are discussed, confirming there is plenty of room for the possibility that the negative results occurred because the task was not powerful enough. This point, along with other discussed weaknesses, was taken into account during the construction of the tasks of the subsequent experiments.

Chapter 4 offered the most noteworthy study within the thesis in terms of significant findings and methodology employed, and it was during this phase that an electrophysiological technique was introduced into the research design. It aimed to test the Dysexecutive Luck hypothesis (Maltby et al. 2013) under electrophysiological methodology. Such hypothesis proposes that believers of 'bad luck' might exhibit a deficiency in executive functioning (EF) and has initial behavioural evidence. The event-related potential (ERP) technique was implemented to assess in this distinctive population the underlying neural activity of the EF activity involved during a Stroop task, this data was then compared side by side with the results of the neutral group test. Results showed indeed during a late time window a stronger Stroop main condition effects (interference effect) in people who consider themselves unlucky with an increase in both reaction times (RTs) and magnitude of ERP late positive complex (LPC), compared with those who do not consider themselves to be unlucky. This late effect was interpreted as a failure to resolve the cognitive conflict due to an EF deficit (namely, semantic inhibition) in a group of 'unlucky' believers while performing a Stroop task. This served as a key

finding within this thesis, and which provided electrophysiological evidence in support of the Dysexecutive Luck hypothesis.

Chapter 5 presented an exploratory study that was dedicated to follow the dysexecutive symptom correlation to unlucky beliefs lead found in the preceding study. The intention was to compare it with the previously used EF measure and a recent extension of the scale, along with the beliefs around luck factors, allowing us to test, two of the main topics in the thesis, religious and superstitious factors (i.e. luck factors), to study how do religion and luck ‘behave’ around established EFs and its extended versions centring on emotions (namely emotional attentional control). Thus, for this purpose, a variety of religious factors, religious related factors (i.e. emotions associated to religion), luck factors and EF factors were studied. Data was collected via a range of scales, in order to examine their relationship to EFs and their recent ‘expansion’ revolving around emotions. The findings of this study provided evidence which indicated that religious and luck subfactors go hand in hand and also that both phenomena’s negative factors are strongly connected to dysexecutive symptoms.

6.2. Future Research and Conclusions

It looks as if previous religious and superstitious views oriented towards an irrational and dysfunctional behaviour explanation (irrational belief theory [Ellis, 1994]), along with polemical debates about the social dangers of these, along with the pursue of a social scientific equity (the New Atheist movement [Blackmore, 2001; Dawkins, 2006; Harris, 2004] have turned out to be distracting events to researchers that distanced them to the fact that magical-religious beliefs do confer positive effects. For example, the adaptive trait perspective (i.e. religion can confer or be associated to psychological advantages) had been often overlooked, even with plenty of evidence

supporting this notion in the literature of religious beliefs. In sum, this collection of research suggests positive-oriented beliefs (belief in a general righteous god, being grateful) can bring a variety of positive psychological effects; on the other hand, negative-related beliefs (i.e. believing to be unlucky, being vengeful) would lead to deficits.

By having examined two major forms of magical-religious beliefs, the obtained findings of the present thesis work have direct implications on the discussion of the differentiation and assessment of irrational (and rational) beliefs (Ellis, 1986), namely beliefs around luck and religious ritualistic behaviour. In particular, two central topics within the literature were put into question: 1) a tendency to classify in a reductionist view and generalize beliefs as a loose group of beliefs (i.e. religious and superstitious beliefs), provoking to ignore fundamental characteristics (i.e. the beliefs valence), 2) pretend that one phenomena is the same as the other, and 3) the typical negative/pessimistic approach these two psychological constructs are under, especially in terms of emotionally healthy behaviour, typically seen as inconsequential creations of irrational minds (i.e. irrational beliefs) and as the basis of emotional distress (Ellis, 1994). In the same vein that the concept associated to a better understanding of religion by Emmons & Paloutzian (2003), the *multilevel interdisciplinary paradigm*, this thesis recognizes the value of data from a multi-methodological and dynamic approach to religion and superstition (i.e. the employment of a range of methodological techniques). It is therefore an urge for a compromise position: neither a psychology of religion nor a psychology of superstition as rigid and equal studies, but rather psychology, religion and superstition in interactive and dynamic dialogues.

With respect to future research related to the current thesis work, there is an opportunity to further examine some of the findings presented. For instance, a possible study based on two pending ideas would consist on first seeing if the electrophysiological lead supporting the dysexecutive luck with belief in bad luck in UK can be replicated in another country, and/or the potential to extend the number of luck factors employed in that study and work with all four beliefs around luck factors. This would signal if there were cross-cultural potential to the earlier work and something that could be pursued, as a continuation of this thesis work. Additionally, another feasible option could be to examine how the dysexecutive hypothesis might behave when applied to other related and common beliefs, such as hope.

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APPENDICES

Appendix 2.1

Participant Consent Form

BACKGROUND INFORMATION

Researcher. My name is Jaime Martin del Campo. I am currently coursing a PhD (Psychology) at the University of Leicester (School of Psychology).

Reason for the research. The present study is dedicated to examine the relationship of personal beliefs (i.e. religious beliefs) to cognitive performances in an anagram and a computerized task (i.e. memory and semantic inhibition). Data for 40 participants will be collected to enable us to compare their scores and perform a statistical analysis.

Details of participation. The research involves completing two brief questionnaires to measure different psychological aspects and performing an anagram and a computerized task. The session should take 30 to 40 minutes to complete. The experiment's paradigm demands to omit a specific part of the procedure to avoid any possible bias in the study. However, a full debriefing of the experiment will be given and it will be up to you to decide whether we can conserve the data for analysis or discard it. It does not involve any significantly stressful or uncomfortable issue. Please feel free to ask questions if you have any.

CONSENT STATEMENT

1. I understand that my participation is voluntary and that I may withdraw from the research at any time, without giving any reason.
2. I am aware of what my participation will involve.
3. I understand that there are no risks involved in the participation of this study.

4. All questions that I have about the research have been satisfactorily answered.

I agree to participate.

Participant's signature: _____

Participant's name (please print): _____

Age _____

Tick this box if you would like to receive a summary of the results by e-mail:

E-mail: _____

Date: _____

Appendix 2.2

General Self-Efficacy Scale

Please write a number besides every sentence to indicate your agreement or disagreement. Use the following options and choose the one that is most appropriate. Remember that there are no correct or incorrect answers. Thank You!

1 = Strongly disagree 2 = Disagree 3 = Neither agree nor disagree

4 = Agree 5 = Strongly agree

1. I will be able to achieve most of the goals that I have set for myself.
2. When facing difficult tasks, I am certain that I will accomplish them.
3. In general, I think that I can obtain outcomes that are important to me.
4. I believe I can succeed at most any endeavor to which I set my mind.
5. I will be able to successfully overcome many challenges.
6. I am confident that I can perform effectively on many different tasks.
7. Compared to other people, I can do most tasks very well.
8. Even when things are tough, I can perform quite well

Appendix 3.1

Participant Consent Form

BACKGROUND INFORMATION

Researcher. My name is Jaime Martin and I am currently coursing a PhD at the University of Leicester, School of Psychology.

Reason for the research. The present study is dedicated to examine the relationship of personal beliefs and performances. Data will be collected to enable us to compare different scores of specific psychometric scales, simple tasks, and a computerized test.

Details of participation. The research involves completing two brief questionnaires to measure different psychological aspects, performing a computerized task. The session should take 30 to 40 minutes to complete. Please feel free to ask questions if you have any.

CONSENT STATEMENT

1. I understand that my participation is voluntary and that I may withdraw from the research at any time, without giving any reason.
2. I am aware of what my participation will involve.
3. I understand that there are no risks involved in the participation of this study.
4. All questions that I have about the research have been satisfactorily answered.

I agree to participate.

Participant's signature: _____

Participant's name (please print): _____

Age _____

Tick this box if you would like to receive a summary of the results by e-mail:

E-mail: _____

Date: _____

Appendix 3.2

Religious Orientation Scale

DESCRIPTION: The 'Age-Universal' I-E Scale – 12 (Gorsuch & Venable, 1983; Maltby, 1999). This scale is a derived, revised, and amended measure of the Religious Orientation Scale (Allport & Ross, 1967). Since the inception of the Religious Orientation Scale, a number of suggestions have been made to improve psychometric confidence in the measurement of the intrinsic and extrinsic religious constructs. In the main, consideration of such changes suggest that the intrinsic orientation towards religion is a constant feature of religious orientation, while an extrinsic orientation towards religion represents two separate factors; extrinsic-social and extrinsic personal.

LOCATION: Maltby, J. (1999a). The internal structure of a derived, revised, and amended measure of the religious orientation scale: The 'Age-Universal' I-E Scale-12. *Social Behavior and Personality*, 27, 407-412.

Think about each item carefully. Does the attitude or behaviour described in the statement apply to me?

1=No 2=Not Certain 3=Yes

- | | | | |
|---|---|---|---|
| 1. I enjoy reading about my religion | 1 | 2 | 3 |
| 2. My whole approach to life is based on my religion | 1 | 2 | 3 |
| 3. It is important to me to spend time in private thought and prayer | 1 | 2 | 3 |
| 4. I have often had a strong sense of God's presence | 1 | 2 | 3 |
| 5. I try hard to live all my life according to my religious beliefs | 1 | 2 | 3 |
| 6. My religion is important because it answers many questions about the meaning of life | 1 | 2 | 3 |
| 7. I pray mainly to gain relief and protection | 1 | 2 | 3 |
| 8. What religion offers me most is comfort in times of trouble and sorrow | 1 | 2 | 3 |
| 9. Prayer is for peace and happiness | 1 | 2 | 3 |

10. I go to church mostly to spend time with my friends	1	2	3
11. I go to church because it helps me make friends	1	2	3
12. I go to church mainly because I enjoy seeing people I know there	1	2	3

Items 1 to 6: Intrinsic.

Items 7 to 9: Extrinsic-personal.

Items 10-12: Extrinsic-social.

Appendix 3.3

Spiritual Meaning Scale

1. There is no particular reason why I exist.
2. We are each meant to make our own special contribution to the world.
3. I was meant to actualize my potentials.
4. Life is inherently meaningful.
5. I will never have a spiritual bond with anyone.
6. When I look deep within my heart, I see a life I am compelled to pursue.
7. My life is meaningful.
8. In performing certain tasks, I can feel something higher or transcendent
9. working through me.
10. Our flawed and often horrific behavior indicates that there is little or no
11. meaning inherent in our existence.
12. I find meaning even in my mistakes and sins.
13. I see a special purpose for myself in this world.
14. There are certain activities, jobs, or services to which I feel called.
15. There is no reason or meaning underlying human existence.
16. We are all participating in something larger and greater than any of us.\

Appendix 3.4

Revised Paranormal Belief Scale

Please write a number besides every sentence to indicate your agreement or disagreement. Use the following numbers. There are no correct or incorrect questions. This is a sample of your own beliefs and attitudes. Thank you.

1 = Totally disagree 2 = Moderately disagree 3 = Slightly disagree 4 = Uncertain 5 = Slightly agree 6 = Moderately agree 7 = Totally agree

1. The soul continues existing, even if the body dies.
2. Some individuals can levitate (raise) objects with their minds.
3. Black magic exists.
4. Black cats bring bad luck.
5. Your mind or soul can leave your body and travel (astral projection).
6. The abominable snowman (Yeti?) exists.
7. Astrology is a precise way of predicting the future.
8. A devil exists.
9. Psychokinesis, the movement of objects through psychic powers, exist.
10. Witches exist.
11. If you break a mirror, you will have bad luck.
12. During altered states, like when sleeping or being in trance, the spirit can leave the body.

13. The Loch Ness monster exists.
14. The horoscope says the future of a person in a precise manner.
15. I believe in God.
16. The thoughts of a person can influence the movement of a physical object.
17. Through the use of formulas and charms, it is possible to bewitch people.
18. Number '13' is of bad luck.
19. Reincarnation exists.
20. There is life in other planets.
21. Some physics can predict the future accurately.
22. Heaven and hell exist.
23. Reading minds is not possible.
24. Real cases of witchcraft exist.
25. It is possible to communicate with the dead.
26. Some people have an unexplainable ability to predict the future.

Appendix 4.1

Participant Consent Form

BACKGROUND INFORMATION

Title and researchers. The title of this research is 'Exploring Superstitious Beliefs and their Relation with Executive Functions'. My name is Jaime Martin and I am currently coursing a PhD at the University of Leicester, School of Psychology.

Reason for the research. We are studying how your beliefs in luck are related to different personality factors and we are collecting data from undergraduate students to enable us to compare different scores on certain psychometric and computerized tests that measure these constructs.

Details of participation. The research involves completing 3 brief questionnaires to measure different aspects of personality and beliefs in luck, performing a computerized task meanwhile electrophysiological data will be recorded with technique that requires placing an electrode mask on the scalp in order to record brain waves patterns. The session should take around one hour and a half to complete. Please feel free to ask questions now if you have any.

CONSENT STATEMENT

1. I understand that my participation is voluntary and that I may withdraw from the research at any time, without giving any reason.
2. I am aware of what my participation will involve.
3. I understand that there are no risks involved in the participation of this study.

4. All questions that I have about the research have been satisfactorily answered.

I agree to participate.

Participant's signature: _____

Participant's name (please print): _____

Tick this box if you would like to receive a summary of the results by e-mail:

E-mail: _____

Date: _____

Appendix 4.2

Belief Around Luck Scale

Instructions: please respond how strong you agree or disagree on the following statements by matching them with the following options

1 = Strongly disagree 2 = Somewhat disagree 3 = Slightly disagree

4 = Slightly agree 5 = Somewhat agree 6 = Strongly agree

1. I consider myself to be an unlucky person
2. I consistently have bad luck
3. Even the things in life I can control in life don't go my way because I am unlucky
4. Luck works against me
5. I often feel like it's my unlucky day
6. I mind leaving things to chance because I am an unlucky person
7. Even the things in life I can't control tend to go my way because I'm lucky
8. I consistently have good luck
9. I often feel like it's my lucky day
10. Luck works in my favour.
11. I consider myself to be a lucky person
12. I don't mind leaving thucky person
13. It's a mistake to base any decisions on how unlucky you feel

14. Being unlucky is nothing more than random
15. It's a mistake to base any decisions on how lucky you feel
16. Being lucky is nothing more than random
17. Some people are consistently lucky, and others are unlucky
18. Some people are consistently unlucky, and others are lucky
19. There is such a thing as good luck that favours some people, but not others.
20. There is such a thing as bad luck that affects some people more than others.
21. Luck plays an important part in everyone's life
22. I believe in Luck

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Appendix 5.1

Participant Consent Form

BACKGROUND INFORMATION

Researcher. My name is Jaime Martin del Campo. I am currently coursing a Psychology Research PhD at the University of Leicester, School of Psychology (England).

Reason for the research. The main objective of the present study is to examine information regarding religious and superstitious beliefs. More specifically the relationship these may have in common to higher cognitive process such as executive functions (e.g. abstract problem solving). Data will be collected from around 200 undergraduate participants.

Details of participation. The research requires completing a series of religious and superstitious scales in two sessions. Each session should not take more than 30 minutes to complete. Please feel to ask any question regarding the study. Anyone who might feel that they may be offended by the assumptions of the study (e.g. religion results from key cognitive processes) should not take part.

CONSENT STATEMENT

1. I understand that my participation is voluntary and that I may withdraw from the research at any time, without giving any reason.
2. I am aware of what my participation will involve.
3. I understand that there are no risks involved in the participation of this study.
4. All questions that I have about the research have been satisfactorily answered.

I agree to participate.

Participant's signature: _____

Participant's name (please print): _____

Age _____

Tick this box if you would like to receive a summary of the results by e-mail:

E-mail: _____

Date: _____

Appendix 5.2

Brief Religious Coping Scale

The brief RCOPE (Pargament et al., 1998). This religious coping measure is a 14-item indicator of a 2-factor model (comprising 7 items) of Positive and Negative Religious Coping. Positive coping items include ('I looked for a stronger connection with God' [item 1], 'Focused on religion to stop worrying about my problems' [item 7]), and Negative Religious Coping items ('Wondered whether God had abandoned me' [item 8], 'Questioned the power of God' [item 14]). The scale demonstrates adequate reliability and validity (Pargament, 1997; Pargament et al., 1998). Responses to items are scored on a 5-point Likert-type scale (1=Strongly disagree to 5=Strongly Agree). On both scales, scores range from 7 to 35 with higher scores indicating a higher level of each religious coping style.

Instructions. Think about the most stressful event you experienced in the last three years. Now indicate on the scale if you felt any of these feeling. If you feel the question does not apply to you then put not a lot.

Looked for a stronger connection with God	Not a lot	A Little	A lot	A great deal
Sought God's love and care	Not a lot	A Little	A lot	A great deal
Sought help from God in letting go of my anger	Not a lot	A Little	A lot	A great deal
Tried to put my plans into action together with God	Not a	A Little	A lot	A great deal

	lot			
Tried to see how God might be trying to strengthen me in this situation	Not a lot	A Little	A lot	A great deal
Asked forgiveness for my sins	Not a lot	A Little	A lot	A great deal
Focused on religion to stop worrying about my problems	Not a lot	A Little	A lot	A great deal
Wondered whether God has abandoned me	Not a lot	A Little	A lot	A great deal
Felt punished by God for my lack of devotion	Not a lot	A Little	A lot	A great deal
Wondered what I did for God to punish me	Not a lot	A Little	A lot	A great deal
Questioned God's love for me	Not a lot	A Little	A lot	A great deal
Wondered whether my church had abandoned me	Not a lot	A Little	A lot	A great deal
Decided the devil made this happen	Not a lot	A Little	A lot	A great deal
Questioned the power of God	Not a lot	A Little	A lot	A great deal

1st 7 positive items, 2nd 7 negative items

Appendix 5.3

Religiosity-related Factors Questionnaire Item

Forgiveness/love Factor

- 1) I try to live by the saying “love thy neighbor as thyself.”
- 2) I can forgive even if someone hurts me on purpose.
- 3) I try to care for other people even if I don’t really like them.
- 4) I believe that you have to care about people regardless of how they treat you.
- 5) Even when it is difficult, I try to forgive other people who have hurt and offended me.
- 6) I try to be forgiving toward other people.
- 7) I feel deep love for the world and all the creatures in it.

God as Judge Factor

- 8) I believe that God has a lot of rules about how people should live their lives.
- 9) I believe that God can be counted on to reward goodness and punish evil.
- 10) I believe God is very strict.
- 11) I believe God will punish me if I do something wrong.
- 12) Do you believe that this God or universal spirit observes your actions and rewards or punishes you for them?
- 13) I feel that stressful situations are God’s way of punishing me for my sins or lack of spirituality.
- 14) The Bible is the actual word of God and is to be taken literally word for word

Unvengefulness Factor

- 15) It is all right to get back at someone who hurts or offends you (scored negatively).
- 16) I believe that if I do a lot of wrong things, God will stop loving me (scored negatively).
- 17) The only person I have to thank for what I have received in life is me (scored negatively).
- 18) When someone hurts me, I want to get whatever revenge I can (scored negatively).
- 19) If people are not kind to me, I am not going to be kind to them (scored negatively).
- 20) People tell me that I am not grateful enough for what I have in life (scored negatively).
- 21) When someone hurts or offends me, I can only get over it when I have figured out how to get my revenge (scored negatively).
- 22) When I look at the world, I don't see much to be grateful for (scored negatively)

Thankfulness Factor

- 23) I feel thankful for what I have received in life.
- 24) I feel grateful nearly every day.
- 25) I express anger at God for letting terrible things happen (scored negatively).
- 26) I wonder whether God has abandoned me (scored negatively).

Appendix 5.4

DEX-Questionnaire

Instructions: please write a number besides every sentence to indicate your agreement or disagreement. Use the following options and choose the one that is most appropriate. There are no correct or incorrect questions. This is a sample of your own beliefs and attitudes. Thank you.

1 = Never 2 = Almost never 3 = Sometimes 4 = Often 5 = Very often

1. I have problems in understanding what other people mean unless they keep things simple and straightforward
2. I Act without thinking doing the first thing that comes to mind
3. I sometimes talk about events or details that never actually happened, but I believe did happen
4. I have difficulty thinking ahead or planning for the future
5. I sometimes get over-excited about things and can be a bit over the top at these times
6. I get events mixed up with each other and get confused about the correct order of events
7. I have difficulty realizing the extent of my problems and am unrealistic about the future
8. I seem lethargic and unenthusiastic about things
9. I do or say embarrassing things when in company of others
10. I really want to do something one minute but couldn't care less about in the next
11. I have difficulty showing emotion
12. I lose my temper at the slightest
13. I seem unconcerned about how I should behave in certain situations
14. I find it hard to stop repeating saying or doing things once started

15. I tend to be very restless and I can't sit still for any length of time
16. I find it difficult to stop doing something even if I know I shouldn't.
17. I will say one thing but will do something different
18. I find it difficult to keep my mind on something and am easily distracted
19. I have trouble making decisions or deciding what I want to do
20. I am unaware of, or unconcerned about, how others feel about my behaviour

Appendix 5.5

Emotional Attentional Control Scale (eACS) items.

Instructions: please write a number besides every sentence to indicate your agreement or disagreement. Use the following options and choose the one that is most appropriate. There are no correct or incorrect questions.

0 (almost never)

1 (sometimes)

2 (often)

3 (very often)

4 (always)

1 When I am emotional, it is hard for me to stay focused

2 When I feel happy, it is hard for me to pay attention

3 When I am emotional, my attention shifts from one thing to another

4 I tend to notice anxiety provoking things

5 I get distracted by my feelings

6 My attention easily shifts to my emotions

7 I am able to put my feelings aside when I need to focus

8 It is very hard for me to concentrate when I am upset

9 Even when I am busy, anxiety-provoking things tend to stand out

10 When I am working hard on something I still get distracted by

unpleasant events around me

11 When I am in an unpleasant situation, I am still able to concentrate

12 I can easily switch my attention from something unpleasant to something else

13 After being interrupted by something unpleasant, I can easily switch my attention back to what I was doing previously.

14 When a negative thought comes to mind, I can easily switch my attention away from it

15 If I have a negative thought about something, it is difficult for me to look at it from another perspective

16 I tend to interpret things in a negative way

17 Upsetting information captures my attention

18 When I am anxious, I more easily notice upsetting things

Note: All eACS items, including those that were excluded (Items 2, 9, 16 and 18).

Appendix 5.6

Pearson's Correlation For all Religious Attitudes, Religious, and Luck Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Inhibition (DEX)	-																		
2 Intention (DEX)	.48*	-																	
3 Social Regulation (DEX)	.40*	.50**	-																
4 Abstract Problem Solving (DEX)	.61*	.51**	.40**	-															
5 Dysexecutive Total (DEX)	.85*	.78**	.72**	.77**	-														
6 eACS	.39*	.30**	.21**	.25**	.38**	-													
7 Positive Religious Coping	-.01	.17*	-.01	.03	.05	.11	-												
8 Negative Religious Coping	.24*	.30**	.26**	.23**	.33**	.24*	.21*	-											
9 Intrinsic Religiousness	.02	-.05	.06	-.07	-.01	-.07	-.71*	-.02	-										
10 Extrinsic – Personal Religiousness	-.01	-.12	.03	-.07	-.04	-.07	-.56*	.16*	.78**	-									
11 Extrinsic – Social Religiousness	-.04	-.02	-.02	-.14*	-.01	-.10	-.20*	.02	.40**	.14*	-								
12 Forgiveness/love	-.08	-.00	-.02	-.01	-.04	.07	.15*	-.11	-.16*	-.05	-.10	-							
13 God as Judge	.01	.17*	.11	.07	.09	.13	.40*	.28*	-.36**	-.40**	-.03	.01	-						
14 Unvengefulness	-.25*	.17*	.24**	.20**	.28**	.15*	.22*	-.31*	-.25**	-.07	-.07	.41**	-.08	-					
15 Thankfulness	-.09	-.11	.19**	-.04	-.14	-.18*	.11	-.37*	-.11	-.03	.03	.19**	-.24**	.43**	-				
16 Belief in Being Unlucky	.06	.20**	.21**	.17*	.19**	.09	.03	.26*	.03	-.08	.03	-.04	.11	-.23**	-.26**	-			
17 Belief in Being Lucky	.09	-.03	-.08	-.05	-.00	-.04	.21*	-.07	-.20**	-.28**	-.06	.05	.14*	-.00	.02	.06	-		
18 Rejection of Belief in Luck	.09	.02	.13	.04	.10	-.02	-.09	.09	.13	.08	.07	.06	.08	-.11	-.11	.13	.04	-	
19 General Belief in Luck	.06	.11	.03	.05	.08	.12	.23*	.17*	-.22**	-.28**	-.11	.14*	.30**	-.07	-.12	.33**	.47**	.10	-

Note: Correlational analysis conducted on entire sample group. N = 192; * p < .05; ** p < .01