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On the psychology of paranormal belief and experience

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Declaration

I hereby declare that this thesis is of my own composition, and that it contains no material previously submitted for the award of any other degree. The work reported in this thesis has been executed by myself, except where due acknowledgement is made in the text.

Signed,

Milan Valášek

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Note

Modified versions of Studies 1, 2, and 3 have been published prior to the submission of this thesis. Studies 4 and 5 are, at the time of writing, under review. For references, see the list of publications in Appendix E. In order to acknowledge the contributions of co-authors and advisors, "we" will be used instead of "I" throughout this thesis.

All research reported in the following chapters of this thesis has been reviewed and approved by the University of Edinburgh's Psychology Department research ethics board. All analyses were conducted using the R software version 2.15.3 (R Core Team, 2012) and IBM SPSS Statistics for Windows, version 19 (IBM Corp., 2010). The list of R packages used for analyses along with citations can be found in Appendix F. All reported *p*-values are 2-tailed, unless stated otherwise. Throughout the text, CI* refers to bias-corrected and accelerated confidence intervals based on a bootstrap sample of $N = 2{,}000$.

Lay Summary

The aim of this thesis is to contribute to the understanding of paranormal beliefs and experiences. The introduction provides a review of past research in the field and the rationale for our decision to focus on a specific type of paranormal experience – precognitive, or prophetic, dreams. We address several different hypotheses that have been proposed to account for such experiences. Chapter II describes an online dream precognition study testing the so-called psi hypothesis (Study 1). Participants collected their dreams over four weekly periods. Independent judges rated the similarity of the dream reports to a set of video clips. The dreams were found to be more similar to the video clips than could be expected by chance alone. However, based on further exploration of the data, we concluded that these results did not support the notion that dreams can provide information about the future. They did, however, illustrate the potential theoretical and methodological issues with the psi hypothesis and the way it is commonly tested. Chapter III focuses on explanations of precognitive dreams in terms of unconscious cognition. Two studies test the hypothesis that precognitive dreams arise as a result of unconscious inferences about likely future events based on subtle cues from the environment perceived in the absence of awareness. We predicted that participants with prior precognitive dream experience would perform better at measures of learning without awareness. However, no such relationship was found. Additionally, we predicted that performance on a task assessing perception without awareness would be related to belief in and experience of precognitive dreams. The results did not support this prediction. Study 4, reported in Chapter IV, explores several demographic and sleep- and dream-related variables and their relationship with precognitive dream belief and experience. We hypothesised that precognitive dream experience is associated with erratic patterns of sleep behaviour. As predicted, we found that a higher subjective

frequency of precognitive dreams was associated with more nocturnal awakenings, higher dream recall, lower overall sleep quality, and a higher likelihood of using sleep medication. We also explored the demographic factors of precognitive dream belief and experience, namely gender, age and education. Women were more likely to believe in the reality of precognitive dreams as well as report experiencing them. And there was a negative relationship between completed years of formal education and the precognitive dream variables. Frequency of these experiences was positively related to age. Moreover, we found support for our prediction that both precognitive dream belief and experience would be positively related to the subjective importance ascribed to one's dreams in general. Finally, the study investigated the relationship between the belief in and the experience of precognitive dreams. Although, as could be expected, we found these two to be strongly positively related, we argued that this relationship is not sufficient to gloss over the conceptual distinction. In order to further develop our line of research, we identify a need for a new measurement tool addressing attitudes towards one's precognitive dream experiences. Study 5, reported in Chapter V, concerns the development of such a questionnaire. A subset of people who reported having had such experience completed the questionnaire. After removing problematic items, the questionnaire was found to be satisfactory and additional variables collected on the sample were subsequently used to test its validity. Overall, the predicted relationships were confirmed by the analyses, which indicates the questionnaire is validity. Importantly, we found that personal significance of one's precognitive dreams was related to the frequency with which they are experienced. Chapter VI, reports two studies exploring the relationship between precognitive dream belief and experience, their personal significance and memory. Study 6 tested three hypotheses: earliest precognitive dream experiences would tend to date to a period of identity formation in

one's life; the vividness of the memory of this earliest experience would be related to the frequency of precognitive dream experience; and this relationship would be accounted for by the personal significance ascribed to one's precognitive dreams. All three hypotheses were supported. Finally, Chapter VII summarises the findings of the six studies conducted for this dissertation. We discuss our results in the context of the existing literature and highlight the main theoretical, methodological, and empirical contributions of our research. Directions for future research are also provided.

Thesis abstract

The aim of the present dissertation is to contribute to the understanding of putative paranormal beliefs and experiences. The introduction provides a conceptual analysis of past research into the paranormal and establishes the rationale for our decision to focus on a specific type of paranormal experience – precognitive dreams. The dissertation evaluates several different hypotheses that have been proposed to account for such experiences.

Chapter II describes an online dream precognition study testing the so-called psi hypothesis (Study 1). Participants (N = 50) collected details of their dreams over four weekly periods. Independent judges rated the similarity of the dream reports to randomly selected target and decoy video clips. Compared to the chance baseline of 50 hits out of 200 trials, the obtained 64 hits was significantly more than could be expected under the null hypothesis. However, based on a post hoc exploration of the data, we concluded that Study 1 yielded no evidence of any anomalous cognition within participants' dreams. It did, however, illustrate the potential theoretical and methodological issues with the psi hypothesis and the way it is habitually assessed.

Chapter III focuses on explanations of putative precognitive dreams in terms of unconscious cognition. Two studies test the hypothesis that precognitive dreams arise as a result of unconscious inferences about likely future events based on subtle cues from the environment perceived in the absence of awareness. Study 2 explores individual differences in implicit processing and their relationship to precognitive dream belief and experience. Participants (N = 50) completed the serial reaction time task as well as a series of questionnaire measures. Contrary to prediction, no relationship was found between precognitive dream experience – or belief – and implicit task performance.

Following these null findings, Study 3 tested another prediction of the same hypothesis. Participants (N = 49) completed a modified change detection task. The modification allowed for assessing explicit and implicit change detection separately. The results of Study 3 did not support the hypothesis, as the measure of explicit change detection was not related to precognitive dream experience. They did, however, provide a conceptual replication of the findings of Study 2, since we again found no relationship between implicit detection and precognitive dream experience.

On a large sample of participants (N = 672), Study 4, reported in Chapter IV, explores several demographic and sleep- and dream-related variables and their relationship with precognitive dream belief and experience. We hypothesised that precognitive dream experience is associated with erratic patterns of sleep behaviour. Consistent with this hypothesis, we found that a higher subjective frequency of precognitive dreams was associated with more nocturnal awakenings, higher dream recall, lower overall sleep quality, and a higher likelihood of using sleep medication. We also explored the demographic factors of precognitive dream belief and experience, namely gender, age and education. Women were more likely to believe in the reality of precognitive dreams as well as report experiencing them. And there was a negative relationship between completed years of formal education and the precognitive dream variables. Frequency of these experiences was positively related to age. Moreover, we predicted that both precognitive dream belief and experience would be positively related to the subjective importance ascribed to one's dreams in general. We found support for this hypothesis. Finally, the study investigated the relationship between the belief in and the experience of precognitive dreams. Although, as could be expected, we found these two to be strongly positively related, we argued that this relationship is not sufficient to gloss over the conceptual distinction. In order to further develop our line of research,

we identify a need for a new measurement tool addressing attitudes towards one's precognitive dream experiences.

Study 5, reported in Chapter V, concerns the development and validation of such a tool. A sample of people who reported having had a precognitive dream experience (N = 330) completed an initial 49-item questionnaire. After removing items with unsatisfactory psychometric characteristics an exploratory factor analysis coupled with exploratory structural equation modelling revealed a well-interpretable 5-factor structure with good internal consistency. Additional variables collected on the sample were subsequently used to test the validity of the derived subscales. Overall, the predicted relationships were confirmed by the analyses, which indicates both convergent and divergent/discriminant validity of the questionnaire. Importantly, we found that personal significance of one's precognitive dreams was related to the frequency with which they are experienced.

The final empirical chapter, Chapter VI, explores the relationship between precognitive dream belief and experience, their personal significance, and memory. Study 6 tested three hypotheses: earliest precognitive dream experiences would tend to date to a period of identity formation in one's life; the vividness of the memory of this earliest experience would correlate with the frequency of precognitive dream experience; and this relationship would be accounted for by the personal significance ascribed to one's precognitive dreams. All three hypotheses were supported.

Finally, Chapter VII summarises the findings of the six studies conducted for this dissertation. We discuss our results in the context of the existing literature and highlight the main theoretical, methodological, and empirical contributions of our research. Directions for future research are also provided.

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Chapter I

Theoretical issues

1.1. Introduction

Recently, there has been an increase in scientific papers related to putative paranormal phenomena published in high profile psychological outlets. In 2010, a paper by Storm, Tressoldi, and Di Risio (2010a) appeared in *Psychological Bulletin*, reporting on a meta-analysis of 11 years of parapsychological research into extrasensory perception (ESP) research. Based on 30 ESP studies employing the so-called *Ganzfeld* protocol (see section 1.3.1 below), they reported a small but statistically significant mean effect size ($ES = 0.152$, Stouffer $Z = 6.34$, $p = 1.15 \times 10^{-10}$), which they interpreted as supportive of the existence of ESP. A year later, Bem's (2011a) controversial paper was published in *Journal of Personality and Social Psychology*. In this paper, Bem describes 9 studies he conducted to test precognition, the reception of information regarding future events by means not currently acknowledged by science. In order to do this, he employed several novel and rather ingenious research paradigms. For instance, in "precognitive detection", the participants' task was to guess behind which of 3 curtains a stimulus (a picture) would subsequently appear. The number of correct guesses was then compared to a chance baseline and, if it was significantly higher, the result was taken as evidence for precognition. His "retroactive priming" paradigm was a spin on classic priming studies, however, unlike in these, the prime appeared *after* the response. Reaction time on the trials that were subsequently thus primed was compared to control trials. In the studies using the "retroactive facilitation of recall" paradigm participants recalled words

from previously studied word lists. A random subset of these words was then presented again. This additional, *a posteriori* presentation was hypothesised to improve the prior performance on the recall task compared to the words that were not re-presented in this way. Across all 9 studies, Bem reported an overall effect size of $d = 0.22$, with 8 studies yielding a significant result in the predicted direction.

Given the controversial subject of these papers as well as the eminent standing of the journals in which these studies appeared, it is perhaps not surprising that a lively debate duly ensued. Hyman (2010) in his reply to Storm and colleagues (2010a) criticised the meta-analysis on grounds of inadequate homogenisation of a heterogeneous sample and inappropriate use of composite effect sizes and raised objections against reliance on the meta-analytic techniques to confirm or disprove claims of replicability of parapsychological effects. The authors of the original paper replied defending their practices and findings (Storm, Tressoldi, & Di Risio, 2010b). Rouder, Morey, and Province (2013) later replied with further criticism and provided a Bayesian reanalysis of the data and conclude that, when accounted for methodological flaws in the original meta-analysis, the results do not by far provide as strong a support for the so-called psi hypothesis (see sections 1.2 and 1.3.3.3) as Storm and colleagues claim. However, Storm, Tressoldi, and Utts (2013) subsequently published their own Bayesian reanalysis of their reassessed dataset based on the methods applied by Rouder and colleagues and claimed that the original conclusion remained valid.

The reaction to Bem's (2011a) paper was even more turbulent. Apart from Bayesian re-analyses discounting the evidence for ESP presented by the original paper (Wagenmakers, Wetzels, Borsboom, & Van Der Maas, 2011; Rouder & Morey, 2011), replies to these re-analyses also within the Bayesian framework (Bem, Utts, & Joohnson, 2011), and strong methodological criticism (Alcock, 2011a; see Bem, 2011b and Alcock,

2011b for a back and forth), some prominent researchers have called for a change in the way in which data analysis is conducted in psychology (Wagenmakers *et al.*, 2011). Others used the Bem paper as a case study to illustrate publication bias (Francis, 2012) as well as certain questionable research practices they thought were endemic in the field of psychology (and, by association, parapsychology; Simmons, Nelson, & Simonsohn, 2011). Furthermore, the reported difficulties encountered by Ritchie, Wiseman, and French regarding the publication of their triple failure to replicate one of the original 9 studies (Ritchie, Wiseman, & French, 2012) significantly contributed to the ensuing lively debate regarding what has been dubbed the crisis of replication in psychology (Pashler & Wagenmakers, 2012). The literature reviewed above as well as the social and methodological impact the Storm *et al.* (2010a) and Bem (2011a) papers have had on the entire field of psychology is indicative of the value in exploring the issue of paranormal phenomena.

Indeed, surveys into supposed paranormal beliefs and experiences have consistently shown that this issue is by no means a marginal one. According to these surveys, between 59-73% (Blackmore, 1997; Moore, 2005) of the general population believe in, and about half as many people report having experienced, at least one such phenomenon (Ross & Joshi, 1992; Castro, Burrown, & Wooffitt, 2014). These levels of belief and experience seem to be fairly stable through time (*e.g.*, Francis & Williams, 2009; Gallup & Newport, 1991; Haraldsson, 1985; Moore, 2005) as well as across geographic regions. Similar level of endorsement of the paranormal can be found in the UK (Francis & Williams, 2009; Moore, 2005), the USA (Rice, 2003; The National Science Foundation, 2002), Canada (Ross & Joshi, 1992), Sweeden and Iceland (Haraldsson, 1985), the Czech republic (Quesnell, 2000), and South Africa (Williams, Francis, & Robins, 2007). Given the prevalence of paranormal beliefs and experiences,

coupled with the fact that there is no widely accepted evidence of the existence of paranormal phenomena, we believe that the issue of paranormal belief and experience merits considerable scholarly attention. Providing it is the aim of this dissertation.

In this introductory chapter, we first discuss the definition of the concept of the paranormal as well as some issues stemming from this definition. Next, we consider the three conceptual approaches to studying this topic. Subsequently, we review the scientific literature on the psychology of paranormal belief and experiences and analyse some conceptual problems in this field. This analysis will provide the rationale for our decision to focus our research on a specific type of paranormal phenomenon – precognitive dreams – which will subsequently be discussed in greater detail. Finally, we outline the research that forms the content of the five empirical chapters of this dissertation.

1.2. The paranormal: Definition and conceptual issues

From the examination of the relevant literature it is apparent that defining the concept of the paranormal is not a straightforward issue. For instance, Lindeman and Aarnio (2006) define the paranormal as encompassing superstition, the supernatural, and magic without further elaborating on the meaning of these terms. In her subsequent work Aarnio (2007) views paranormal beliefs as category errors, whereby core attributes of mental, physical, and biological entities are being conflated. While this definition may well be accurate, being clearly informed by an ontological position that assumes that the phenomena in question do not exist, it is not conducive to research into the question of the reality of the paranormal and is only useful for research in psychology or psychiatry. Others construe the paranormal in terms of the current state of scientific knowledge and philosophy of science. Broad (1949) describes paranormal phenomena as such

phenomena whose existence, if they indeed exist, defies the fundamental principles of science. In a similar vein, the oldest operating society dedicated to the study of these phenomena, the UK's Society for Psychical Research (SPR, 2009), sees as paranormal a "[p]henomenon which is considered impossible according to the established scientific world-view". French (1992) gives a slightly less radical version of this definition stating that they are those assumed phenomena that, if real, cannot be accounted for by current scientific knowledge.

There are two principal issues with the concept of the paranormal. Firstly, its lack of conceptual clarity: The definitions given above do not provide sufficient guidance for deciding what qualifies as paranormal and what does not. As a consequence, there is a lack of consensus on the matter. Some authors, for example Tobacyk and Milford (1983), include under this umbrella term religion-related concepts such as the existence of deities, miracles, the power of prayer to affect reality, traditional superstitions regarding, for example, Friday 13th and touching wood, the existence of cryptids (mythical creatures, *e.g.*, the Loch Ness monster, Yeti, and the likes), extra-terrestrial contact with the Earth, witchcraft, or telepathy. Lange, Irwin, and Houran (2000) then further divide the beliefs concerning these phenomena into traditional (religion-related, superstitions, witchcraft, etc.) and New-age (ESP, UFO, horoscopes, spiritualism, etc.). Others, however, find this breadth of scope – which would qualify for the paranormal label even such phenomena as vitalism or homoeopathy – undesirable. In an attempt to narrow down the definition, the SPR, in addition to the above-mentioned definition, describes the object of its interest as "the scientific investigation of the ways that organisms communicate and interact with each other and with the environment, that appear to be inexplicable within current scientific models" (SPR, 2009). Thus, apart from not being explicable by the current scientific knowledge, paranormal phenomena

are understood as interactions between organisms and the environment. However, this still does not preclude the examples of phenomena not usually construed as paranormal in the sense the researchers in the field use from being classified as such. For that reason, on its website, USA's most notable Parapsychological Association (PA) opts for a definition by enumeration: "[members of the PA study] 'psi' (or 'psychic') experiences, such as telepathy, clairvoyance, remote viewing, psychokinesis, psychic healing, and precognition" (PA, 2010), subsequently describing the individual supposed phenomena. Psi here refers to a category of convenience, whose characteristics are that its membership is predicated on the fulfilment of the above-mentioned definitions of the paranormal but, at the same time, is restricted to only those phenomena that are of interest to parapsychologists. Other than this, we can see no other criteria for inclusion of the given phenomena and the exclusion of others. This *ad hoc* nature of the definition is problematic and not only reflects the absence of a theoretical framework within parapsychology but, it could be argued, even inhibits the development of one.

The second, arguably even more critical issue is the negative definition of the concept. As Alcock (2003) in his excellent essay points out, the paranormal is invariably defined in terms of what it is not rather than what it is. Whichever constituent phenomenon of psi, the defining characteristic is always that it operates through means other than the ones widely recognised. For instance, telepathy is the exchange of information between two minds through channels other than the ones mediated by the senses. Similarly, precognition refers to the reception of information pertinent to future events that could not be obtained by "normal" intuition or rational inference. As demonstrated in Chapter II, this feature of the definition is problematic, as it presents issues for research. Due to the negative definition of the object of study, paranormal phenomena are operationalised as anomalies that cannot be accounted for by any

normal explanation. Since, as dictated by the maxim of philosophy of science that it is not possible to prove a universal negative, to declare that all normal explanations have been ruled out is a daunting task. It also provides opponents of the very idea of the existence of the paranormal with infinite grounds for reasonable doubt, thus hampering any consensus between psi proponents and sceptics. It is indeed difficult to imagine an end to this impasse unless both conceptual and operational definitions of the paranormal are developed characterising it in positive terms.

Considering the above, even 15 years later we agree with Roberts and Seager (1999) that there is currently no universally accepted, unambiguous, and systemic conceptual definition of the paranormal. However, most authors agree that whatever the paranormal is, it should include at the very least ESP and psychokinesis (PK, direct, unmediated influence of the mind on physical objects). ESP then further breaks down into individual phenomena, such as precognition, clairvoyance, or telepathy, whose definitions can be found in SPR's glossary (http://www.spr.ac.uk/page/glossary-paranormal). This arguably unsatisfactory definition appears to be the most useful one available and it is therefore the one we adopt in this dissertation.

1.3. Studying the paranormal

The research into the topic of paranormal phenomena can be categorised into three principal approaches: testing the psi hypothesis, finding alternative "normal" explanations for these phenomena, and exploring the psychological factors of paranormal belief and experience. These categories are not always clearly demarcated and, sometimes, a single study will employ more than one approach. This is also not the only possible way to categorise research in the field. However, it provides a useful framework for the purpose of this dissertation. Below we discuss each one of the three

approaches in turn. It is not the aim of this chapter to give an exhaustive review of past research in every category. Our goal here is to introduce the topic of research into the paranormal and to highlight what we perceive to be the main conceptual issues in the area. The literature review is then limited to the topics most pertinent to the empirical chapters of this thesis. It should also be noted, that we use the term "parapsychology" in a specific way in further writing. Although many authors (*e.g.,* Irwin & Watt, 2007) regard the field of parapsychology as encompassing all of the above-mentioned avenues of research, for the sake of clarity, we use the term to only refer to the endeavour to test the psi hypothesis, or the ontological reality of paranormal phenomena. As such, parapsychology can then be contrasted with anomalistic psychology (French & Stone, 2014; Zusne & Jones, 1989) which, under our definitions of terms, deals with psychological factors responsible for experiences that are deemed paranormal.

1.3.1. Parapsychology: Testing the psi hypothesis

As stated above, one of the ways of approaching the topic of the paranormal is to test whether the purported phenomena actually exist. This question has been of interest to intellectuals and even eminent scientists of their time for over a century. With the establishment of the Society for Psychical Research in 1882 and the birth of parapsychology as a discipline, the effort to study the paranormal using the scientific method was institutionalised. Originally, the focus of the research in the new field was pointed at demonstrable putatively paranormal real-word phenomena, such as communication with spirits or what is nowadays referred to as macro-PK, that is manipulation of physical objects by means of direct mental influence (*e.g.*, levitation). Claimants to extraordinary psychic powers and supposed spiritual mediums would often be the objects of study. Gradually, beginning in the 1930's, the centre of gravity within

the field has moved towards a more laboratory-based, controlled setting, focusing, instead of "big" paranormal phenomena, on more subtle and inconspicuous effects detectable only by means of statistical analysis. Nowadays, this kind of research represents the majority of work in the field. As a consequence of this development, the very object of study has been modified. Parapsychology no longer deals primarily with impressive individual manifestations of what was once thought to be the paranormal (ghosts, the so-called physical mediums, etc.) and instead construes the paranormal as a subtle effect normally distributed in the population.

The reasons for this conceptual and methodological shift are a matter of debate. Some, for instance Irwin and Watt (2007), see as its driving force the movement within parapsychology towards increasing scientific rigour, experimental control, and replicability of the measured effects. Others, such as Alcock (2003), provide a somewhat less charitable rationale: According to their view, the above-mentioned shift can be attributed to the failure of parapsychology to demonstrate that the feats of supposedly extraordinary individuals are anything but trickery. Thus, moving towards the exploration of ever more subtle statistical anomalies can be viewed as moving the goalpost in an attempt to preserve the *raison d'être* of the discipline in the face of failure. Parallels can be drawn between the apparent shrinking of the paranormal and the seemingly diminishing role of deities throughout human history, referred to as the God of the gaps (Coulson, 1955). Indeed, it is difficult to imagine the establishment of a research field focused on such minute statistical deviations without the benefit of the above-mentioned historical context. Although we do not doubt that the motivation voiced by Irwin and Watt has been a factor in the development of parapsychology, we agree with Alcock that the conceptual rift between the field's original purpose and its current focus is problematic. In any case, the fact of the matter remains that these days,

laboratory-based parapsychological research has been focusing on detecting presumably subtle anomalous effects in samples drawn from the general population under strict experimental controls designed to prevent contaminating of the effects by those from normal sources (*e.g.*, trickery or information leakage).

There are two principal modes of investigation within parapsychology. On the one hand, studies that aim to test the existence of psi phenomena follow the proof-oriented research. On the other hand, the process-oriented research attempts to identify the mechanisms governing the detected effects as well as the conditions conducive to them. Apart from experimental studies, the latter may employ a phenomenological approach, using the exploration of qualitative characteristics of paranormal experience in order to gain insight into the processes by which psi operates. It is beyond the scope of this thesis to give a thorough review of the various methods and paradigms used in parapsychology. However, given that the main principles of this kind of research are relevant to parts of the following content, some discussion of the logic behind parapsychological research is appropriate. In order to illustrate this logic, we use the example of the so-called *Ganzfeld* protocol, a popular research paradigm in ESP research that has received substantial mainstream attention (see above). For a more in-depth review of research methods in parapsychology, we recommend the textbook by Irwin and Watt (2007).

In a typical *Ganzfeld* setting, a participant (a *receiver*) is seated in a comfortable chair in a darkened room. Their eyes are covered by halved translucent table tennis balls illuminated by a red light. Additionally, headphones playing white or pink noise are placed over their ears. The receiver undergoes an initial period of relaxation in this setting. These conditions are created in order to induce an undifferentiated sensory field, resulting in a mild sensory deprivation, which is thought to be psi-conducive. This

reflects the aforementioned notion of psi as a weak signal that may be masked by cognitive and sensory noise under normal circumstances (Storm *et al.*, 2010, Irwin & Watt, 2007). The receiver is then asked to verbalise their mentation. A target, usually a static picture or a short video clip is randomly drawn from a target pool. It is then, along with typically three decoy stimuli, judged for similarity with the receiver's mentation. If the target is judged to be the most similar of the group, the trial is declared a "hit", otherwise it is a "miss". The overall number of hits is then tested against a mean chance expectation (MCE; in the example, MCE = 25%). If the number of hits is significantly higher than what could be expected under the null hypothesis of chance performance, the result is taken as evidence of psi. There are many variations to this basic paradigm. For instance, different ways of handling the target are used, based on the particular paranormal phenomenon being tested by the given study. If it is telepathy, there is also a *sender* present in another room viewing the target and attempting to mentally communicate its content to the receiver. In another case, if the phenomenon of interest is precognition, the receiver provides their mentation first and only after that, the target is randomly drawn. In order to study PK, however, there may be no mentation or targets at all and the participant's task is to attempt to mentally influence the sequence produced by a random event generator (*e.g.,* a sequence of heads-or-tails coin flips). The resulting sequence is then tested for randomness and the outcome is declared evidential of psi if the null hypothesis of randomness is rejected. In all such variations, due care is taken to guard against all sources of sensory leakage that could provide the receiver with information about the target via non-paranormal channels. Furthermore, crucial importance is placed on the absence of any bias in the target draw, since this is the only source of randomness in the setting, required by the assumptions of the statistical tests used to assess the significance of the results.

Other research paradigms used in parapsychology usually apply the same logic: a participant is faced with a task to influence/guess an outcome of a randomly generated event. A significant statistical anomaly is then equated with evidence for psi, provided all plausible alternative explanations for the detected effect have been ruled out. However, as mentioned in the preceding sections, there are philosophical issues associated with this kind of method stemming from the impossibility of confidently accounting for all possible alternative explanations. Furthermore, the negative approach to ascertaining the existence of psi (an anomaly not explainable by any known means), which is a direct consequence of the lack of a good conceptual definition of the object of study, is incapable of providing any information regarding the actual nature of psi.

Having discussed what we perceive to be the main issues in parapsychological research, we now turn, one at a time, to the other two approaches to studying the paranormal.

1.3.2. Pseudo-psi: In search for alternative explanations

The second approach to the study of the paranormal assumes that even if the phenomena in question are not a result of any scientifically inexplicable mechanisms, they do in fact occur. Paranormal phenomena thus are not *de facto* paranormal but are rare and striking enough as to give the impression. These occurrences that are not psi yet look like it have been labelled pseudo-psi (Morris, 1986). Studies taking this approach search for potential physical (Lambert, 1959), physiological (Blanke *et al.*, 2005), and psychological (Wilson, 2002) mechanisms, that can lead to such apparently paranormal events. Thus, this avenue of research represents a transition between the parapsychological approach discussed above and the purely psychological which is introduced in the following section. This fact also illustrates the fuzzy demarcation

between individual approaches. On the one hand, there is considerable conceptual overlap between psi and pseudo-psi research. Some parapsychologists have hypothesised that psi operates through some, currently unknown, but ultimately natural and knowable mechanism (*e.g.,* Wassermann, 1956). If this is the case for all the phenomena of interest, the distinction between psi and pseudo-psi ceases to exist. On the other hand, given that the construal of an event as paranormal is contingent upon the appraisal of the observer, no matter the actual external mechanism at play, psychology is necessarily going to be a relevant factor. For instance, it may be the case that, due to a pure coincidence, a person's dream literally comes true. Even in face of such rare occurrence, it is still a matter of individual psychological setting whether or not the person attributes paranormal causation to this experience.

Studies applying the pseudo-psi approach tend to employ emulation as the core principle of their methodology: they attempt to recreate a seemingly paranormal experience under controlled laboratory conditions through various mechanisms. The rationale behind this is that, consistent with the principle of parsimony, if phenomena that are for all purposes indistinguishable from purportedly paranormal events can be created by deliberate manipulation of well-understood normal mechanisms, then there remains little reason to assume the existence of genuinely paranormal phenomena. Alternatively these studies may seek to identify evidence of factors with known effects operating in putatively paranormal situations. For example, some researchers have suggested that *poltergeist* occurrences (such as "haunted" places) may arise as a result of mild tectonic or geophysical activity (Lambert, 1959). Also, it has also been suggested that certain naturally occurring environmental stimuli, such as infrasound emitted by wind, waterfalls, or thunder (Gužas & Viršilas, 2009), can induce anxiety, nausea, even optical illusions in people and thus can lead to putatively paranormal experiences

(Tandy, 2000; Tandy & Lawrence, 1998). Braithwaite and Townsend (2006), however, dispute the evidence for these phenomena. Other studies provide naturalistic accounts of various such experiences, invoking physiological processes. Mobbs and Watt (2011) review the existing body of relevant neurophysiological knowledge and suggest that near-death experiences are a result of events taking place in a stressed, oxygen-deprived brain. A related kind of experience, the so-called out-of-body experiences (OBEs), has been successfully simulated using several methods including brain stimulation (Blanke, Ortigue, Landis, & Seeck, 2002; Blanke *et al.*, 2005) and complex multisensory illusions (Ehrsson, 2007; Lenggenhager, Tadi, Metzinger, & Blanke, 2007). Furthermore, experiences such as alien abductions and the "old hag syndrome" (a terrifying experience of waking up to being suffocated by an evil presence, often in the form of an old hag) have both been linked to sleep paralysis, a situation of awakening from rapid-eye-movement (REM) sleep, when voluntary control of muscles is suppressed, often accompanied by a feeling of terror (Blackmore & Cox, 1988; Firestone, 1985; French & Santomauro, 2007; McNally & Clancy, 2005). Finally, there have also been attempts to explain some seemingly paranormal phenomena through known psychological mechanisms. Wilson (2002) uses the hypothetical example of a woman who, on her way to work, crosses a footbridge every day. One day, she decides, for the first time, to take a different route to work only to learn later on that the footbridge collapsed around the same time she would have been crossing it, had she taken the usual route. After learning what happened, she may ascribe precognitive or clairvoyant character to her decision. However, she might have simply picked up on a slightly unusual behaviour of the footbridge the day before, perhaps a sign of structural damage, without consciously realizing it. This perception without awareness might have led to her putatively precognitive decision. In line with this hypothesis, Crawley, French, and Yesson (2002)

showed that subliminal cues can be exploited as a source of information even if one is not aware of doing so. In a supposedly ESP-focused experiment, they had their participants guess the pattern on a sequence of computer-generated cards. Half of the tasks were, unbeknownst to the participants, primed with a subliminal stimulus showing the correct answers. The researchers found that participants hypothesised to be more sensitive to subliminal priming were indeed more successful at guessing the correct answers on the primed trials (but not on the control ones) than less sensitive participants.

Research, such as that of Crawley and colleagues (2002) reviewed above, focuses, in line with the pseudo-psi hypothesis, on potential psychological processes that can lead to genuine knowledge of a future event, albeit this knowledge is acquired via normal means. The last of the three approaches, to which we turn next, is concerned with those psychological factors that may be responsible for paranormal attribution in the face of an unusual experience.

1.3.3. The paranormal as attribution

The third approach to the study of the paranormal focuses on psychological factors that are likely to play a role in differentiating people with a propensity to perceive certain phenomena as paranormal from those who tend to reach for a "normal" explanation. A related but distinct object of study within this approach is the underlying psychology of belief in the existence of paranormal phenomena. Literature in this field tends to make few assumptions about the ontological validity of the paranormal (see *e.g.,* Irwin & Watt, 2007). If such phenomena do not exist, it is all the more interesting to study the mechanisms responsible for above-mentioned beliefs and experiences. Even if they are genuine, they are probably not as frequent as reported, thus leaving a certain

proportion of the population whose beliefs and experiences are not a true reflection of paranormal phenomena. In either case, the effort to identify psychological mechanisms contributing to these beliefs and experiences is justified. Thus, the issue of whether or not these things are ontologically real is not of primary relevance. In this dissertation, we also subscribe to this rationale and do not make any specific claims regarding the existence, or otherwise, of the paranormal. When it comes to assessing this matter, we would, however, argue that, as with other objects of scientific inquiry, the default position is that of open-minded scepticism and that the burden of proof lies with the proponents, whose task is to demonstrate the existence of these kinds of phenomena beyond reasonable doubt. Based on our evaluation of the existing parapsychological literature (Ritchie *et at.*, 2012; Rouder *et at.*, 2013; Storm *et at.*, 2013; Wagenmakers *et at.*, 2011), we are of the opinion that this goal remains to be achieved. Therefore, from now on, when referring to 'paranormal experiences' or 'paranormal phenomena', we mean experiences and phenomena construed as paranormal by the particular person.

Given the relevance of this approach for the aim of this thesis, we review the past literature in this area to a somewhat larger extent than we did with respect to research applying the other two approaches. In particular, we focus on the measurement of paranormal belief and experience, the main hypotheses framing the research into these topics, as well as the conceptual and methodological issues that, in our opinion, threaten its validity.

1.3.3.1. Measurement of paranormal belief and experience

There is a notable variety in the tools used to assess paranormal beliefs and experiences. Many studies use *ad hoc* scales (*e.g.*, Blackmore & Trościanko, 1985; Beck & Millner, 2001; Lawrence & Peters, 2004; McGarry & Newberry, 1981). Some, usually clinical studies, address these topics (alternatively referred to as supernatural, magical, or

superstitious) as part of broader clinical constructs, such as the Magical Ideation scale of the Wisconsin-Madison scales (Chapman, Chapman, & Kwapil, 1995). However, several scales (*e.g.*, Blackmore & Moore, 1994; Sheils & Berg, 1977; Wiseman & Morris, 1995), have been used in further research. Two of these, namely the Revised Paranormal Belief Scale (R-PBS, Tobacyk, 1988/2004) and the Australian Sheep-Goat Scale (ASGS, Thalbourne & Delin, 1993) have since become the most widely used tools for the assessment of paranormal belief and experience (Goulding & Parker, 2001; Irwin, 1993).

Given the sheer number of available tools, it is not surprising that there is a considerable variability in the scope of phenomena these tools assess. On one end of the spectrum, there are scales that focus on a particular type of paranormal phenomenon, such as ESP (Thalbourne & Haraldsson, 1980). These have, however, been more often used for parapsychological research of the co-called "sheep-goat" effect (believers tend to outperform disbelievers at parapsychological tasks), rather than for exploring the psychological correlates and mechanisms of belief and experience (Irwin, 1993). Then there are scales that explore a variety of paranormal phenomena, as understood under the narrow parapsychological definition of the term. A good example of such a measure is the ASGS, a three-point forced choice (True/Uncertain/False) questionnaire of 18 items assessing the personal experience of and belief in ESP, telepathy, precognition, and phenomena related to the survival of mind after the physical death of the body. Finally, on the other end of the spectrum, scales such as the R-PBS address the belief in a broad range of phenomena from religious (deities, the devil) and superstitious (the unluckiness of the number 13) to extraordinary life forms (Loch Ness monster) and psi. This breadth of scope resulted in some researchers (*e.g.*, Lindeman, Svedholm-Häkkinen, & Lipsanen, 2015) modifying the scale and excluding certain items for reasons of their cultural specificity or outdatedness. We suggest that

this variability in available measurement methods is symptomatic of the lack of conceptual clarity and consensus regarding the subject of study, which we discussed above (see section 1.2).

Related to the above is the issue of dimensionality of paranormal belief and again, opinions on the matter differ (Irwin, 1993; Lindeman & Aarnio, 2006). For instance, Grimmer and White (1990) factor-analysed the data from an Australian psychology student sample and found seven oblique factors accounting for 2.68 – 10.04 % of the total variance each: traditional religion, obscure unbelief, popular science, alternative treatments, paratherapies, structural psi, and functional psi. Other analyses yielded a lower number of factors: two orthogonal factors, general superstitious belief and traditional religious belief, for Sullivan (1982); three factors related to belief in religion, psi, and the existence of extraordinary forms of life for Clarke (1991) and Sobal and Emmons (1982). Some authors have even suggested a general factor of paranormal belief (Zusne & Jones, 1989), although this view has attracted criticism (Irwin, 1993; Rattet & Bursik, 2001). Different still, Lindeman and Aarnio (2006) found a satisfactory fit for their hierarchical model with a single general factor of paranormal belief and four uncorrelated second-order factors. However, the scope of the measure employed was rather broad including all the R-PBS items and adding further ones. The resulting 68-item scale encompassed topics such as beliefs in psi, astrology, magical beliefs about food, and more.

The lack of consensus regarding the dimensionality of paranormal belief is also apparent in the scoring of the widely-used Paranormal Belief Scale. Tobacyk and Milford (1983) factor-analysed the original version of the PBS and found what they claimed to be 7 orthogonal factors. Identical structure was later advocated by Tobacyk (1988/2004) for the revised version of the scale. However, Lawrence (1995a) criticised

these findings and suggested that a 5 oblique factor solution is a more appropriate one. As a result of the ensuing debate (Lawrence, 1995b; Lawrence, & De Cicco, 1997; Lawrence, Roe, & Williams, 1997; Tobacyk, 1995a; 1995b; Tobacyk & Thomas, 1997) the claim of orthogonality of the factors was retracted. In the scale's latest development, Lange, Irwin, and Houran (2000) used the Rasch model to explore the structure of the scale and, after excluding items with problematic psychometric properties, found that the items grouped into two clusters. They labelled them New Age Philosophy and Traditional Paranormal Beliefs. As we argue further in the text, the dearth of clarity with respect to the underlying structure of paranormal beliefs and experiences has consequences for research into these topics. Next, we provide an overview of the main theoretical frameworks that underpin this research.

1.3.3.2. Theoretical frameworks

The overarching idea informing the research under this approach that at least some paranormal beliefs and experiences arise as a result of one's erroneous construal of a phenomenon, an event, or an experience as paranormal has been dubbed the "misattribution hypothesis" (Wiseman & Watt, 2006). Although originally proposed as, more-or-less, an alternative term for the cognitive deficit hypothesis (see below), we suggest that, given its principal tenets, it applies for and subsumes all the other partial hypotheses that have been proposed in order to explain paranormal belief and experience in psychological terms. There are four such hypotheses (Irwin, 1993; Irwin & Watt, 2007), which we discuss below. It is important to point out that the following section is not meant to be an exhaustive review of the empirical literature in psychology of paranormal beliefs and experiences. This literature is rather extensive and providing such a review is beyond the scope of this dissertation. To a reader interested in this literature, we highly recommend the review papers by Irwin (1993) and Wiseman and

Watt (2006), as well as the chapter on paranormal belief in Irwin and Watt (2007). Let us now provide an account of the aforementioned four hypotheses that have informed past research in this field.

Firstly, it has been proposed that an important factor behind the misattribution is a disadvantaged social situation. This is known as the "social marginality hypothesis" (Bainbridge, 1978). This hypothesis is mainly tested by exploring various demographic correlates of paranormal belief and experience. The findings have, however, been mixed, which is a theme that permeates a substantial portion of research into paranormal belief and experience. For example, Haraldsson (1981), in his Icelandic sample (N = 568) found no relationship between age and paranormal belief, however in the British sample (N = 896), it seems that belief in the paranormal weakens with age for some phenomena, such as hauntings and poltergeists, witchcraft, or ESP, while remaining fairly stable for telepathy. Other studies exploring age (Castro *et al.*, 2014; Irwin, 1993; Lindeman & Aarnio, 2006) also yielded conflicting results. When it comes to gender, the literature seems to paint a somewhat more homogeneous picture. Women have been consistently shown to report higher levels of both paranormal belief and experience (Castro *et al.*, 2014; Haraldsson, 1985; Lindeman & Aarnio, 2006). This effect of gender varies between individual facets of the paranormal (Rice, 2003). However, Lange, Irwin, and Houran (2001) suggest that the observed differences might be a methodological artefact caused by differential item function of the used measures. Some studies have also investigated the relationship between paranormal belief on one hand and socioeconomic status and race/ethnicity on the other. No clear pattern of findings supporting the social marginality hypothesis has emerged (Emmons & Sobal, 1981; Irwin & Watt, 2007).

Secondly, the "worldview hypothesis" (Zusne & Jones, 1989) states that these beliefs and experiences are merely one facet of a person's general life philosophy that entails a highly subjective, intuition-guided, and esoteric epistemology. Studies based on this hypothesis thus tend to explore various associated attitudes of these beliefs and experiences. Traditional religious beliefs and religiosity are among such attitudes but the results of the research into their association with paranormal belief are mixed. There is a small positive correlation between overall paranormal belief and belief in a deity (Thalbourne, 2003) but again, the effect varies across individual facets (Clarke, 1991; Hillstrom & Strachan, 2000; Tobacyk & Milford, 1983). Furthermore, there is evidence that the type of religiosity is also a factor in the relationship (Hergovich, Schott, & Arendasy, 2005). Further, it has been found that believers in the paranormal tend to subscribe to a more subjectivist personal philosophy (Zusne & Jones, 1989). Finally, perhaps unsurprisingly, belief in the paranormal has been associated with an inclination towards a substance dualist metaphysics (Stanovich, 1989; Svensen, White, & Caird, 1992).

Under the "cognitive deficit" hypothesis (Alcock, 1981), the misattribution of paranormal causation is seen as a result of a suboptimal cognitive system whose functioning is laden with irrationality, various biases, or even pathology. Researchers testing this hypothesis therefore look for various cognitive correlates of paranormal belief and experience. Several studies have focused on the topic of general cognitive ability. There is, however, a substantial methodological variability in the way cognitive ability is assessed (see Musch & Ehrenberg, 2004; Pennycook, Cheyne, Seli, Koehler, & Fugelsang 2012; Wiseman & Watt, 2002) and the results of these studies have been mixed, with some studies reporting a negative relationship between cognitive ability and paranormal belief (*e.g.,* Gray, 1987; Messer & Griggs, 1989; Musch & Ehrenberg, 2002;

Otis & Alcock, 1982; Smith, Foster, & Stovin, 1998), others failing to find any such relationship (Dagnall, Parker, & Munley, 2007; Pennycook *et al.*, 2012; Stuart-Hamilton, Nayak, & Priest, 2006; Thalbourne & Nofi, 1997; Wiseman & Watt, 2002), and others still even finding a relationship in the opposite direction (Emmons & Sobal, 1981; Jones, Russell, & Nickel, 1977; Haraldsson, 1985). Other correlates explored under the cognitive deficit hypothesis include preference for analytical versus intuitive thinking styles (*e.g.,* Aarnio & Lindeman, 2005; Bensley, Lilienfeld, & Powell, 2014; Blackmore & Moore, 1994; Genovese, 2005; Saher & Lindeman, 2005), critical thinking ability (*e.g.,* Alcock & Otis, 1980; Gray & Mill 1990; Hergovich, & Arendasy, 2005; Royalty, 1995), susceptibility to various cognitive biases (*e.g.,* Tobacyk, Milford, Springer, & Tobacyk , 1988; Willard & Norenzayan, 2013; Wilson & French, 2006), or probabilistic reasoning (*e.g.,* Blackmore & Trościanko, 1985; Bressan, 2002; Brugger, Landis, & Regard, 1990; Brugger, Regard, & Landis, 1991; Dagnall *et al.*, 2007; Musch & Ehrenberg, 2004; Roberts & Seager 1999; Stuart-Hamilton *et al.*, 2006; Williams & Irwin, 1991). Considering the inconclusive outcomes of these studies, Wiseman and Watt (2006) note that while studies using decontextualised laboratory tasks, such as coin toss sequences or the birthday paradox, tend to yield significant results in support of the cognitive deficit hypothesis, more ecologically valid measures typically fail to replicate these effects.

Finally, it has been proposed that these beliefs and experiences are fundamentally functional and serve to fulfil certain needs. This "psychodynamic function" hypothesis (Irwin, 1993) primarily informs research into personality and experiential correlates of paranormal beliefs and experiences. For instance, studies have explored the relationship between paranormal belief and experience and perceived control over the environment (Blackmore & Trościanko, 1985; Rudski, 2004). Irwin (1992; 1993) suggests that this illusion serves to satisfy the believers' need to feel in control that arises as a consequence

of certain childhood experiences, such as trauma or a perceived lack of control over one's environment and actions. However, it is not clear what predictions this hypothesis makes with respect to believers' locus of control (LoC): do they feel that events in their lives are fundamentally controlable because of their tendency towards illusion of control, or do they feel passive with respect to these events as a result of their childhood experiences? Indeed, paranormal belief has been linked to both a tendency to an internal (McGarry & Newberry, 1981) as well as an external (Dag 1999; Dudley, 1999; Newby & Davis, 2004) LoC and both outcomes have been interpreted as supportive of the psychodynamic function hypothesis. While Newby and Davis (2004) argue that a person who believes in the existence of mysterious powers that govern the ways of the world will obviously have an external LoC, McGarry and Newberry (1981) suggest that one's belief in one's ability to influence the reality through paranormal means, such as psychokinesis, is logically connected to an internal LoC. We believe that the psychodynamic function hypothesis has yielded some promissing findings, however there is a need for more specific predictions, perhaps at the level of individual facets of paranormal phenomena.

Having discussed the main hypotheses of the psychological approach to the paranormal, it should be noted that, once again, these hypotheses are not mutually exclusive. It is, for example, possible that it is the psychological motivation to satisfy frustrated needs that drives paranormal beliefs and experiences in socially marginalised individuals. Similarly, this sort of need fulfilment only provides motivation, not a psychological mechanism through which the paranormal misattribution takes place. That may plausibly be achieved through some of the many cognitive biases explored within the framework of the cognitive deficit hypothesis.

1.3.3.3. Further conceptual and methodological issues

Having discussed the main hypotheses under which the research into the psychology of paranormal belief and experience is conducted, it is crucial to address two main conceptual and methodological issues within this literature that we believe deserve some attention.

Firstly, a substantial proportion of the previous psychological research into paranormal beliefs and experiences has, in general, treated its object of study as a homogenous entity, thereby tacitly assuming that all the individual facets of the paranormal (ESP, PK, life after death, *etc.*) are a result of more-or-less the same mechanisms. There is, however, no good evidence to support this assumption. Indeed, some researchers have previously pointed out that different paranormal beliefs have different structures and correlates (*e.g.*, Irwin, 1993; Lindeman & Aarnio, 2006; Perkins & Allen, 2006). If this is the case, then the effort to reliably identify the correlates of belief and experience of the paranormal in general may, to a certain extent, be misguided. This is not to say that the entirety of the existing literature suffers from this shortcoming. Studies into correlates of paranormal belief and experiences conducted by parapsychologists tend to distinguish between individual facets of the paranormal more than those in mainstream psychological literature. The assessment of the individual paranormal phenomena is, however, seldom guided by hypotheses and is often done in an *ad hoc* fashion (*e.g.*, Agorastos *et al.*, 2012; Davies & Kirkby, 1985; Hergovich *et al.*, 2005). Also, surveys of beliefs and experiences (*e.g.,* Castro *et al.*, 2014; Haraldsson, 1985) often provide a detailed break-down of individual phenomena and their relationship with demographic variables. Moreover, studies often provide a similar break-down in their descriptive analysis sections (*e.g.*, Williams & Irwin, 1991), however they typically do not proceed to explore the differences between individual types of

beliefs and experiences. Finally, there are a small number of studies that focus on a specific facet of the paranormal (*e.g.*, Brugger, Landis, & Regard, 1990) and those that take a genuinely multidimensional, hypothesis-driven approach to studying the belief in the paranormal (*e.g.*, Perkins & Allen, 2006; Tobacyk, Nagot, & Miller, 1988). However, there appears to be no systematic effort to identify mechanisms underpinning belief in and experience of individual types of these phenomena. We would argue that this state reflects the methodological developments undergone by the Paranormal Belief Scale discussed in section 1.3.3.1. Exploring individual facets of paranormal belief appears to have been more common since the 1980s, when Tobacyk's orthogonal 7-factor solution was proposed. Nowadays, since the 2-factor solution has become widely accepted (Wiseman & Watt, 2006), the trend is to treat paranormal beliefs – in the narrow sense, as captured by the New Age Philosophy factor – as a single concept. Arguably, there is a reason to do so; the individual facets of paranormal belief are positively correlated and thus it is plausible that there indeed exists a general factor of paranormal belief (Lindeman & Aarnio, 2006). However, this general tendency might merely represent a predisposition to this kind of belief while the particular manifestation may be determined by unique psychological mechanisms. This would explain the lack of conclusive findings in paranormal belief research.

The second issue affecting the research in this field is the insufficient delineation of paranormal belief and experiences. It is commonplace in studies on the psychology of these phenomena not to draw a clear conceptual distinction between a belief in a given phenomenon and an experience of it (Rattet & Bursik, 2001), although there are notable exceptions (*e.g.*, Blagrove, French, & Jones, 2005; Rattet & Bursik, 2001). To the best of our knowledge, only a few studies have explored the relationship between the two (Glicksohn, 1990; Lawrence, Edwards, Barraclough, Church, & Hetherington, 1995;

Rattet & Bursik, 2001). These studies found that paranormal belief and experience share about 25-40% of variance which, albeit a significant proportion, suggests the two constructs are not interchangeable and should not be treated as such.

In order to emphasise the relevance of these issues, we illustrate how they impact the main hypotheses proposed to account for paranormal belief and experience. As we will show, these hypotheses do not sufficiently distinguish between individual paranormal phenomena in question on the one hand and between belief in and experience of the paranormal on the other.

Firstly, as mentioned above, the overarching theme of research into the psychology of the paranormal is that of a misattribution of paranormal causation to normal albeit peculiar experiences (*e.g.,* Alcock, 1981; Blackmore, 1992). This hypothesis has been important in the study of paranormal beliefs and has prompted much research (see above). However, we would argue, that it serves primarily to explain paranormal *experience*, and only secondarily belief; there needs to be an experience in order for it to be misconstrued as something paranormal. While it is true that it may be difficult to imagine someone who does not believe in the existence of, say, telepathy attributing some unusual experience to direct exchange of information between two minds, the idea that there are people who endorse paranormal belief without ever having had a subjectively paranormal experience is undoubtedly less controversial. Indeed, the aforementioned variance overlap between paranormal experience and belief of 25-40% provides, in our view, sufficient grounds for the need to treat these two concepts as related but distinct.

Secondly, paranormal beliefs have been linked to a need for control (Irwin, 2000). The rationale behind the link with belief in general is, however, rather weak. There is no good reason to assume that a belief in the existence of any paranormal phenomenon

would fulfil one's need for control (see *e.g.*, Whitson & Galinksy, 2008; Greenaway, Louis, & Hornsey, 2013). If, on the other hand, the hypothesis is reformulated in terms of belief that one can gain information or influence the present or the future, for instance, by using precognition, lucky charms, or horoscopes, the connection to a need for control appears better justified. Thus, more than the belief in the existence of the paranormal, the hypothesis deals with the belief in one's ability (or one's access to those who possess such an ability) to influence reality through paranormal means. Perkins & Allen (2006) argue along similar lines and in their study, categorise different types of paranormal belief into "control" and "noncontrol" beliefs. Although their rationale for which beliefs fall within which category can be argued with, their approach, along with that of a few others (*e.g.*, Davies and Kirkby, 1985; Tobacyk and Wilkinson, 1991), presents a welcome, if rare, occurrence.

Finally, the view of paranormal beliefs as a coping mechanism (Callaghan & Irwin, 2003; Rogers, Qualter, Phelps, & Gardner, 2006) suffers from a similar overgeneralisation. It is, again, difficult to imagine how a belief in UFO or the experience of distressing poltergeist or precognitive dreams, for instance, can help one cope with one's circumstances. However, a belief in things such as deities, fate, soul, survival of consciousness after death, or psychic mediums may well help people come to terms with loss of a beloved person, a lack of meaning, or a feeling of randomness in life.

Based on this critique, we second the call made by others before us (*e.g.*, Glicksohn, 1990; Lindeman & Aarnio, 2006) and propose that research in the area should more clearly differentiate between paranormal belief and experience as well as address specific phenomena, rather than focusing on the heterogeneous overarching category of "the

paranormal". For this reason, the research reported in this dissertation focuses on a particular paranormal phenomenon, namely precognitive dreams.

1.4. Precognitive dreams

The notion that dreams can serve as an arcane source of knowledge of things to come has been persistent throughout human history and across cultures. It figures, for instance, as a major plot element in the story of Joseph in the Jewish and Christian religious scriptures. This tradition of ascribing mystical if not outright magical significance to dreams echoes, to a certain extent, even in relatively recent psychotherapeutic methods, such as Freudian or Jungian dream analysis.

Even in modern times, surveys have shown that a large proportion of the general population believes that dreams can literally provide information about future events that could not have been obtained by any known means (*e.g.*, rational inference, intuition, or coincidence). The belief in the reality of these, so-called precognitive dreams, was espoused by around 55-70% of participants in three representative samples of Britons, Icelanders, and Swedes, with about half as many reporting having had such a dream (Haraldsson, 1985). Similarly, it has been found that out of all spontaneous precognitive experiences 60 % occurred during sleep with a further 10 % taking place in near-sleep states (Green, 1960; Van de Castle, 1977). Based on these findings, it is apparent that precognitive dreams are one of the most frequent of all paranormal beliefs and experiences. For that reason, we chose it as the object of study of this dissertation.

The topic of dream precognition has, over the years, attracted substantial interest from parapsychologists. On several occasions, accounts of purportedly precognitive dreams related to high-profile disasters, such as the sinking of the Titanic (Stevenson, 1960) and the Aberfan tragedy (Barker, 1967) have been gathered. These were, however,

exclusively *post hoc* reports, which makes their validity impossible to verify. Following Aberfan, the British Premonitions Bureau was set up in London and a few years later in the USA the Central Premonitions Registry was established (Nelson, 1970). Not much is known about the operation of these registries, but they both faltered apparently because of limited funds and insufficiently specific predictions (MacKenzie, 1974).

There have also been attempts to test precognition through postal dream diary studies. Participants in Besterman's (1933) study recorded their dreams upon awakening and sent a copy of the records by mail to the SPR. They were also asked to notify the experimenter if they experienced any events that corresponded to their dreams. Forty-five such events were reported. However, out of the total 430 submitted dreams, only two were judged as providing sufficient support of a paranormal interpretation. Similar, not hugely encouraging results were obtained by a more recent postal study (Hearne, 1984).

An important milestone in parapsychological exploration of this topic are the so-called Maimonides studies, a series of experiments conducted at the Maimonides Medical Center in Brooklyn, New York (Ullman & Krippner, 1970; Ullman, Krippner, & Vaughan, 1989) designed to test dream ESP (telepathy, clairvoyance, and precognition). The experiments took place in a sleep laboratory, with the participants connected to electroencephalogram (EEG) and electrooculogram (EOG). These would be used to identify the rapid eye movement (REM) phase in participants' sleep cycles, a stage when dreaming is most likely to occur. Once the participants entered the REM phase, they were woken up and interviewed about the content of their dreams. The dreams were then matched with targets in various modifications of the general parapsychological procedure exemplified by the *Ganzfeld* described in section 1.3.1 above. The two studies that focused on testing the existence of precognitive dreams

were conducted using a single participant, a self-proclaimed psychic Malcolm Bessent (Krippner, Ullman, & Honorton, 1971; Krippner, Honorton, & Ullman, 1972). The results of the studies were interpreted by the authors as evidence of dream precognition, with effect sizes of 0.73 and 0.65 respectively, although criticism has been levied against the methodology applied (*e.g.*, Alcock, 1981). There have been several subsequent dream ESP studies aiming to conceptually replicate the findings of the Maimonides group. Sherwood and Roe (2003) reviewed this research and found an overall significant effect, although its size was considerably smaller ($r = .14$) than the original studies ($r = .33$). Sherwood and Roe speculated that the drop in effect size might be because the post-Maimonides studies did not employ sleep laboratory and EEG/EOG methodology. However the only study post-Maimonides to test the dream precognition hypothesis in a sleep laboratory found no support for the hypothesis (Watt, Wiseman, & Vuillaume, in press).

In contrast with the amount of parapsychological research on putative precognitive dreams, the other two approaches (see sections 1.3.2 and 1.3.3) have yielded considerably less output. Madey (1993) proposed that prophetic experiences, such as precognitive dreams, are a result of the inherent characteristics of vague, temporarily unbounded predictions. Such predictions are easy to forget if they are not confirmed but become very salient if they are. Although he found support for this biased processing of such predictions, there was no relationship with paranormal belief. Recently, this research was replicated with similar results (Watt, Ashley, Gillett, Halewood, & Hanson, 2014). However, Watt and colleagues also found that precognitive dream belief and experience were both related to a higher propensity to find correspondences between unrelated events. Interestingly, this was only the case in a precognitive dream context and not in a decontextualized neutral scenario. Applying the

probability-judgement approach of Blackmore and Trościanko (1985) and Brugger *et al.*, 1990) to precognitive dream belief and experience, Blagrove and colleagues (2006) found that a higher number of reported precognitive dream experiences was associated with a tendency to consider a lottery ticket filled by someone else as not equally likely to win than one filled by the participant. However, this relationship only held for non-university-educated participants. Furthermore, when it came to judging the likeliness of sequences of dice rolls, there was no relationship between the performance on the task and precognitive dream experience. These results agreed with those for paranormal belief. Finally, precognitive dream experience and paranormal belief were both related to a tendency to answer yes to three personal questions (*e.g.*, "Do you have a scar on your left knee?"). The authors suggest that this result may be seen as evidence that paranormal believers and precognitive dreamers adopt broader inclusion criteria. This is in line with the findings of Watt and colleagues (2014) regarding the propensity to find connections. Similarly, Houran and Lange (1998) suggest that precognitive dreams can be interpreted as purely coincidental, albeit personally significant, correspondences between mundane dreams and real-life events. Other interpretations have also been proposed. For instance, Fukuda (2002) proposes that the majority of such experiences are, in fact, instances of déjà vu.

As for the demographics of precognitive dream experiences, Haraldsson (1985) found that women were more likely to both believe in the reality of precognitive dreams and report having experienced them. However, Aumann, Lahl, and Pietrowsky (2012) found that women tend to ascribe more personal significance to their dreams in general. This may be relevant for the issue of precognitive dream experiences which has also been linked to attitudes towards dreams in general (Schredl, 2009). On the one hand it is possible that these gender differences in the significance ascribed to one's dreams are a

result of the tendency of women to believe in precognitive dreams as well as to experience such dreams. On the other hand, it is possible that the unequal rate of precognitive dream belief and experience with respect to gender is a result of these differences towards dreams in general. Beaulieu-Prévost and Zadra (2005) found that a tendency to ascribe importance to one's dreams leads to overestimation of one's dream recall frequency. By extension, it is plausible that women, who in general tend to consider their dreams as more important than men do, are likely to overestimate the frequency of their own subjective precognitive dream experience, thus leading to the gender differences found by Haraldsson (1985). It should be noted, however, that other studies did not find gender differences in precognitive dream frequency (Blagrove *et al.*, 2006; Rattet & Bursik, 2001; Schredl, 2009).

There is also psychological research not primarily aimed at precognitive dream belief and experience that may nevertheless be relevant to the topic. We review this research in the subsequent chapters.

For the purpose of this dissertation, we define precognitive dreams as dreams that provide information about future events that cannot be attributed to prior knowledge, rational inference, intuition, or coincidence. When communicating this definition to our participants, the following five criteria (Bender, 1966) are used:

1. The dream must be recounted or recorded before its fulfilment (*e.g.*, was it written down or described to another person before it 'came true'?);

2. The dream must include enough details to render chance coincidence unlikely;

3. The possibility of inference from actual knowledge must be excluded (i.e., the dream must refer to an unexpected or unpredictable event);

4. Self-fulfilling prophecies must be excluded (i.e., you could not make the dream 'come true' through your own actions after the dream);

5. Telepathic influences should not be able to explain the occurrence of the precognitive dream (i.e., no one else could know the information in the dream at the time that you had the dream).

In addition, when discussing precognitive dream experiences, we refer to subjective assessment of a dream as precognitive by the experiencer. Whether or not these experiences meet the evidential criteria stated above is not relevant.

1.5. Thesis outline

As is apparent from the literature reviewed above, there has not been much research into the topic of precognitive dreams. For this reason, we believe, it would be beneficial to explore several lines of inquiry with the aim of identifying potentially promising avenues. This dissertation therefore presents research in line with each of the three approaches to the study of the paranormal outlined in section 1.3. Six studies are reported in this dissertation.

In Chapter II we report on an online dream precognition study conducted in order to test the psi hypothesis (Study 1). Participants (N = 50) collected details of their dreams over four consecutive weekly periods. At the end of each such period, they submitted their dream reports. A group of four short video clips was then randomly selected from a target pool consisting of 17 such groups. The particular group of video clips was randomly selected for each participant in each trial. Independent judges subsequently rated the similarity of the dream reports with respect to each individual video clip in the selected group, providing both percent and rank ratings. Subsequently,

one target per participant per trial was randomly selected from the group of four video clips and sent to the participants. If the target allocation matched the highest judge rating, the trial was a hit. The testing of the psi hypothesis consisted of comparing the number of hits to a chance baseline of 50 hits out of 200 trials (4 trials per participant). Subsequent post-hoc analyses were conducted exploring patterns in the data relevant to the psi hypothesis. The findings are used to illustrate several conceptual and methodological issues that limit the value of this kind of research.

In Chapter III we move away from the psi hypothesis and focus instead on alternative explanations of precognitive dreams in terms of unconscious cognition, which we believe may be a more fruitful line of research. We present two studies testing the hypothesis that precognitive dreams arise as a result of unconscious inferences about likely future events based on subtle cues from the environment perceived in the absence of awareness. Study 2 explores individual differences in implicit processing and their relationship to precognitive dream belief and experience. Participants (N = 50) completed the serial reaction time task, widely used in implicit learning research, as well as a series of questionnaire measures. We predicted that participants with prior precognitive dream experience will perform better at the implicit learning task. Study 3 tests the hypothesis that it is the ability to notice subtle cues explicitly that relates to precognitive dream experience. In order to test this hypothesis, participants (N = 49) completed a modified flicker task used in change blindness research. Our modification allowed for assessing both explicit and implicit change detection separately. The performance on this task was then related to measures belief in and experience of precognitive dreams.

Chapter IV forms a bridge between the alternative explanation approach and the approach focusing on psychological factors of precognitive dream belief and experience.

On a sample of participants recruited online (N = 672), Study 4 explores several demographic and sleep- and dream-related variables and their relationship with precognitive dream belief and experience. Extending the broad hypothesis tested by the research reported in Chapter III, in Study 4 we hypothesised that precognitive dream experience is associated with erratic patterns of sleep behaviour. We also explored the demographic factors of precognitive dream belief and experience, namely gender, age and education. Moreover, we ascertained the relationship between the measures related to precognitive dreams and attitudes towards dreams in general. Finally, in line with the argument presented in section 1.3.3.3, the study also looked at the mutual relationship between the belief in and the experience of precognitive dreams.

In order to further develop our line of research, we identify a need for a new measurement tool addressing attitudes towards one's precognitive dream experiences. Study 5, reported in Chapter V, concerns the development and validation of such a tool. A subset of the sample used in the previous study consisting exclusively of people who reported having had this kind of experience (N = 330) filled in an initial 49-item questionnaire. After removing items with unsatisfactory psychometric characteristics an exploratory factor analysis, coupled with an exploratory structural equation modelling, revealed a well-interpretable 5 factor structure with good internal consistency. Additional variables collected on the sample were subsequently used to test the validity of the derived subscales.

The final empirical chapter, Chapter VI, explores the relationship between precognitive dream belief and experience, their personal significance and memory. Study 6 draws on the findings reported in Chapter IV as well as on the new attitude questionnaire described in Chapter V in order to investigate the relationship between self-relevance of one's supposed precognitive dreams, one's memory of the earliest

experience of such dreams, and the frequency with which one has these experiences. Using the data collected on the sample described in Chapter IV, we tested three hypotheses. Firstly, we predicted that the earliest precognitive dream experiences tend to date to a period of identity formation in one's life. Secondly, we predicted that the vividness of the memory of this earliest experience will be related to the frequency with which one reports experiencing precognitive dreams. Finally we predicted that this relationship will be accounted for by the personal significance ascribed to one's precognitive dreams.

Finally, Chapter VII summarises the findings of the seven studies conducted as a part of this dissertation. We discuss our results in the context of the existing literature and highlight the main theoretical, methodological, and empirical contributions of our research. Directions for future research are also provided.

Chapter II

Testing the psi hypothesis

2.1. Study 1 Introduction

Testing claims of the paranormal has a long tradition which has historically been rather intimately connected to that of mainstream psychology. Indeed, some of psychology's most notable personalities have been involved in the development of the field of parapsychology. For instance, both William James and William McDougall have, in their time, presided over the Society for Psychical Research which, having been established in 1882, is the oldest extant professional organisation devoted to the study of the paranormal. Later in his career, even Hans Eysenck turned his attention towards the topics of astrology and other paranormal phenomena (*e.g.* Eysenck, 1975; Mayo, White, & Eysenck, 1978; see also Dean, Nias, & French, 1997). Most recently, the publication of Bem's (2011a, see section 1.1) research on 'retroactive priming' in a top psychology journal has contributed to the stirring up of a lively debate about the state of research in psychology and shown that, despite often unfavourable views of psychological scientists on the topic of the paranormal, the two fields have still not entirely divorced. This recent development also illustrates how parapsychology has contributed to the methodological advancement of psychology as a science. It has been argued that experimental controls, such as blinding and randomisation, statistical methods, such as meta-analysis and Bayesian inference, and concepts, such as researcher degrees of freedom, have often been introduced into psychology as a result of its

interaction with parapsychology (see Watt, 2005; Wagenmakers *et al.*, 2011; Simmons *et al.*, 2011).

We thus think that while the core of this dissertation concerns the psychology of precognitive dream experience and belief, it is appropriate to address the topic also from the point of view of parapsychology. The reason for this is twofold: firstly, albeit at odds with the current state of scientific understanding of the universe, the claim that people's dreams literally predict the future by supernatural means is, in principle, a testable hypothesis and as such should be given a dispassionate scholarly treatment. A book-size dissertation on the topic of precognitive dreams should, arguably, include such treatment. Secondly, it is our opinion that researchers who deal with paranormal beliefs and experiences find themselves necessarily treading the borderline between psychology and parapsychology and thus need to have a good knowledge of both these disciplines. A first-hand experience of parapsychological research provides insight into the methodology applied in the field and its potential shortcomings and controversies that may be difficult to gain by a mere study of published parapsychological work. Therefore, in the first empirical chapter of this thesis, we focus on what is known within the field of parapsychology as 'testing the psi hypothesis', i.e., exploring whether people's dreams contain anomalous information predictive of future events.

When considering possible explanations for spontaneous paranormal experiences, parapsychologists tend to turn to controlled laboratory settings in order to test the psi hypothesis. However, only a minority of laboratory dream extrasensory perception (ESP) studies have investigated precognition, which is perhaps odd given the prevalence with which spontaneous dream precognition experiences are reported. Controlled laboratory studies of dream ESP took off from 1962, after psychiatrist Montague Ullman established a dream laboratory at the Maimonides Medical Center (Krippner,

1993; Ullman *et al.*, 1970; 1989, see section 1.4). Thirteen formal dream ESP studies (11 telepathy, 2 precognition) were conducted at the lab before it closed in 1978, the majority of which obtained medium to large positive effect sizes (Sherwood & Roe, 2003). A review of the post-Maimonides dream ESP research identified that, for the majority of the studies, the research environment had moved from the relatively expensive and time-consuming sleep laboratory to participants' own homes (Sherwood & Roe, 2003). The studies had a modest combined effect size ($r = 0.14$) – significantly less than for the Maimonides studies, but still regarded as successful by Sherwood and Roe, who expressed the hope that dream ESP research would be 're-awakened'.

Nowadays, it is possible to present stimuli and collect data rapidly from participants online, something that is particularly practical when investigating dream precognition. Sleeping in their own homes, participants keep dream diaries and use a website to complete questionnaires and submit dream summaries and ratings at times that are convenient to them. Email is used to coordinate and communicate with participants; target feedback is rapidly given via video-streaming portals. The present study makes use of these advances in order to test the hypothesis that participants' dreams will resemble a future randomly chosen target to an extent greater than chance expectation.

Participants were asked to complete questionnaire measures concerning their precognitive dream experience and dream recall. Their task was then to dream about a target video clip that would subsequently be sent to them. They submitted a weekly dream summary that was rated for similarity with randomly-chosen target pools by independent hypothesis-blind judges. We used independent judges because if participants were to assess the similarity themselves, they would see all target possibilities therefore their dreams could in theory 'precognise' one of the decoy targets. Having participants only view their designated target video was, we felt, a way to 'focus'

any precognition on the target. After the judges had made their ratings, a target video clip was randomly selected and sent to participants, who were not informed of the judges' ratings. After viewing the target clip, participants were asked to rate it for similarity with their dreams. If the psi hypothesis is true, we would expect to obtain significantly more hits than can be predicted by chance alone.

2.2. Method

2.2.1. Participants

Participants were recruited through various means: via posts on Twitter; by email sent to former participants of an online parapsychology course led by CW (thesis supervisor); through the Koestler Parapsychology Unit website; from amongst acquaintances of the authors; and by word of mouth. Individuals were invited to volunteer if they were interested in their dreams (precognitive or otherwise) and able to recall their dreams. MV (thesis author) sent participants detailed information on the study prepared by CW. Volunteers received no financial reward for participating in the study. A total of 99 volunteers were sent the link to the initial questionnaire (see section 2.2.3). Twenty-two of them did not return a completed questionnaire, and thus did not proceed with the study. Recruitment continued until 50 participants (20 males, 30 females; M_{age} = 42.8, range 21–82, SD = 14.41) had completed four trials each. Twenty-one others dropped out of the study before completing four trials; 6 completed four trials after the pre-planned N of 50 participants had been reached. Data for these 27 participants is not included in this report.

2.2.2. Independent judges

Two individuals who had an interest in parapsychology (a psychology PhD student and a psychology undergraduate student) acted as independent judges. They were each paid for their work as judges. Because they had no previous experience in judging, they were given guidelines on free-response ESP judging (Delanoy, Morris, & Watt, 2004).

2.2.3. Materials

Participants provided of the following information via online questionnaires: demographics and beliefs; dream summary and confidence ratings; and similarity ratings.

Initial questionnaire

A questionnaire inquiring into demographic characteristics as well as the following sections was presented (see Appendix A.1 for full wording of the used measures):

Frequency of dream recall was measured using a single item ("How often have you recalled your dreams recently (in the past several months)?") with the following response options: *Never*; *Less than once a month*; *About once a month*; *Two or three times a month*; *About once a week*; *Several times a week*; *Almost every morning*. This Dream Recall Frequency scale was developed by Schredl (2004), who reports a high test-retest reliability over approximately 70 days of $r = 0.85$, $N = 198$.

Belief in precognitive dreaming was assessed using a single item ("Do you believe that some individuals have dreams that predict future events and that are not just coincidence?") with response options *Yes*, *No*, and *Unsure*. Bender's (1966, see section 1.4) five criteria for judging a dream as precognitive were provided to participants, along with parenthetical explanations where appropriate, in order to ensure conceptual clarity.

Another single-item measure assessed the subjective frequency of precognitive dream experience ("Based on the five criteria above, please indicate approximately how

often you have had a precognitive dream over the last few years."). Response options were *Never; Less than once a year; About once a year; About once in six months; About once a month;* and *About once a week*.

Dream summary form

Participants provided a concise (maximum 300 words) written account of their dreams over each of four 5-day periods (one preceding each tiral) and assessed how confident they were that any of the dreams therein would relate to the target stimulus with which they were about to be presented. Response options were *Not at all confident; Not very confident; Somewhat confident; Very confident;* and *Completely confident*. Participants were also asked to explain why they chose their particular confidence rating (see Appendix A.2 for more detail).

Similarity rating form

After participants were sent a link to their target video, they were asked to indicate how much similarity, they felt, there was between their submitted dream summary for the given trial and the target with which they had been presented. They were also asked to bear in mind not just the dream content, but also potential associated themes and emotions. Participants typed in a number between 1 (*No similarity*) and 100 (*Complete similarity*). The form can be found in Appendix A.3)

Target pool

The stimulus pool consisted of 68 short (around one minute) video clips divided into 17 target pools of four videos each uploaded to YouTube as private videos accessible only through an unindexed URL (for a sample video clip see https://www.youtube.com/watch?v=5_GLuUlt8u4). The target clips were digitized from a pool used in KPU ganzfeld-ESP research that had obtained positive psi results (*e.g.*, Dalton, 1997; Morris, Dalton, Delanoy & Watt, 1995), and included scenes from

films, nature documentaries and music videos. There were originally 18 target pools (i.e., 72 video clips), but one was withdrawn prior to the commencement of the study after a copyright query was raised by YouTube.

Random number generator

For random selection of the target pools and targets we used a RNG function of the website RANDOM.ORG (https://www.random.org/integers/), which generates numbers based on atmospheric noise and is therefore a true random source. This is more appropriate for a precognition study than a pseudo-random source, because it rules out the possibility of clairvoyance.

2.2.4. Procedure

The study consisted of 200 trials (pre-planned as four trials each from 50 participants). For security reasons, the target for any one trial was randomly selected and sent to participants only *after* the independent blind judge had submitted his rating of the four randomly-chosen target pool videos against the dream summary for that trial. Therefore, there could be no leakage of target information, either from the randomiser to the judges or from the participants to the judges. Participants were not informed of the outcome of their judge's ratings while the study was underway, but they were sent a summary of the overall study results once concluded. For the independent judging, no tied ratings were permitted, and a 'hit' was defined as a Rank 1 corresponding to the designated target.

The initial questionnaire, as well as the two forms, was published online using Google Forms service. Participants could therefore complete the online questionnaire and forms after being sent the appropriate URL.

Each participant was assigned by MV to one of two judges and was sent a hyperlink to the initial questionnaire (participants had no contact with the judges, nor were they aware of the judges' identities; likewise, judges were unaware of the participants' identities). After completing and submitting the initial questionnaire, the participants were informed that their five-day dream collection period had commenced. They were reminded that, once their dream summary had been received by the researchers, they would be sent a "target" video clip to view. They were asked to take a few moments every night, before going to sleep to gently remind themselves that their dreams during the night would be linked to the target clip they were going to watch in due course.

On the fifth night, they were sent an email informing them that the dream collection period was about to end and that their first dream summary was due the next morning. They were also sent a hyperlink to the dream summary form. Upon receiving the dream summary from a participant, MV randomly selected a target pool for that participant (one of the 17) and sent the anonymised dream report along with the URLs of the target pool videos to the judge. Within each target pool, the number of the clip determined the position in which its URL would be presented to the independent judges. So, for target pool 1, clip 1_1 would be first in the list of four URLs, clip 1_2 would be second, 1_3 third, and 1_4 fourth. Judges could (and did) review the four clips in whatever order they chose and could (and did) view the clips more than once during the judging process for any particular trial.

The judges were instructed to provide a percentage rating of the similarity between each of the four videos in a given target pool and the contents of the dream summary, as well as ranking of the videos based on these ratings (rank 1 = greatest similarity, rank 4 = lowest similarity). No tied ratings were permitted. They subsequently emailed their judgements to MV in an attached file. MV then, without viewing the judgements,

randomly selected a target video from the given pool and sent its URL to the particular participant via email. The participants were also instructed to follow a hyperlink to the dream similarity rating form upon viewing the target videos.

Two to three days after receiving the participants' similarity rating, MV informed the participants by email that the second dream collection period was commencing and the procedure repeated itself. Altogether, for each participant four trials were conducted over approximately a four-week period. Throughout the study, the participants were thanked for their involvement and indirectly encouraged to continue. If a participant failed to submit either of the forms, they were sent a gentle reminder to do so.

At the conclusion of the study, participants were sent a short summary of the overall study results.

2.2.5. Hypothesis

We predicted that there would be significantly more hits than mean chance expectation, based on the independent judges' ranks of the target and three decoy clips (assessed by an exact binomial test[1]).

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[1] This analysis was planned (rather than, for instance, sum-of-ranks, binary hits where rankings or ratings in the top half = binary hit and in the bottom half = binary miss, or z-score based on judges' ratings), firstly because Child's (1985) meta-analysis of Maimonides dream-ESP studies used direct-hits outcome measure to allow comparison between studies, and secondly because participants only viewed the target videos so we predicted that any precognitive dream content would focus on these videos. As it turns out, the decision to base analyses on hits rather than ratings did not disadvantage the psi hypothesis: judges' ratings of the targets and decoys did not show elevated ratings for the target video clips relative to decoy clips, Mann-Whitney $U = 56073.5$, $p = .162$.

2.3. Results

2.3.1. Descriptive statistics

Table 2.1 shows the mean, *SD*, *N*, and range of scores on the questionnaire measures.

Dream recall

A large proportion of participants (50%) reported that they recalled their dreams several times a week, followed by almost every morning (28%), about once a week (10%), two or three times a month (8%), once a month (2%) and less than once a month (2%). As participants needed to be able to remember their dreams in order to successfully participate in the study, it was reassuring that the majority (88%) remembered their dreams at least once per week.

Table 2.1

Summary of descriptive statistics of measured variables

Variable	*M*	*SD*	Range
Age	42.82	14.41	21–82
Dream Recall Frequency (0-6)	4.88	1.10	1–6
PD Belief (0-2)	1.58	0.64	0–2
Prior PD Experience (0-5)	1.70	1.53	0–5
Mean Confidence Rating (1-5)	2.04	0.74	1–3.75
Mean Similarity Rating (1-100)	15.15	15.95	0.25–60

Note. $N = 50$ in all cases.

Precognitive dream belief

Having been asked to use Bender's (1966) criteria for evidentiality, most participants (66%) expressed a belief that individuals could have precognitive dreams; 26% were 'unsure'; and 8% did not believe in precognitive dreams. Thus, the sample was skewed towards individuals believing in precognitive dreams. Because there were so

few disbelievers in the sample (4 out of 50), no attempt was made to compare disbelievers and believers on the other study measures.

Precognitive dream experience

Twenty-eight percent of participants indicated that they had never had a prior precognitive dream experience (again, as defined by Bender's criteria); 26% less than once a year; 14% about once a year; 16% about once in six months; 12% about once per month; 4% about once a week. Thus the majority of participants (72%) reported having had at least one prior precognitive dream experience that would be considered evidential.

Confidence ratings

Participants were not particularly confident that their dream summaries would relate to the future target video (mean rating = 2.04 on a scale from 1-5). Participants who gave low confidence ratings reported that they did so either because they did not believe in dream precognition, or because their own precognitive dreams were more personal and they did not think their dream would relate to a randomly selected target video.

Similarity ratings

After they were given feedback about the target video identity, participants' similarity ratings suggested that they saw little similarity between their dream summary and the target video (mean rating 15.15 on a 1–100 scale).

2.3.2. Hypothesis testing

Sixty-four hits were obtained out of 200 trials, giving a 32% hit rate. Using an exact binomial test, this result is significant at $p = .015$ (1-t, $Z = 2.21$, ES ($Z/\sqrt{N}$) = 0.16.) Thus, the hypothesis was supported.

2.3.3. Exploratory Analyses

Independent judges

There was little difference between the hit rate obtained by each judge (Judge 1, 26 hits out of 84 trials, 31.0%; Judge 2, 38 hits out of 116 trials, 32.8%). A test for comparison of two independent proportions showed that this difference was not significant, $z = -0.27$, $p = .787$.

Prior dream recall, precognitive experience, confidence and similarity ratings

Older participants tended to report having had greater frequency of precognitive experiences than younger participants, $r_s = .287$, $p = .043$, $N = 50$. Also, as one might expect, there was a significant tendency for participants reporting greater numbers of prior precognitive experiences to give higher ratings of confidence that their dream reports would contain material relating to the future target video, $r_s = .322$, $p = .023$, $N = 50$. However, as these two relationships were not predicted, and as several correlations were calculated for the psychological variables (see Table 2.2), it would be wise to regard them as only tentative relationships, in need of replication.

Table 2.2

Matrix of Spearman correlations between the measured variables

	1	2	3	4	5
Age	−				
Dream Recall	−.186				
PD Experience	.287*	.158			
Total Hits	−.123	.158	−.005		
Mean Confidence	.059	−.060	.322*	−.139	
Mean Similarity	.012	−.068	.066	.026	.409**

Note. $N = 50$ in all cases. * = $p < .05$, ** = $p < .01$.

After receiving feedback of the target video identity and giving it ratings for similarity to their previously-submitted dream report, participants who had previously given higher confidence ratings tended also to give higher similarity ratings, $r_s = .409$, $p = .003$, $N = 50$. However, there was little relationship between these ratings and actual psi performance: the correlation between confidence ratings and hit rate was slightly negative but not significant, $r_s = -.139$, $p = .335$, $N = 50$, and there was no correlation between hit rate and similarity ratings $r_s = .026$, $p = .860$, $N = 50$.

Self-reported prior dream recall did not significantly correlate with precognitive dream experience, confidence ratings, similarity ratings, or hit rate. Table 2.2 gives the full matrix of correlations between the variables reported here.

We also explored whether the participants may have given higher similarity ratings to the target clips than the judges, for instance perhaps the participants were better able to recognise their own dream content in targets than the judges were. While participants' mean ratings were slightly higher than those of the judges, this was primarily attributable to a small number of outlier similarity ratings above the mid-point of the scale. The distributions of ratings by judges and participants were strongly skewed towards the bottom end of the 100-point scale (judges' median rating 4.5, $SD = 12.35$; participants' median rating = 5.0, $SD = 21.67$); we also found a small but significant correlation between judges' and participants' similarity ratings ($r_s = .144$, $p = .04$, $N = 200$).

2.4. Discussion

The present study represents a controlled test of the hypothesis that individuals' dreams can contain information about unpredictable future events; in other words that some form of anomalous cognition can occur. The majority of individuals who took

part in this study reported that they believed in precognitive dreaming, had experienced an evidential (according to Bender's criteria) precognitive dream personally at least once in their lifetime, and were able to recall their dreams at least once per week. So, on the face of it, this sample would seem to be appropriate for a dream precognition study. Independent judges rated each participant's dream summary for similarity to the contents of a randomly-selected pool of four video-clips, and then one of these clips was randomly selected as target and sent to the participant for feedback. Judges gave the highest similarity ratings to the future target clip significantly more often than would be expected by chance, thus supporting the hypothesis. Because of the negative definition of paranormal phenomena (see section 1.2), an above-chance hit rate provides evidence for a psi process only if all possible non-paranormal alternative explanations can be ruled out. Before focusing on several such alternative accounts, we turn to the discussion of the exploratory results of the study.

We found indications of the operation of psychological mechanisms that can lead to increased subjective experience of precognitive dreams. Participants who had higher confidence tended to report greater levels of similarity between their dreams and the target video, though perceived similarity was not associated with greater hit rate or actual similarity ratings. So, prior confidence appeared to be associated with perceived correspondences between dreams and subsequent events. Some previous research has suggested that frequency of dream recall is a factor likely to create more opportunities for correspondences between dreams and subsequent events to be noticed (*e.g.*, Lange, Schredl, & Houran, 2000). Contrary to this suggestion, our study found only a weak positive correlation between reported dream recall and prior precognitive experience, which did not reach statistical significance. It could be argued that there may be difficulties in interpreting participants' responses to the dream recall measure due to the

nature of the question, which required retrospective reflection and self-report from participants (rather than, for instance, having them keep a diary and then count how often they remembered their dreams). However, this kind of self-report measure is common in psychological research despite response bias that can accompany any such measure. Furthermore, Schredl (2004) reports high test-retest reliability, which indicates consistency in responses.

2.4.1. Alternative explanations for significant hit rate

The following alternative explanation may be proposed to account for the above-chance hit rate. We address them one at a time:

1. *Judges were deliberately or unconsciously biased by the experimenter's knowledge of the selected target.* This explanation does not apply because the experimenter did not select the target until after the judges' ratings were made.

2. *The experimenter's target selection was biased by his knowledge of the judges' ratings.* The experimenter did not view the judges' ratings prior to target selection. Furthermore, target selection was done using an online random number generator, which would not under normal circumstances be influenced by the experimenter.

3. *Participants leaked information about the target identity to the judges, for example using online social networking sites.* The judges did not know the identity of the participants and, even if they had, the judging was completed before participants were given feedback about the target identity.

4. *Participants' dream summaries contained cues as to previous weeks' targets that may have leaked information to the judges about the target identity.* The judges rated each trial on the day that the dream summary was received, so the judging was done in real time. This means that dream summaries could only contain information about previous targets that had

already been judged. This information would not be useful for the present trial being judged.

5. *The coordinating experimenter cheated.* The records for each trial were independently checked and verified after the study was concluded. For cheating to apply, one therefore has to adopt an unfalsifiable conspiracy theory, including fraud by the judges and the principal investigator.

6. *A coincidence between judges' preferences and bias in target selection inflated the hit rate.* A similar issue was encountered by Bem and Honorton (1994) for PRL study 302. In that study only one target pool was used and it was observed that one particular clip from that pool was more often designated as target than the others (though the statistical significance of this trend is not reported), thus raising the question of whether the hit rate might be inflated if that clip was generally preferred by participants. As Bem and Honorton put it: "If a video clip containing popular imagery (such as water) happens to appear as a target more frequently than a clip containing unpopular imagery (such as sex), a high hit rate might simply reflect the coincidence of those frequencies of occurrence with participants' response biases" (p. 12). We will explore this line of argument in more detail because there is some evidence in its support.

Distribution of judges' ranks

A first step to investigate the question of possible judging bias is to look at distribution of the judges' allocation of ranks (1-4) to the clips numbered 1-4 in each pool. As Figure 2.1 shows, judges preferred to assign the second clip in each pool to 4th rank (47.5% of 4th ranks awarded to number 2 clips) and, to a lesser extent, tended to give 1st ranks to the fourth clip in each pool (33.5% of 1st ranks awarded to number 4 clips). This variability in judges' assignment of rankings is statistically significant: $\chi^2(3) = 11.88$, $p = .008$.

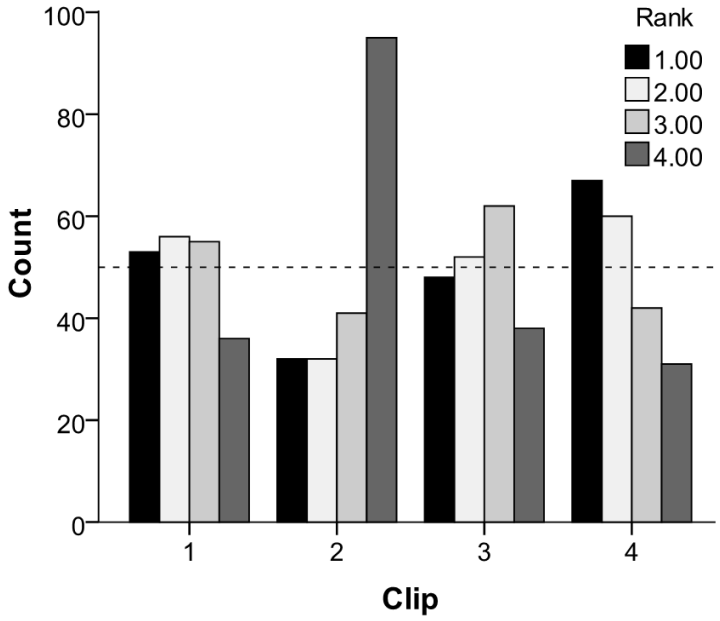

Figure 2.1. The number of Ranks (1-4) assigned to each target clip (1-4), for all 17 target pools combined. Dashed line represents MCE = 50 for each rank.

Hit rate for clips 1-4

Figure 2.2 shows the hit rate obtained by target clips numbered 1–4. Naturally, this hit rate to some extent reflects judges' rating preferences, with a dip in scoring for number 2 clips and a peak for number 4 clips. Specifically, hit rate was near to chance (25%) for clip 1 (28%), 2 (20.5%), and 3 (28.3%), but was considerably higher for number 4 (46.5%). The frequency of hits and misses per target number deviates significantly from chance: $\chi^2(3) = 8.71$, $p = .033$. It is therefore appropriate to investigate the reason for the particularly high hit rate for number 4 clips.

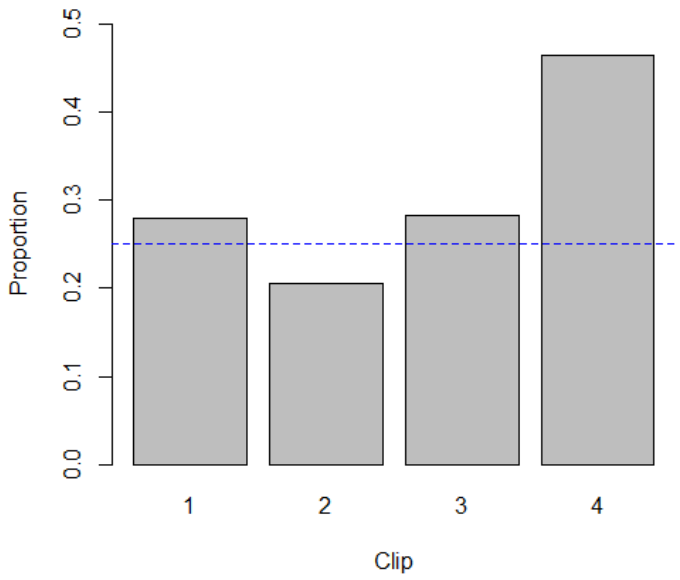

Figure 2.2. Hit rate obtained for clips 1-4 in each target pool. Dashed line represents MCE.

Judges' rankings for number 4 clips

The greater hit rate seen for number 4 clips may in part arise out of a bias, whereby judges tend to give higher similarity ratings for these clips irrespective of whether the clip was assigned as a target or a decoy. In order to test this hypothesis a comparison can be made of the ratio of 1st ranks given to the number 4 clips when target, with the ratio of 1st ranks *for the same clip* when assigned as a decoy. This comparison controls for any inherent differences in individual target clip 'attractiveness' to the judges, and is similar to the analysis conducted by Bem and Honorton (1994) when faced with a potential coincidence of biases in PRL study 302. Subtracting the decoy ratios from the target ratios gives a single 'difference' figure for each clip. If each clip is only preferred when it is the target, the difference figure would be consistently positive. This would provide evidence in support of a communication anomaly whereby the participants' dream summaries were judged to be more similar to the target than to decoys. If there is little difference between judges' preference for the number 4 clips when decoy and the

number 4 clips when target, the difference figure would vary around zero. A one-sample *t*-test showed that the difference figures (see Table 2.3) did not significantly differ from zero, M_{diff} = 0.125, 90% CI [0.018, 0.26], SD = 0.373, $t(16) = 1.38$, $p = .093$ (1-t). This analysis demonstrates that judges have a preference for the number 4 clips irrespective of whether or not they are designated as target.

Table 2.3

Ratio of Rank 1 given by judges when number 4 clips are assigned as target and decoy

Target	Rank 1 / target	Rank 1 / decoy	Difference
1_4	0 (0/3)	.25 (1/4)	−.25
2_4	.50 (1/2)	.29 (2/7)	.21
3_4	0 (0/2)	.25 (2/10)	−.25
4_4	.50 (2/4)	.70 (7/10)	−.2
5_4	.60 (3/5)	0 (0/13)	.6
7_4	.50 (2/4)	.13 (1/8)	.37
8_4	.43 (3/7)	0 (0/5)	.43
9_4	.50 (2/4)	0 (0/4)	.5
10_4	0 (0/3)	.29 (4/14)	−.29
11_4	0 (0/1)	.50 (4/8)	−.5
12_4	.75 (3/4)	.50 (4/8)	.25
13_4	0 (0/1)	.67 (4/6)	−.67
14_4	.80 (4/5)	.18 (3/17)	.62
15_4	.50 (1/2)	0 (0/3)	.5
16_4	.36 (4/11)	.57 (4/7)	−.21
17_4	.67 (2/3)	.40 (4/10)	.27
18_4	.25 (1/4)	.30 (3/10)	−.05

RNG performance

If the RNG assigned number 4 clips as target considerably more often than the other clips, then this might contribute to the higher hit rate for number 4 targets. Figure 2.3 shows the percentage of times that the RNG selected the number 1 clip as target, number 2 as target, etc. Although there was a trend for the number 4 clip to be designated as target more often and for the number 2 clip to be designated as target least often (clip 1, 25%; clip 2, 19.5%; clip 3, 26.5%; clip 4, 29%), this distribution was

not significantly different from the 25% per position expected by chance, $\chi^2(3) = 3.88$, $p = .275$. Using the RNG, we generated a further five arrays of 200 numbers each in order to observe whether there was any systematic bias in the RNG output when assigning the target (number 1-4) for each session. This was not the case, $\chi^2(3) = 1.45$, $p = .695$. Therefore, the RNG behaviour does not account for the larger proportion of hits when number 4 clips are designated as targets.

These investigations raise the question of whether the hit rate in the present study might be inflated by a "matching bias" of random target selection and rank pattern. Although this question cannot be definitively answered based on a pattern that was observed *post hoc*, the apparent coincidence in the rating and target patterns suggest this might indeed have been the case.

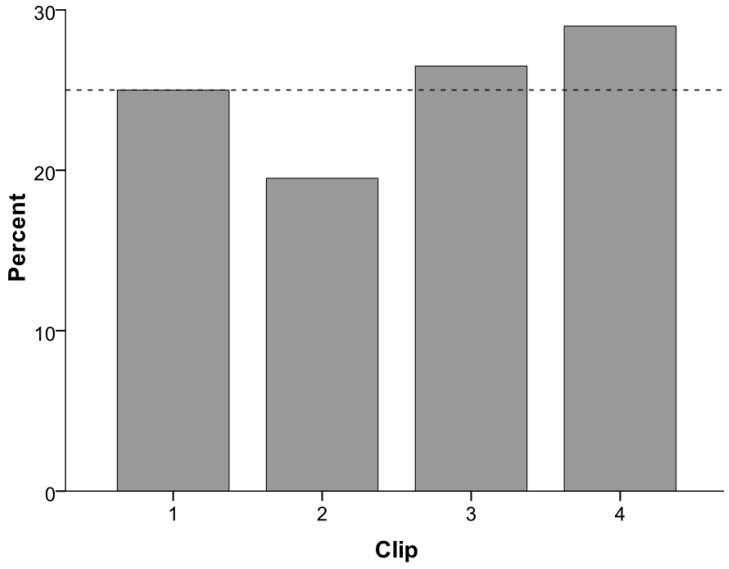

Figure 2.3. Percentage of times that clips numbered 1-4 were selected as target by the RNG. Dashed line represents MCE.

Analysis of judges' ratings

In footnote 1 we provide a justification for our decision to analyse ranks rather than rating scores (1–100). We also showed that there was no difference between the ratings of targets and decoys. However, it could be argued in line with the psi hypothesis that this result could be expected. Even if there was indeed a communication anomaly, there is no reason to expect all targets to be rated as more similar than decoys; only hits should be particularly salient to judges, due to there being a noticeable similarity between the participant's dream report and the target content. This reasoning, however, is problematic because, by definition, targets have the highest ratings in hit trials. Instead, we can explore the difference between the rating of 1st rank videos for hit trials and miss trials. If the saliency hypothesis is true, there should be a difference. However, in the present study, there was no such difference, $U = 4127.5$, $p = .555$. To take this one step further, it could also be argued that it is not the ratings per se that should differ. After all, it is quite possible that the salience matters only in the context of other videos in the pool. If all of them are equally similar to the dream, then there is no particular salience for the target, and hence any hits are due to chance. On the other hand, the argument goes, hits obtained due to psi should be characterised by the target standing out from amongst the other video clips in the pool. If this is true, a comparison of the ratio of the rating for 1st ranked video to the mean rating of rank 2–4 videos (Rank 1 / $M_{\text{rank 2–4}}$) between hit and miss trials should reveal a difference. But again, the analysis did not yield significant results, $U = 4318.5$, $p = .471$. The series of analyses reported above suggests that there was nothing qualitatively special about the hits, compared to the misses.

Target content

The analysis reported above does not address a remaining question, namely why the judges preferred the number 4 clips and avoided the number 2 clips. Perhaps there is something about the content of the number 4 clips that makes them more attractive to raters, while the content of the number 2 clips may be unattractive. For instance, number 4 clips might contain content that also occurs relatively often in dreams, such as imagery relating to being chased, or number 2 clips might contain imagery that tends not to occur in dreams. To explore this idea, we conducted a *post hoc* content analysis which revealed that clips in group 2 include a preponderance of animal themes with 12 out of 17 featuring animals only, accounting for 63% of all animal-themed videos. For comparison, groups 1, 3 and 4 contained 0, 4 and 3 animal-themed videos respectively, with 2 out of 3 videos in group 4 featuring also humans and one depicting unicorns. This distribution departed significantly from the expected uniform, $\chi^2(3) = 16.58$, $p < .001$. If there is a tendency for animal themes not to figure in participants' dream reports, this non-randomness in the pool could account for the low number of first ranks in group 2. To explore this possibility, we conducted a word frequency analysis of a representative sample of the dream reports from half of the participants using the TagCrowd word cloud generator (http://www.tagcrowd.com). The overall length of the analysed dream reports was 22,468 words but only nouns, verbs, adjectives and adverbs were analysed. After excluding words *day, dream, night* and *recall*, which were often used by participants to provide meta-information (*e.g. dream 1, night 1* or *no recall on day 1*) and grouping similar words together (*e.g. learned, learns, learning* −> *learning*), the generator displayed 2,709 different words with frequency ranging from 1 (1,421 words) to 76 for the word 'friend'. The results of the analysis, along with the top 5 nouns for comparison, can be found in Table 2.4.

There were 21 different nouns in the 'animal' category. The total frequency of animal nouns was 82, with the words 'cat' and 'dog' accounting for 34% of this number. Animal-related nouns made up 0.36% of the total word count of analysed dream reports. Compared to the top 5 most frequently used nouns that accounted for 1.26% of the total word count, the frequency of occurrence of animal-related words is rather low. Thus, in context of the preponderance of animal-themed imagery in group 2 videos, the low number of first ranks awarded to group 2 videos is not surprising.

Table 2.4

Word frequency content analysis of half of the dream reports

Noun	Instances (%)	Noun	Instances (%)
Animal	5 (0.18)	Fur	4 (0.15)
Bear	4 (0.15)	Horse	7 (0.26)
Bird	7 (0.26)	Hound	1 (0.04)
Cat	15 (0.55)	Insect	3 (0.11)
Creature	3 (0.11)	Leeches	1 (0.04)
Dinosaur-like	1 (0.04)	Lion	4 (0.15)
Dog	13 (0.48)	Pig	2 (0.08)
Dolphin	3 (0.11)	Puppy	1 (0.04)
Ferret	2 (0.08)	Snake	2 (0.08)
Fish	2 (0.08)	Wildlife	1 (0.04)
Flea	1 (0.04)		
Total animal-related nouns			82 (3.03)
Most often used nouns			Instances
Man			42 (1.55)
Woman/women			46 (1.70)
House			50 (1.85)
People			69 (2.55)
Friend			76 (2.81)

Although it is arguably impossible to assess *post hoc* the effect of video content on the hit rate, some indirect information about the hypothesis that the video imagery might have elevated the observed hit rate can be obtained by the examination of judges' ratings of hits with respect to the video groups. Using the Kruskal-Wallis one-way

analysis of variance, we discovered a significant difference of rating for hits between the groups of videos, $H(3df) = 20.38$, $p < .001$. A subsequent series of Mann-Whitney *U* tests revealed that the source of the significant difference were the videos in group 2, which differed from all the other groups at $p < .001$ (comparisons of group 2 with group 1, 3, and 4 yielded Mann-Whitney *U* values of 14,236, 14,838, and 17,949.5 respectively). Group 2 hits thus had significantly lower ratings than the rest of the hits. There was no difference between any other pair of groups. These results suggest that not only were the hits rare in group 2 videos, but their ratings were also particularly low, indicating low similarity between the dream reports and group 2 targets.

Summary of alternative interpretations of significant hit rate

This study found a significantly higher hit rate than would be expected by chance alone. The question is whether this outcome reflects a similarity between the participants' dream reports and the target they subsequently viewed, in line with the dream precognition hypothesis, or whether some other unexplained process may be at work. Below we summarise the outcome of the additional analyses that we have undertaken in an attempt to interpret the observed hit rate.

1. For the target group that obtained the highest hit rate (46.5%), judges tended to assign these clips first rank regardless of whether they were target or decoy clips.

2. Looking at all targets, there was no significant difference between the judges' ratings of targets and decoys.

3. The analysis of the judges' ratings shows that targets that scored a hit were on average no more similar to the dream reports than those that did not, whichever way we look.

4. The content analysis of the video clips used revealed a preponderance of animal motifs in group 2 of the target pool. At the same time participants dream reports were

found to contain little animal imagery. These findings provide a tentative yet plausible explanation of the low hit rate and judges' ratings on videos in group 2.

We acknowledge that no one definitive argument can be made based on these exploratory analyses. However, we believe that, taken together, the above mentioned four points strongly suggest that the hit rate in this study is not due to the judges detecting a similarity between the participants' dream reports and the randomly chosen target. Thus, our data do not support the hypothesis of dream precognition as usually operationalized in parapsychology, for instance in the Maimonides dream ESP studies (Krippner, 1993). Due to the lack of an accepted theory of psi, which in turn leads to a negative definition of psi (see section 1.2), we cannot rule out the possibility that our significant hit rate is due to the operation of a non-psi process.

The above discussion serves to illustrate the crucial importance of randomisation in studies with similar methodology to the present one (Ganzfeld, remote viewing, dream ESP, etc.) that employ a theoretical control such as MCE instead of an empirical control group or condition. As is the case with every statistical analysis, when using theoretical models it is necessary to examine whether the underlying assumptions have been met. With respect to MCE, as applied to methods similar to the one used in this study, there are three principal underlying assumptions.

Firstly, it is assumed that every clip in the target pool has an equal probability of being designated as a target. As discussed previously, unless the number of trials is very large, there will be random fluctuations in the randomly generated strings which, albeit not significantly different from uniform distribution, may give rise to potentially problematic distributions due to knock-on effects. For illustration, in the present study the RNG-produced distribution of targets across clips did not depart significantly from chance (p = .275) and yet clips number 2 were designated as target 19.5% of the time,

while the frequency for clips number 4 was 29%. Bem and Honorton (1994) had to grapple with a similar issue. In co-occurrence with other contextual factors, this could obscure or inflate evidence of anomalous cognition.

The second assumption of MCE is that all stimuli in the target pool are equally likely to feature in the imagery produced by participants. Given that the target pools are often constructed with the aim of creating – at least to some extent – thematically orthogonal groups (*i.e.*, the individual video clips within a group are selected so that there is little overlap in content among the video clips), it is very difficult to ensure the equality of likelihoods. When using a single target pool, as was the case for Bem and Honorton's (1994) PRL study 302, a differential likelihood with which the target imagery appears in participant's mentation is potentially problematic since it can coincide with fluctuations in the random target assignment, thereby inflating the probability of a direct hit. When employing multiple target pools the threat of such matching bias can be somewhat attenuated by randomising the position of a stimulus within individual pools. However, given the relatively modest knowledge of the prevalence of individual topics in people's mentation, it is very difficult to ensure an unbiased arrangement of the target pools.

It is important to emphasise that no one of the above mentioned issues can lead to distorted findings *per se*. However, we argue that random fluctuations and non-uniformities such as the ones discussed occur rather habitually and even though non-significant on their own, in combination they can contribute to a matching bias, yielding spurious results in either direction. Although these spurious results may be the consequence of short-run biases and random fluctuations that would cancel out in the long-run, results in the positive direction may become over-represented in the literature due to the pervasive publication bias in favour of significant results. For this reason, we

would like to encourage the use of multiple randomisation precautions and thorough examination of potential matching biases in similar studies employing theoretical controls such as MCE. As with many other areas of psychology, researchers could alternatively implement empirical control conditions, something that is arguably more labour-intensive, but that may allow more confidence that any obtained effect is valid.

The study presented in this chapter explored the topic of precognitive dreams from the point of view of parapsychology. We applied methodology considered standard in the field and discussed potential pitfalls of this kind of research. We would agree that the extent and *ad hoc* nature of the exploratory analysis conducted in order to test the alternative explanations for the observed significant result are not usual in theory-driven research and may invite accusations of 'explaining away' the result. However, given the lack of theory in parapsychological research, we believe that this approach is appropriate. Moreover, since psi is defined as a category of anomalous effects that cannot be attributed to normal factors, attempts to 'explain away' any significant results are implicitly required in the process of testing the psi hypothesis.

Given the philosophical and methodological issues in testing the psi hypothesis discussed above as well as the main topic of focus of this dissertation, in the following chapters, we abandon parapsychology and focus on somewhat more mundane processes that could account for the belief in and experience of precognitive dreams.

Chapter III

Precognitive dreams and implicit processing

Beside the hypothesis that precognitive dreams are a genuine paranormal phenomenon amenable to scientific testing explored in the previous chapter, there have also been proposed several alternative hypotheses to explain how this and similar experiences could occur by purely natural means yet have the appearance of the paranormal. One such, as of yet unexplored, hypothesis proposes that precognitive dreams might be a result of inferences during sleep based on subtle cues from the environment perceived outside of awareness. This hypothesis was first proposed by Aristotle over 2,000 years ago in his treatise *On Prophesying by Dreams*, and was more recently voiced by Alcock (1981). To illustrate, a fulfilled nightmare about the death of an elderly relative might be caused by perceiving, without awareness, a slight change in their appearance, behaviour or physiology (*e.g.*, heavier breathing, paler complexion) during a previous encounter. These subtle, yet disconcerting indications of ill health might create a seemingly precognitive dream about the death of the person in question. If this person then passes away, the dream is recalled and the attribution of precognition is made.

The plausibility of the implicit processing hypothesis (IPH) of precognitive dream experiences rests on the notions that dream imagery can reflect waking life events and that sleep and dreams can facilitate learning and memory consolidation and inspire insight. If there is no relationship between a person's waking life experiences and the content of their dreams, it is uncertain how precognitive dreams such as the ones described in the example above could originate from previously acquired information.

Similarly, even if people are able to detect subtle cues from their environment without being aware of it, the hypothesis under consideration still requires a certain amount of associative processing and insight to take place in order for the inference from the detected cues to the conclusion to be made.

The claim about the relationship between waking life and dream content appears to be intuitively true. People often report dreaming about something that happened previously or having their dreams influenced by their mental states; many of us still occasionally pass or fail our final school exams in dreams and re-live the anxiety they once induced. The support for this so-called continuity hypothesis is, however, not merely anecdotal. There exists extensive literature supporting the notion that dreams reflect, to some extent, waking life experiences (*e.g.* Schredl & Hofmann, 2003; Fosse, Fosse, Hobson, Stickgold. 2003; Pesant & Zadra, 2006; Hobson, & Schredl, 2011, for discussion). In light of this research, there appears to be no reason why information acquired in waking like could not, in principle, manifest itself in dream imagery.

With regards to the issue of memory, learning, and insight, the prevailing expert opinion again appears to agree with the claim that these processes take place, or at the least are facilitated by sleep (see Walker & Stickgold, 2006 for review), although there are also opposing views on the matter (Vertes, Eastman, 2000; Frank & Benington, 2006). Previous research in this area has found support for the role of REM sleep in consolidation of memory and learning (Ellenbogen, Payne, & Stickgold, 2006; Stickgold & Walker, 2007; Wamsley, Tucker, Payne, Benavides, & Stickgold, 2010), including probabilistic and procedural learning (Walker, Brakefield, Morgan, Hobson, & Stickgold, 2002; Djonlagic *et al.*, 2009). There is also some evidence that sleep causes improved performance on tasks requiring insight into hidden rules (Wagner, Gais, Haider, Verleger, & Born, 2004) and primes associative networks (Cai, Mednick, Harrison,

Kanady, & Mednick, 2009). Thus, even though there is an ongoing debate about the role of sleep in learning and memory (Frank & Benington, 2006), there is at the very least circumstantial support for the plausibility of the IPH of precognitive dream experiences.

In this chapter, we present two studies testing this hypothesis. Study 2 explores the relationship between implicit learning and precognitive dream experiences while Study 3 focuses on perception without awareness and its relationship to these experiences.

3.1. Study 2

One prediction of the IPH is that people who tend to have precognitive experiences are better able to pick up on subtle cues and process them without being aware of it. This can be tested in the framework of the implicit learning paradigm. Implicit learning occurs when people acquire new information without intending it or being consciously aware of having done so (Cleeremans, Destrebecqz, & Boyer, 1998; Kaufman *et al.,* 2010). Several methods for exploring implicit learning have been developed but one in particular, the Serial Reaction Time task, seems to be the most appropriate and most widely used (Jiménez & Vázquez, 2005). Moreover, this method has recently been used in individual differences research, where implicit learning significantly correlated with the personality factors of intuition, openness to experience, and impulsivity, as well as with cognitive variables including verbal analogical reasoning, processing speed, and academic performance (Kaufman *et al.*, 2010). This individual differences approach regards implicit learning as an ability and is in line with our hypothesis.

Of potential interest in exploring the relationship between implicit processing and precognitive dream experience is the concept of transliminality, developed by

Thalbourne and Delin (1999) and defined as "a largely involuntary susceptibility to, and awareness of, large volumes of inwardly generated psychological phenomena of an ideational and affective kind" (Thalbourne & Delin, 1999, p25). Crawley and colleagues (2002) found a link between transliminality and susceptibility to subliminal priming. Participants in this study were led to believe they were taking part in an extra-sensory perception card-guessing task. Unbeknownst to them, half of the trials were preceded by a subliminal prime showing the correct response. The results showed that transliminality was positively related to number of correct responses only on the primed trials. Furthermore, in a subsequent task, high transliminality subjects were more successful at detecting which trials had been primed, even though they reported no conscious awareness of the priming in the card-guessing task. These findings suggest that transliminality might play a role in the kind of implicit processing required by the IPH. If high levels of transliminality are conducive to the ablility to detect subtle environmental cues (*e.g.*, subliminal primes used in the above-mentioned study) without being aware of them, then people who experience precognitive dreams should, under the IPH, score high on transliminality. Similarly people who possess higher levels of this trait should show superior implicit learning ability compared to low transliminality individuals. Study 2 therefore predicts that precognitive dream experience will positively correlate with transliminality and implicit learning.

3.1.1. Method

3.1.1.1. Participants

A planned number of participants (N = 50, 31 females), mostly undergraduate students, were recruited and paid for their participation. Data from one participant were excluded due to incompleteness and another participant was recruited in order to

preserve the planned number of participants. Participants' ages ranged from 17 to 53 years (M = 21.98, SD = 17.49).

3.1.1.2. Materials and apparatus

Serial Reaction Time task

To assess the individual differences in implicit learning, we used a modified version of the widely-used Serial Reaction Time task (SRT; Nissen & Bullemer, 1987) used by Kaufman *et al.* (2010). This particular version of the SRT task draws on multiple sources.

The basis of the task is the SRT paradigm (Nissen & Bullemer, 1987), which consists of presenting stimuli, each of which appears in one of several different positions. The participant's task is to indicate the position of the stimulus as quickly and accurately as possible by pressing a button corresponding to the given position, while reaction time is measured. Unbeknownst to the participants, the positions of the stimuli follow a predetermined sequence. As participants learn the sequence, their reaction time shortens.

This task has been modified by Cohen, Ivry, and Keele (1990) and further developed by Reed and Johnson (1994) and Destrebecqz and Cleeremans (2001). The modification consists of employing sequences of positions based on co-called second order conditionals (SOC). Here, every position in the sequence is unambiguously determined by a combination of two previous positions, while a single preceding position provides no information about the following position (Reed & Johnson, 1994). The use of SOC makes the sequence difficult to detect explicitly.

Yet another modification of the classic SRT task was introduced by Schvaneveldt and Gomez (1998). In addition to the previous modification, the positions of the stimuli

in their second experiment were controlled by two independent SOC sequences, with one occurring 90% of the time (probable sequence) and the other occurring 10% of the time (improbable sequence). Assuming that the improbable sequence is not learnt, it provides a baseline against which the learning of the probable sequence can be compared. The probabilistic version of the SRT task based on SOC has been praised as an excellent means of assessing implicit learning (Jiménez & Vázquez, 2005). The version used in the present study, which is closely modelled on the one reported by Kaufman and colleagues (2010), combines the above-mentioned modifications as follows. During a trial, an 'X' appeared in one of four possible locations represented by underscores and arranged horizontally in the centre of the screen. The keys 'z', 'x', 'n', and 'm' were assigned one to each location ('z' to the leftmost, 'm' to the rightmost). The task was to press the appropriate key as quickly and accurately as possible. The next trial followed 500 ms after a key was pressed. Reaction time was measured from the onset of the stimulus. If no response was recorded, the next stimulus appeared after five seconds. The sequence of locations was governed by two SOC sequences; the Probable sequence (1–2–1–4–3–2–4–1–3–4–2–3) occurred on 85% of the trials, and the Improbable sequence (3–2–3–4–1–2–4–3–1–4–2–1) occurred on 15%. Note that none of the transitions appear in both sequences. In order to achieve this, the rules governing the sequences must prohibit the occurrence of the same location twice in a row. Thus, each position is followed equally often by each other location. For example, the likelihood of locations 2, 3, or 4 given location 1 on the immediately preceding trial, is equally divided between these three locations. Furthermore, not allowing for repetitions also excludes extremely salient trials that might provide memorable cues. The task consisted of seven blocks of trials with 102 trials per block. Because SOC requires two pre-existing trials, the first two trials were selected at random. Whatever these first two

trials may be, they conform to both sequences and thus it is not possible to assign them to either one. For this reason, these trials were not analysed. The first block served as a practice block and was not included in the analysis either. The occurrence of Probable and Improbable trials was randomised. The task was designed using E-prime version 2.0 software (Psychology Software Tools, Pittsburgh, PA) in white on black background. The design of the SRT task is summarised in Fig. 3.1.

Precognitive Dream Belief and Experience

Belief in precognitive dreams was assessed using a 6-item scale (see Appendix B.4). Response options on the 5-point Likert scale ranged from 1 (Completely disagree) to 5 (Completely agree). The overall reliability[2] of this scale reached the acceptable level (ω_t = .75; 95% CI [.58, .86]) but the analysis revealed one very weakly and one negatively correlated item, which we omitted from further analysis, raising the reliability index of the scale to ω_t = .88; 95% CI [.79, .93].

One further question that related to precognitive dream frequency ("Approximately how often you have had a precognitive dream over the last few years?") was included in the battery with response options: *Never*; *Less than once a year*; *About once a year*; *About once in six months*; *About once a month*; and *About once a week*. This item was used to divide participants into those with and without experience of precognitive dreams.

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[2] We chose McDonald's ω_t over the traditionally used Cronbach's *a* as an index of psychometric reliability because of the many problems associated with the latter (see *e.g.*, Dunn, Baguley, & Brundsen, 2013). McDonald's ω_t provides a superior measure of reliability and, unlike α, does not rely on the often broken assumption of essential tau-equivalence (Dunn *et al.*, 2013; Zinbarg, Revelle, Yovel, & Li, 2005).

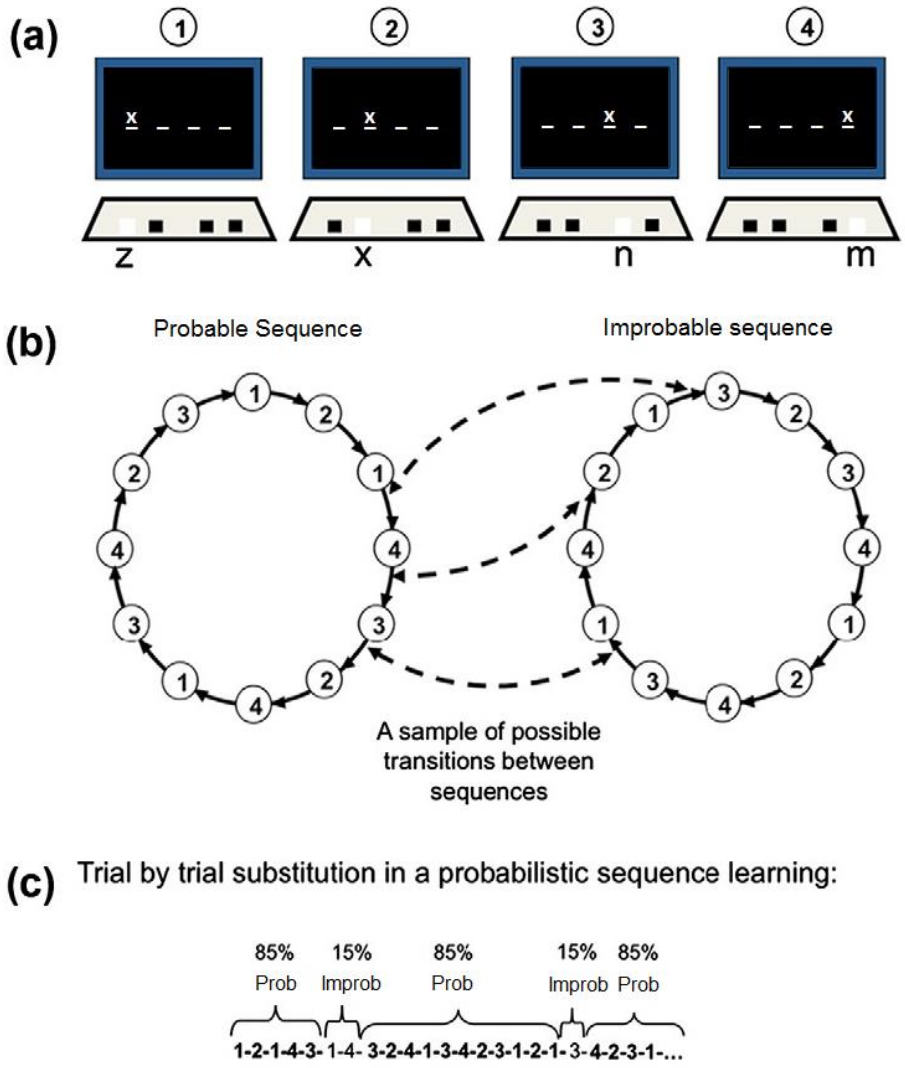

Figure 3.1. Structure of the SRT task. a) Participants are instructed to press the key corresponding to the position of the stimulus as quickly and accurately as possible. b) The position in which the stimulus is presented is governed by two exclusive second-order conditional sequences. A transition between the sequences is possible at every step (three such transitions are illustrated). c) The probabilistic nature of the task is characterised by one sequence appearing on 85% of the trials (Probable Sequence) and the other (Improbable Sequence) appearing on 15% of the trials. Adapted from Kaufman *et al.* (2010), with permission from Elsevier.

Transliminality

In order to measure participants' transliminality, we used the Revised Transliminality Scale (RTS; Lange, Thalbourne, Houran, & Storm, 2000), a 17-item forced choice scale. The scale is presented in an earlier 29-item form (Thalbourne, 1998)

in order to preserve the context but only the 17 items of interest are scored. Houran, Thalbourne, and Lange (2003) report the scale's high internal consistency (KR-20 r = .85) and test-retest reliability over an average of 50 days, r = .82, p < .001, N = 51. In the present sample, the reliability of the full scale was comparably high (ω_t = .85; 95% CI [.75, .9]), while the reliability of the 17 items was moderate to high (ω_t = .77; 95% CI [.64, .85]). This, however, is not necessarily a problem given that the RTS was validated using Rasch model and therefore its reliability should be independent of the sample (Hambleton, 1991).

3.1.1.3. Procedure

Participants were shown individually into an experimental cubicle where they were seated in front of a computer with standard 16 in CRT monitor with 75 Hz refresh rate. They were given an information sheet and a consent form. Next, demographic data were collected and participants were asked to complete the SRT task which was described as a reaction time task without a mention of implicit learning or the probabilistic SOC nature of the stimuli. Participants were encouraged to get comfortable pressing the assigned keys and then asked to proceed when they were ready by pressing the space bar. Once participants completed 102 trials, the block ended and they were asked to take a break. After a minute they were asked to continue, when ready, by pressing the space bar again and the next block of trials ensued in the same fashion. Once the SRT task was over, subjects were asked to complete the questionnaire part of the study. The battery of items was presented in electronic form using the Google forms service. Upon completion, subjects were thanked for their participation, debriefed about the actual nature of the SRT task, paid, and dismissed.

3.1.1.4. Hypotheses and analysis

Based on the implicit processing hypothesis of precognitive dream experience, we predicted the following:

H1: There is a positive relationship between the performance on the SRT task and precognitive dream belief.

H2: Performance on the SRT task is positively related to transliminality score.

H3: Transliminality is positively related to precognitive dream belief.

H4: Participants with prior precognitive dream experience will perform better at the SRT task than those who have not had such experience.

H5: Participants with prior precognitive dream experience will score higher on transliminality than participants without such experience.

To assess the individual differences in implicit learning, the SRT task was analysed using a mean difference score. To arrive at this score, we first deleted all error responses (5.08% of all trials). Next, we calculated a 20% trimmed mean reaction time (RT) for each block (2-7) per participant, separately for Probable and Improbable trials. Subsequently, we calculated the difference between the trimmed mean RT of Improbable trials and the trimmed mean RT of Probable trials in each block for each participant. The mean of the resulting six numbers was the participant's mean difference score (MDS). For readers who may prefer a more formal notation,

$$MDS_i = \frac{\sum_{j=2}^{N_{block}} \left(\overline{X}_{20\%\,RTimprob_{ij}} - \overline{X}_{20\%\,RTprob_{ij}} \right)}{N_{block} - 1},$$

where *i* is any given participant and *j* represents block. We chose the 20% trimmed mean over mean because it provides a more reliable estimator of location for non-

normally distributed data (Wilcox, 2010). Higher MDS represents greater implicit learning on the SRT task.

The Revised Transliminality Scale was analysed using the Rasch score derived according to Lange and colleagues (2000).

3.1.2. Results

3.1.2.1. SRT task validation

First, we analysed the overall data from the SRT task in order to validate the implicit learning effect. Fig. 3.2 shows the pooled performance by trial type across blocks.

A repeated measures factorial analysis of variance (ANOVA) was conducted with block (6 levels) and sequence (2 levels; probable v improbable) as within-subjects factors and 20% trimmed mean RT calculated per block per trial type for each participant as dependent variable. The results showed a significant effect of type of trial, $F(1,49) = 37.95$, $p < .001$, $\eta_P^2 = .45$, and block, $F(3.51,172.1)$[3] $= 2.54$, $p = .049$, $\eta_P^2 = .05$. There was also a significant interaction between trial type and block, $F(5,245) = 3.78$, $p = .003$, $\eta_P^2 = .07$. These results, combined with examination of Fig. 3.2, indicate that learning did indeed take place and that the greatest differences appeared later in the task.

3.1.2.2. Hypothesis testing

Table 3.1 summarises the descriptive statistics for the analysed variables for the overall data as well as separately for the two compared groups.

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[3] Greenhouse-Geisser ($\widehat{\varepsilon} = .702$) corrected degrees of freedom due to significant Mauchly's test of sphericity ($W = 0.357$, $\chi^2(14) = 48.502$).

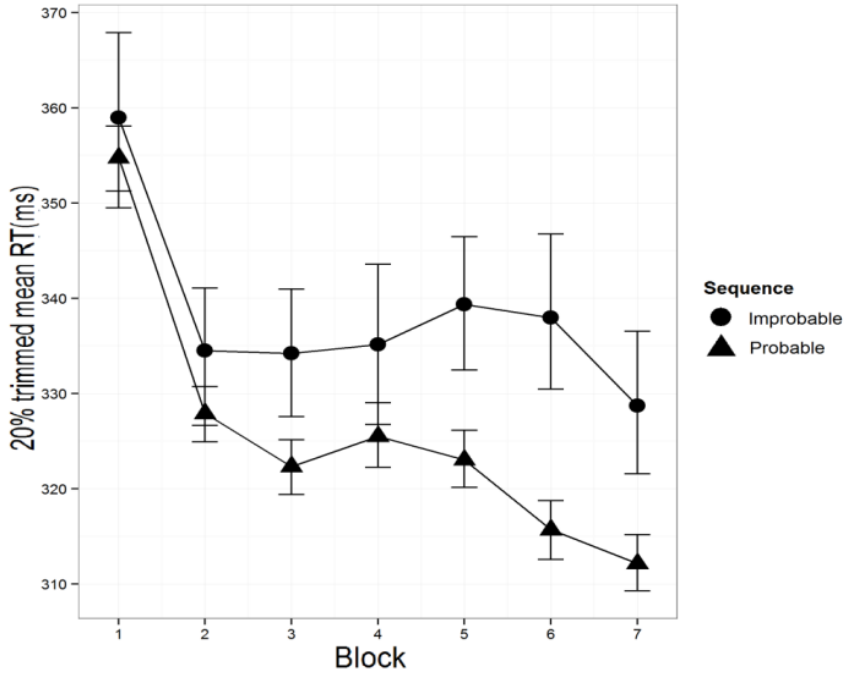

Figure 3.2. Overall performance on the SRT task across individual blocks. Points represent 20% trimmed means, error bars represent 95% confidence intervals based on a bootstrap sample of $N = 599$.

Table 3.1

Descriptive statistics for variables analysed in Study 2 for all data and for the compared groups

			Group 1		Group 2	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Precognitive dream belief	9.20	4.28	7.18	2.70	13.12	4.01
MDS	14.87	17.07	16.82	16.51	11.10	18.01
Transliminality	23.11	3.65	22.03	3.14	25.22	3.74

Note. MDS = Mean Difference Score on the SRT task; Total $N = 50$; Group 1 = participants without precognitive dream experience ($N = 33$); Group 2 = participants with previous precognitive dream experience ($N = 17$).

In order to assess the relationships predicted by H1 and H2, we conducted a series of simple regression analyses with MDS as outcome variable and precognitive dream belief and transliminality respectively as predictors. Precognitive dream belief was not a significant predictor of performance on the SRT task ($\beta = 0.14$, $t(48) = 1.00$, $p = .322$,

R^2 = .02, F(1,48) = 1.00, p = .322). Transliminality scores also did not significantly predict participants' performance on the implicit learning task (β = −0.21, t(48) = −1.48, p = .146, R^2 = .04, F(1,48) = 2.18, p = .146). These results did not support hypothesis H1 about a positive relationship between performance on the SRT task and precognitive dream belief, or hypothesis H2 about the relationship between SRT performance and transliminality.

We also conducted a simple regression to explore the role of transliminality in precognitive dream belief (H3). Transliminality was a significant predictor of precognitive dream belief, b = 0.51, 95% CI* [0.15, 0.83], p = .002. Transliminality accounted for a significant portion of variance in precognitive dream belief, R^2 = .19, F(1,48) = 10.95, p = .002, thus supporting the hypothesis H3 of a positive relationship between transliminality and precognitive dream belief.

Given this relationship between precognitive dream belief and transliminality, we investigated the unique contribution of transliminality to SRT performance. In order to do this, we conducted a simultaneous multiple regression analysis with MDS as outcome variable and precognitive dream belief and transliminality as predictors, thus controlling for precognitive dream belief. As shown in Table 3.2, transliminality was a significant predictor of performance on the SRT task, p = .035. However, the direction of the relationship was opposite to the one predicted by H2. In addition, we included an interaction term in the model which was also not significant (b = 0.24, 95% CI* [−0.03, 0.51], p = .080). This hypothesis therefore remains unsupported by the data.

Finally, we compared the participants with and without a reported precognitive dream experience. This binary variable was derived from the precognitive dream frequency item. Those who selected the option 'Never' (N=33) were designated as 'non-precognitive dreamers' while the rest were considered 'precognitive dreamers' (N=17).

An independent *t*-test revealed no significant difference in the performance on the SRT task between non-precognitive dreamers and precognitive dreamers, $t(48) = 1.13$, $p = .265$, $r^2 = .03$. Hence, the hypothesis H4 about differences in SRT task performance was not supported. There was, however a significant difference between these groups in transliminality scores (mean difference = −3.19, 95% CI* [−5.20, −1.18], $t(48) = -3.19$, $p = .003$, $r^2 = .17$. This finding lends support to the hypothesis H5 about differences in transliminality between people with and without precognitive dream experience.

Table 3.2

Results of multiple regression analysis of SRT performance on precognitive dream belief and transliminality

Variable	*b*	*SE*	β [95% CI]	*p*
Precognitive dream belief	1.14	0.6	0.29 [−0.07, 2.469]	.067
Transliminality	−1.56	0.72	−0.33 [−2.61, −0.116]	.035

3.1.3. Study 2 Discussion

Study 2 tested the hypothesis that people with precognitive dream belief and experience exhibit superior implicit learning ability compared to those without these beliefs and experiences. This hypothesis was not supported by the data. There was no statistically significant relationship between the performance on the SRT task and belief in precognitive dreams, nor a significant difference in the SRT task performance between participants who have had this kind of experience and those who have not. Moreover, this difference was in the opposite direction from the one predicted by the hypothesis. Our findings specifically concerning precognitive dream belief and

experience and implicit learning are in line with an earlier study that found no relationship between general paranormal belief and performance on a different implicit sequence learning task (Palmer, Mohr, Krummenacher, & Brugger, 2007).

Potential criticism of our findings could concern whether the learning exhibited by participants was really implicit. Previous research employing modifications of the SRT task in combination with the process dissociation procedure has shown that under some circumstances participants are able to discriminate between the test sequence used and random sequences at an above-chance level, although there was nevertheless evidence of implicit learning (Destrebecqz & Cleeremans, 2001; Fu, Bin, Dienes, Fu, & Gao, 2011). Therefore, there is a possibility of explicit learning contamination in the study. However, we echo Kaufman and colleagues' (2010) argument that the probabilistic second order conditional version of the task employed in the present study makes explicit learning difficult, thus lowering this probability.

It could also be argued in defence of the IPH that, although not better at implicit learning *per se*, precognitive dreamers are more sensitive to implicit pattern violation than those people who have not had precognitive dream experience. While we agree that this is indeed a possibility, we would posit that the analysis reported above already tests this hypothesis by using the mean difference score as a measure of implicit learning. This index takes into account the difference between RT on improbable and probable trials and therefore the response latency on improbable trials compared to probable ones.[4]

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[4] This argument is supported by the corroborative nature of the result obtained from an additional analysis of covariance that explored the differences in mean RT on improbable trial between the two groups while controlling for the mean RT on probable trials, $F(1,47) = 1.27$, $p = .265$.

Finally, it is important to emphasise that this study tested merely one possible prediction of the IPH. It may be the case that the difference between precognitive and non-precognitive dreamers lies in the better ability of the latter group to notice subtle cues consciously. This would imply that although their implicit processing ability is not better, precognitive dreamers' failure to notice these subtle cues explicitly might leave more opportunities for them to process them outside of awareness. To explore this, a measure of implicit processing is required that would provide a means to clearly differentiate processing accompanied by awareness from processing in its absence.

Study 2 also investigated the role of transliminality in implicit learning and precognitive dream belief and experience. Transliminality was positively related to both precognitive dream belief and experience. However, the significant relationship between transliminality and measure of implicit learning after controlling for precognitive dream belief was in the opposite direction to the one predicted. We find this result difficult to reconcile with that of Crawley and colleagues (2001) who found that high transliminality individuals performed better on a subliminal priming task than those low on transliminality as well as with our prediction which follows from the concept of transliminality itself. We can only speculate about the reasons for this contradiction. Perhaps the transliminality measure partly taps into some other variable that mediates the relationship between transliminality and susceptibility to subliminal priming. If believers in precognitive dreams happened to score higher on this unknown variable, it would explain the findings reported by Crawley and colleagues (2001), who did not control for precognitive dream/paranormal belief. If true, this would call into question the validity of transliminality as a unitary construct. Alternatively, the inconsistent nature of the findings obtained using transliminality scales could be caused by suboptimal psychometric characteristics of these measures. Although Lange and colleagues (2000)

claim that the revised transliminality scale is a unidimensional measure, an additional principal component analysis of the data from the present sample revealed that the first principal component accounted merely for 26% of the total variance in the scores. Bartlett scores based on this principal component correlated with precognitive dream belief even more strongly than the Rasch scores used in the primary analysis ($r = .498$, 95% CI* [.195, .745], $p < .001$). In order to account for over a half of the total variance of the RTS scores, a total of five components would need to be extracted. Furthermore, only four of the scale's 17 items had communalities over .3 (items 3, 8, 16, and 18 with $h^2 = .53, .62, .56$, and .53 respectively), while seven items had communalities below .1. It thus seems that, at least in the present sample, the Revised Transliminality Scale cannot be considered a valid measure. We encourage researchers working with this scale to pay closer attention to its psychometric characteristics in future studies.

3.2. Study 3

In the previous section, we outlined an alternative prediction of the implicit processing hypothesis of precognitive dream experience. We hypothesised that if these experiences really arise through the proposed mechanism, and if people without these experiences are better at noticing subtle cues explicitly, then non-precognitive dreamers are less likely to be influenced by this mechanism than precognitive dreamers, because precognitive dreamers are less able to consciously notice subtle cues. In other words, non-precognitive dreamers may have fewer precognitive dream experiences because they tend to notice potentially relevant subtle cues consciously more often than precognitive dreamers.

In order to explore this prediction, Study 3 uses the flicker task, a well-established paradigm used in change blindness research. The term change blindness (Rensink,

O'Regan, & Clark, 1997) describes a phenomenon whereupon people fail to notice sometimes major changes in stimuli when the presentation of the stimuli is disrupted (for example by camera cuts) and the change occurs during this disruption. This phenomenon has been extensively studied and has proved to be highly robust and generalisable (Rensink, 2000; Simons, 2000; Simons & Rensink, 2005). The flicker task developed by Rensink and colleagues (1997) and used in Study 3 involves presenting participants with stimuli in quick succession interrupted by a mask, usually a monochrome empty screen. The stimuli are two photographs, sometimes identical, sometimes with a single change to one of the pair. This task is appropriate for the purposes of the present study for several reasons. Firstly, as stated above, it is a widely-used research method in the field capable of creating a robust change blindness effect. Secondly, a modification of the flicker task described in the Methods section below offers means to distinguish conscious identification from implicit change detection and thus to assess them separately. It therefore appears appropriate for our purposes. Finally, the flicker task has previously been used in studies investigating implicit detection. In his study, Rensink (2004) asked participants to press a key when they feel a change has occurred and then again once they are able to identify the change explicitly. He found that some participants were able to 'sense' the change in the stimulus several seconds before they could consciously identify it. In light of this finding, it is possible that the individual differences in the ability to 'sense' and 'see' the change might be related to precognitive dream experience. This argument is in line with Rensink's suggestion that this ability to sense, or *mindsight*, is related to the popular notion of a 'sixth sense' (2004). In this study, we therefore test the discussed prediction in terms of the change blindness paradigm, using a variation on the flicker task.

3.2.1. Method

3.2.1.1. Participants

As in Study 2, a planned number of mostly undergraduate student participants (N = 50, 26 females) were recruited for the study and paid £6.20 each for their participation. Participants' ages ranged from 15 to 53 years (M = 21.64, SD = 6.33). Data from one participant were omitted due to outlier values on the change detection measures.

3.2.1.2. Material and apparatus

Flicker task

In order to assess both explicit and implicit change detection, we used a modified version[5] of the flicker paradigm used in change blindness research (Rensink *et al.*, 1997). In this task, participants are presented with two pictures that oscillate in quick succession and asked to identify which element in the pictures undergoes change. In the present study, participants completed a total of 43 trials each, three practice trials and forty test trials. The stimuli, arranged in pairs, were all colour images with a resolution of 700 × 500 pixels, displayed full-screen. The images used depicted everyday scenes (*e.g.*, a picture of a train station) and were downloaded from Ronald Rensink's personal website (http://www2.psych.ubc.ca/~rensink/). The first image of the pair was shown for 240 ms, followed by a 120 ms mask (grey screen), after which the second image of the pair appeared for another 240 ms again followed by the mask. Each trial consisted of six such cycles, thus lasting 4.32 seconds. Figure 3.3 shows a flowchart of a trial's design. The pictures were identical ('no-change trials') in half of the test trials, while in the other half ('change trials'), there was a single change, easily detectable under normal viewing

[5] We are grateful to Professor Richard Wiseman for suggesting this modification.

conditions. The change to an object in the picture could be either in its presence (*e.g.*, appearance and disappearance of a person) or in its location (*e.g.*, horizon shifting up and down). The order of the trials was randomised.[6] The task was designed using E-prime version 2.0 software (Psychology Software Tools, Pittsburgh, PA). All instructions were written in white font on black background.

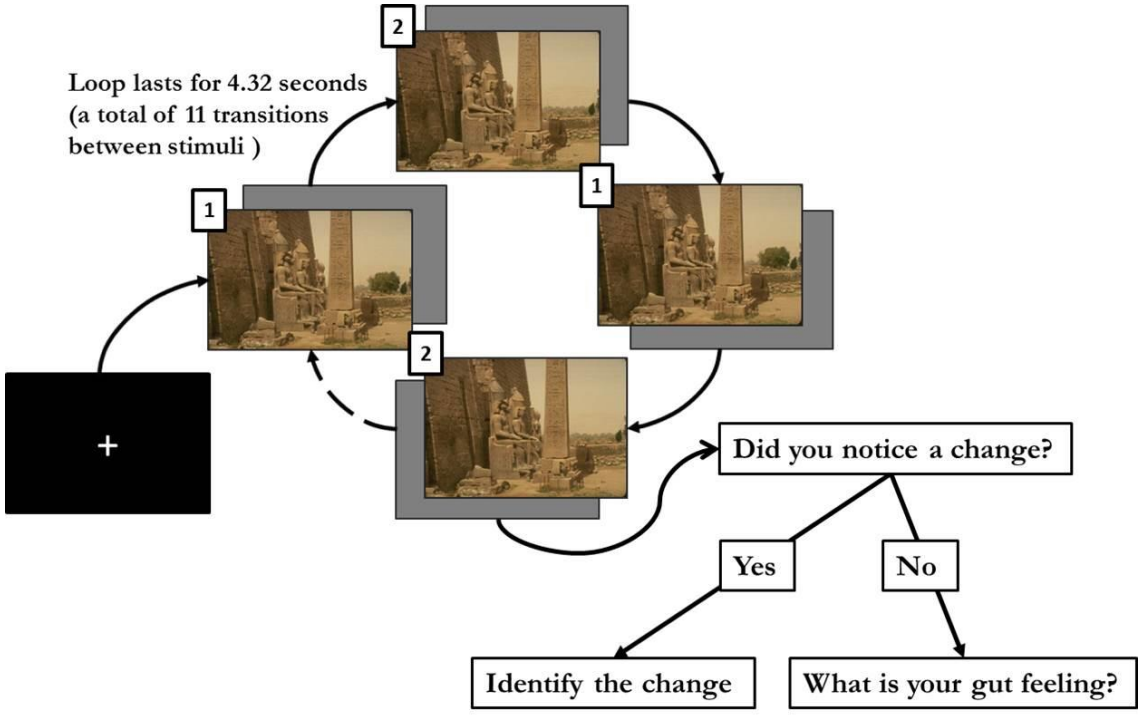

Figure 3.3. Flowchart of the flicker task. First, a fixation target is presented for 3,000 ms. Next, the two versions of the stimulus (1 and 2) are presented for 240 ms with a grey mask in between presented for 120 ms. One trial consists of six such cycles with a total of 11 transitions between stimuli. Afterwards, a change detection prompt appears with two possible outcomes.

[6] Due to an error in the design, one trial was presented twice, which did not influence the total number of trials but, as a result, only 39 different test stimuli were presented. Both the duplicated and the omitted stimuli were 'no-change' stimuli and therefore this error did not increase the likelihood of change detection.

Precognitive dream belief and experience

Participants' belief in precognitive dreams was assessed using the same scale as in Study 2. This time, the reliability of the scale was high for all six items, ω_t = .86; 95% CI* [.76, .91]. The scale was again followed by an item inquiring into the frequency of participants' precognitive dreams used to assess precognitive dream experience.

3.2.1.3. Procedure

As in Study 2, participants were seated in an experimental cubicle in front of a computer with standard 16 in CRT monitor with 75 Hz refresh rate. Participants were given an information sheet and a consent form, after which demographic data were collected.

Next, participants completed the flicker task. They were asked to carefully read the instructions and were informed that the first three trials would serve as practice trials. Subjects then proceeded, when ready, by pressing the space bar. Subsequently, a fixation cue in the form of a plus sign appeared in the centre of the screen for three seconds, after which the task began. After each trial, participants were prompted to indicate whether or not they detected a change by pressing the 'y' key for yes and the 'n' key for no. If they answered yes, they were asked to report verbally to the experimenter what the change was. If they did not see a change, they were prompted to decide based on their 'gut feeling' whether or not there was a change. The task terminated after three practice and forty test trials. Responses to the first prompt were labelled 'explicit trials' and responses to the gut feeling prompt were labelled 'implicit trials'.

Finally, they completed the precognitive dream belief and experience questionnaire presented using the Google forms service. After that, participants were debriefed, thanked for taking part in the study, paid, and dismissed.

3.2.1.4. Hypotheses and analysis

Study 3 explores the following hypotheses:

H1: There is a negative relationship between *explicit* performance on the flicker task and precognitive belief.

H2: Participants without precognitive dream experience will perform better on the *explicit* flicker trials than those participants who have had such experience.

As an additional test of the hypothesis investigated in Study 2, we formulated two further hypotheses:

H3: There is a positive relationship between *implicit* performance on the flicker task and precognitive dream belief.

H4: Precognitive dreamers perform better on *implicit* trials than non-precognitive dreamers.

The flicker task was analysed using the d' and c indices as described in Stanislaw and Todorov (1999), used in signal detection analysis. The d' (d prime) index provides an estimate of sensitivity to signal versus noise, which, in the present case, translates to participants' ability to detect change. It can theoretically range from $-\infty$ to ∞ with 0 representing chance performance. The c index is a measure of bias, i.e. a tendency to indicate the presence (liberal bias, $c < 0$) or absence (conservative bias, $c > 0$) of signal in situations of uncertainty. These measures take into account the proportion of correct identifications of signal to the number of signal trials (hit rate) and the proportion of incorrect identifications in the absence of signal to the number of noise trials (false alarm rate). In our analysis, we calculated one set of indices for the explicit hits (exact identification of the element of change) and one for implicit identification, based on participants' 'gut feeling'. The reliance on z-scores makes the use of d' problematic in situations of either a perfect HR or azero FA, for which the corresponding z-score is

±∞. Several corrections have been developed in order to assess this issue, the best of which seems to be the so-called loglinear correction (Stanislaw & Todorov, 1999). When using this correction, extreme values are adjusted by adding 0.5 to (if the extreme value is 0) or subtracting 0.5 from (if it is 1) both number of hits and number of false alarms and adding 1 to both the overall number of signal trials and the number of noise trials respectively before calculating the hit and false alarm rates. However, if the number of signal and noise trials is unequal, as was the case with implicit trials in the present study, this correction is biased. To give an example, with $N_{signal} = 5$ and $N_{noise} = 10$, and both hit and false alarm rates of zero, applying the loglinear correction (HR = 0.5 / (5 + 1) = 0.083; FA = 0.5 / (10 + 1) = 0.045) yields

$$d' = \Phi^{-1}(\mathrm{HR}) - \Phi^{-1}(\mathrm{FA}) = 0.3,$$

where Φ^{-1} is a function that converts probabilities into z-scores. This means that while 0 is the logical value of d', the loglinear correction gives $d' \neq 0$. To overcome this bias, we corrected zero hit rates by adding (subtracting) 0.5 x R to the number of hits and adding 1 x R to the number of 'true' items, where R is the ratio of 'true' and 'false' items. False alarm rates and the number of 'false' items were adjusted by the original loglinear correction. Based on the example above, applying this correction (HR = (0.5 x 0.5)/(5 + 0.5) = 0.045; FA = 0.5/(10 + 1) = 0.045) yields $d' = 0$, thus removing the bias.

3.2.2. Results

Table 3.3 summarises the descriptive statistics for the analysed variables.

Table 3.3

Descriptive statistics for variables analysed in Study 3

			Group 1		Group 2	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Precognitive dream belief	13.20	5.84	10.10	4.00	18.56	4.50
Explicit d'	1.68	0.47	1.74	0.41	1.57	0.56
Implicit d'	0.35	0.61	0.40	0.54	0.25	0.72
Explicit c	0.96	0.24	0.92	0.23	0.97	0.28
Implicit c	1.11	0.58	1.19	0.54	0.98	0.63

Note. Descriptives for all data (N = 49) and for the compared groups. Group 1 = participants without precognitive dream experience (N = 31); Group 2 = participants with previous precognitive dream experience (N = 18).

3.2.1.5. Flicker task item analysis

We verified explicit hits by comparing participants' verbal identifications to the stimuli. If participants scored an explicit hit but were unable to identify the element of change, the trial was re-labelled a false alarm.

Furthermore, we explored the flicker task at the item level (individual stimuli used in trials) to identify potential ceiling and floor effects. We analysed both explicit and implicit hit rate on change items and correct rejection rates on implicit trials only. The rationale for this being that, in case of no-change trials, explicit 'correct rejections' can be expected to be high. Two change items scored a 100% explicit hit rate and were excluded from further analyses of explicit detection due to ceiling effect. One item scored a 0% hit rate and was also excluded due to floor effect. One further change trial was eliminated from implicit detection analysis due to floor effect, having never been implicitly detected.

Finally, in order to assess possible effects of learning, we compared the hit rate on first half of the trials to that on the second half. If, during the course of the task, participants learnt what changes are most likely to occur, their explicit hit rates on the second half of the trials should be higher than their explicit hit rates on the first half. A paired sample *t*-test comparing these groups of hit rates was not significant (mean difference = −0.13, 95% CI* [−0.09, 0.06], $t(49) = -0.335$, $p = .739$).

3.2.1.6. Hypothesis testing

First, we explored the hypothesis H1 about a negative relationship between precognitive dream belief and explicit change detection. Two simple regression analyses conducted on measures of sensitivity and bias respectively, summarised in Table 3.4, did not reveal a significant relationship.

Subsequently, in line with the hypothesis H2, we compared participants with (N = 18) and without (N = 31) precognitive dream experience on the explicit d' and c measures. Participants were divided into these groups by the same principle as in Study 2. Again the difference was non-significant for both sensitivity, $t(47) = 1.28$, $p = .256$, $r^2 = .03$, and bias, $t(47) = .11$, $p = .917$, $r^2 = 2.57 \times 10^{-4}$. The results of this analysis do not lend support to the tested hypotheses.

In order to assess the hypothesised differences in implicit change detection, we first explored participants' overall performance on implicit trials. The mean sensitivity on these trials was 0.35 (SD = 0.61) which indicates an above-chance performance. This value differed significantly from zero, $t(48) = 4.00$, $p < .001$, 95% CI* [0.17, 0.51], $r^2 = .25$, suggesting that participants were able to detect a change even when they reported not having seen it. Another set of simple regression analyses was conducted in order to investigate the hypothesised relationship between precognitive dream belief and

measures of sensitivity and bias on implicit trials (H3), however no significant relationship was discovered. The findings are summarised in Table 3.5. Controlling for sensitivity on explicit trials did not change the null result; the effect of implicit *d′* was still not significant, $b = -1.41$, $SE = 1.40$, $\beta = -0.15$, $p = .318$, 95% CI* of b [−4.14, 2.26]. Again, these findings are corroborated by comparing the implicit performance of precognitive dreamers and non-precognitive dreamers, as stated in the hypothesis H4. There was no significant difference between these groups on sensitivity, $t(47) = 0.84$, $p = .452$, $r^2 = .01$, or bias, $t(47) = 1.24$, $p = .237$ $r^2 = .03$. Thus, the hypotheses about a relationship between implicit change detection and precognitive dream belief and experience were not supported by the data.

Table 3.4

Results of two simple regression analyses of precognitive dream belief performance on measure of sensitivity and bias on explicit trials

Variable	*b*	*SE*	β [95% CI]	*p*
Explicit *d′*	−0.83	1.82	-0.07 [−4.39, 3.70]	.645
Explicit *c*	0.16	3.48	0.01 [−6.73, 6.23]	.963

Table 3.5

Results of two simple regression analyses of precognitive dream belief performance on measure of sensitivity and bias on implicit trials

Variable	*b*	*SE*	β [95% CI]	*p*
Explicit *d′*	−1.36	1.39	−0.14 [−4.81, 1.73]	.332
Implicit *c*	−0.76	1.47	−0.08 [−3.44, 2.15]	.606

3.2.3. Study 3 Discussion

Study 3 focused on the role of explicit and implicit change detection in precognitive dream belief as well as differences in these variables between people with and without precognitive dream experience. We hypothesised a negative relationship between explicit change detection and precognitive dream belief and a positive one between implicit detection and this belief. Furthermore we predicted differences in explicit and implicit change detection between precognitive and non-precognitive dreamers. None of the hypotheses were supported by the data. In contrast to a previous study investigating paranormal belief using signal detection methods (Krummenacher, Mohr, Haker, & Brugger, 2010), we did not find that paranormal believers exhibited a lower response criterion (i.e., favoured false alarms over misses).

It could be argued that the employed task did not in fact measure implicit detection. Indeed, this line of argumentation has been raised in a critique of Rensink's (2004) study by Simons, Nevarez, and Boot (2005). They argued, in terms of signal detection theory, that when participants indicate they sensed a change, they are merely expressing that they have evidence of change but that this evidence has not yet reached the decision criterion. In other words, the 'sensing' detections represented merely liberal responses waiting to be confirmed. If this criticism applies to the present study, one would expect to find the participants exhibiting liberal bias in their performance on implicit trials. However, in the present study, participants tended to adopt a somewhat conservative bias for both explicit and implicit trials. Furthermore, Simons and colleagues (2005) showed that participants in the 'can-sense' category (those who 'sensed' the change substantially sooner than they 'saw' it) made more false alarms than 'only-see' participants. In our study, however, the mean sensitivity to change on implicit trials was

significantly higher than chance-level, which would not occur had false alarms been proportional to hits.

Granted the argument above, one could nevertheless suggest that the hits and correct rejections on implicit trials represented situations when the phenomenon of change was detected consciously but the particular element that changed was not. This argument would imply that participants first use some kind of global perception to assess the overall state of the stimuli and only then use a more analytical approach to identify the changing element. While this idea seems plausible at least at face value, we would suggest that a potential proponent of this explanation needs to provide an explanation of what it means to notice something without knowing what it is, as well as account for why participants indicated that they had not noticed a change.

3.3. General discussion and conclusion

In this chapter, we investigated the hypothesis that putative precognitive dream experiences are caused by implicit processing of subtle environmental cues. Study 2 explored the hypothesis of a positive relationship between transliminality, implicit learning ability, and precognitive dream belief and experience. None of the predictions were confirmed by the data analysis. Furthermore, contrary to prediction, we found a negative relationship between transliminality scores and performance on the SRT task. Study 3 focused on the relationship between implicit and explicit change detection ability on one hand and precognitive dream belief and experience on the other. We hypothesised that belief in and experience of precognitive dreams would be negatively related to explicit change detection. Neither of these hypotheses was supported by the data. In light of these two studies, we conclude that although individual differences in explicit and implicit processing abilities, such as the ones assessed by the reported

studies, may play a role in precognitive dream experiences, they are most likely not a major factor.

Some remarks on the limitations of the reported studies are in order. Firstly, there is an ongoing discussion in the scientific community about whether or not the methods employed in these studies have demonstrated the existence of true implicit processing in the absence of awareness (c.f. Mitroff, Simons, & Franconeri, 2002; Destrebecqz & Cleeremans, 2001). If we adopt the negative stance on this debate, there are two possible implications; either this kind of higher processing cannot take place without being accompanied by awareness or it can take place but there are currently no good methods of assessing it. In case of the latter, further development in this field is needed before the IPH can be reliably tested. However, if there is indeed no such thing as implicit processing, the hypothesis in question becomes false by definition.

Secondly, it could be argued that more emotionally impactful stimuli than those used in the present studies are needed in order for the implicit mechanisms leading to precognitive dreams to take effect. Returning to the hypothetical example in the introduction, anxiety resulting from unrealised concern for one's relative's health certainly bears more personal relevance than a sequence of characters on a computer screen, however, the aim of this chapter was to examine the variability of general implicit processing ability, not of implicit processing of emotionally upsetting stimuli. The point is nevertheless valid and we would encourage future research on this topic.

Furthermore, the sample sizes used in our studies might not have been large enough to detect the true effects. There were only 17 precognitive dreamers (34%) in Study 2 and 18 (37%) in Study 3, which might not have been sufficient numbers for the conducted comparisons. We might have obtained a higher proportion of precognitive dreamers had we used a sample with a cultural background that particularly endorsed

such experiences. Our sample consisted mostly of white, UK-domiciled undergraduate psychology students, however the proportion of precognitive dreamers that we obtained with this sample is in line with that found in most representative surveys of paranormal beliefs.

Finally, there are at least two possible predictions of the IPH that were not explored by our studies. Firstly, it may be that precognitive dream experiences are not explained by individual differences in waking life implicit processing, but by differences in the extent to which this processed information manifests itself in the individual's dream imagery. A study exploring this hypothesis could, for instance, assess the relationship of precognitive dream experience and sleep-inspired insight. Secondly, it could be argued that most people have dreams that, to some extent, reflect unconscious inferences about implicitly processed information and that whether or not these are deemed precognitive depends largely on external circumstances and subjective assessment. Some people might be more inclined to attribute precognitive character to such dreams, others might look for other, less extraordinary explanations. Thus, while acknowledging the need for replication of our findings as well as finding alternative means of testing the implicit processing hypothesis, we believe that research into potential psychological factors behind the differences in precognitive dream attribution may be more valuable. It is the exploration of these factors on which we focus in the remaining chapters of this thesis.

Chapter IV

Demographic and sleep-related correlates of precognitive dream belief and experience

4.1. Study 4 Introduction

In Chapter III we conclude that rather than exploring implicit processes that might lead to dream imagery that actually provides information about likely future events, it might be fruitful to focus on potential individual differences in characteristics that may contribute to people's tendency to attribute paranormal explanations to their experiences. In this chapter, we provide a transition between these two areas by exploring individual differences in demographic and sleep-related characteristics and their relationship to precognitive dream experience.

Expanding on the idea behind the implicit processing hypothesis of precognitive dream experience tested in Studies 2 and 3, it could be argued that these experiences come about as the result of processing of external stimuli during sleep or borderline sleep states. For example, if a person falls asleep in front of the television, a news item may get incorporated into the narrative of their dreams. When, once awake, this person learns the news, they can be under the impression that their dream foretold the event in question (Alcock, 1981). Both early and late sleep stages have been shown to be permeable to external stimuli (Hoelscher, Klinger, & Barta, 1981), so it is plausible that the more often one finds oneself in borderline sleep states, the higher the likelihood of putatively precognitive dream experiences will be. Examining the relationship between

precognitive dream experience and various sleep-related behaviours, such as the frequency of nocturnal awakenings or diurnal naps, thus seems worthwhile.

Closely related to the issue of sleep behaviour and its relationship to precognitive dream experience is the topic of sleep medication use. Use of medication alters sleep patterns and certain drugs have been shown to interfere with REM sleep, a stage where most dreams occur (Pagel & Parnes, 2001), as well as induce nightmares (Pagel & Helfter, 2003). Thus, even in the absence of a straightforward mechanism for how sleep medication might induce a precognitive dream experience, we consider it worthwhile to examine the potential relationship between the two.

It could also be argued, and indeed has been argued (Houran & Lange, 1998), that certain individual characteristics raise the likelihood that a seemingly extraordinary coincidence between one's dreams and subsequent events will be ascribed a paranormal attribution. One such characteristic, often mentioned by the proponents of the cognitive deficit hypothesis (Alcock, 1981) discussed in the introductory chapter, is erroneous or biased reasoning. This view has led to studies exploring the role of such factors as general cognitive ability (see Wiseman & Watt, 2006, for review), critical reasoning skills (Pennycook *et al.*, 2012; Roe, 1999; Royalty, 1995), and various cognitive biases (*e.g.*, Blackmore & Trościanko, 1985; Blagrove *et al.*, 2006; Brugger & Taylor, 2003; French & Wilson, 2006). However, as French and Wilson (2007) point out, the findings of these studies are often inconclusive. For example, Musch and Ehrenberg (2002) found that paranormal belief is negatively related to general cognitive ability, as assessed using a measure of scholastic proficiency. On the other hand, Stuart-Hamilton and colleagues (2006) failed to find a significant relationship between intelligence and paranormal belief. A potential weakness of this research may lie in the fact that the studies addressing this issue have mainly explored the relationship between cognitive abilities

and paranormal belief in general (see Wiseman & Watt, 2006). However, as pointed out in section 1.3.3.3, belief in and experience of the paranormal are distinct constructs and thus this approach may be conflating the two. Furthermore, it has been suggested that individual paranormal experiences and beliefs may differ in the psychological mechanisms that underlie them (Irwin, 1993, see also section 1.3.3). We therefore believe that this research will be advanced by focusing separately on the belief in and experience of particular paranormal phenomena. For that reason Study 4 will, in addition to sleep characteristics, look at the relationship between precognitive dream belief and experience on the one hand and education on the other. Although educational achievement is by no means a perfect measure of cognitive ability, we would argue that, given the exploratory nature of the link between precognitive dream belief and experience and cognitive ability, using an easily measurable proxy characteristic, such as years of completed formal education, is justifiable with appropriate caveats.

Another factor contributing to the misattribution of paranormal causality to seemingly extraordinary dream-related experiences may be attitude towards dreams in general. Beaulieu-Prévost and Zadra (2005) found that a tendency to ascribe importance to one's dreams leads to overestimation of one's dream recall frequency and Schredl (2009) found a relationship between the former and precognitive dream experience. Furthermore Haraldsson (1985) found that women were more likely to both believe in the reality of precognitive dreams and report having experienced them, while Aumann and colleagues (2012) found that women tend to ascribe more personal significance to their dreams in general. On the one hand it is possible that these gender differences in the significance ascribed to one's dreams are a result of the tendency of women to believe in precognitive dreams as well as to experience such dreams. On the other hand, consistent with the findings of Beaulieu-Prévost and Zadra (2005), it is plausible that

women, who in general tend to consider their dreams as more important than men do, are likely to overestimate the frequency of their own subjective precognitive dream experience, thus leading to the gender differences found by Haraldsson (1985). It should be noted, however, that other studies did not find gender differences in precognitive dream frequency (Rattet & Bursik, 2001; Schredl, 2009). In order to explore this issue further, the present study will look at the relationship between demographic variables (gender and age), attitudes toward dreams in general, and precognitive dream belief and experience.

To summarise, Study 4 sets out to explore several questions. Firstly, it will look at the relationship between precognitive dream belief and experience, thus adding to the scant available literature on the demarcation between paranormal belief and experiences. Secondly, given the mixed results of previous studies regarding the relationship between cognitive ability and paranormal belief, the study will investigate the role of education, among other demographic variables, in the belief in and experience of precognitive dreams. Thirdly, it will also explore the relationship between precognitive dream belief and experience and attitudes towards dreams in general. Fourthly, based on the argument outlined above, the research presented here will also focus on individuals' sleep-related characteristics and their relationship with subjective precognitive dream experience. And finally, the study will explore the relationship between sleep medication use and the experience of precognitive dreams.

4.2. Method

4.2.1. Participants

Participants were recruited via social networks (Facebook, Twitter, Reddit), blogs, and online discussion forums and interest groups dedicated to various topics (psychology, dreams, scepticism, the paranormal), as well as through word of mouth. A total of 693 participants completed the study. Despite stating in the introductory section of the study that data from minors cannot be used, 10 participants were less than 18 years old and their data were excluded from further analysis due to ethical considerations. Of the remaining participants, 279 were male (41.52%) and 393 (58.48%) female. Eleven participants (1.6%) did not identify as either male or female, and their exclusion resulted in the final sample of 672 participants. Mean age of the sample was 31.47 years (range = 18-75, SD = 11.74). There was no age difference between males and females in the sample (M_{male} = 31.45, SD = 12.67, M_{female} = 31.48, SD = 11.05, $t(546.21) = 0.032$, $p = .974$). The majority of participants found out about the study on social networks (70.8%), from a family member (2.2%), or through word of mouth (2.7%), while the rest of the sample (24.3%) came across the research through their interest in above-mentioned related topics. Participants came from 55 countries, mostly from the United Kingdom (32.7%), the United States of America (24.9%), and Slovakia (13.6%). None of the other countries had frequency over 5%. This distribution is depicted in Fig. 4. 1.

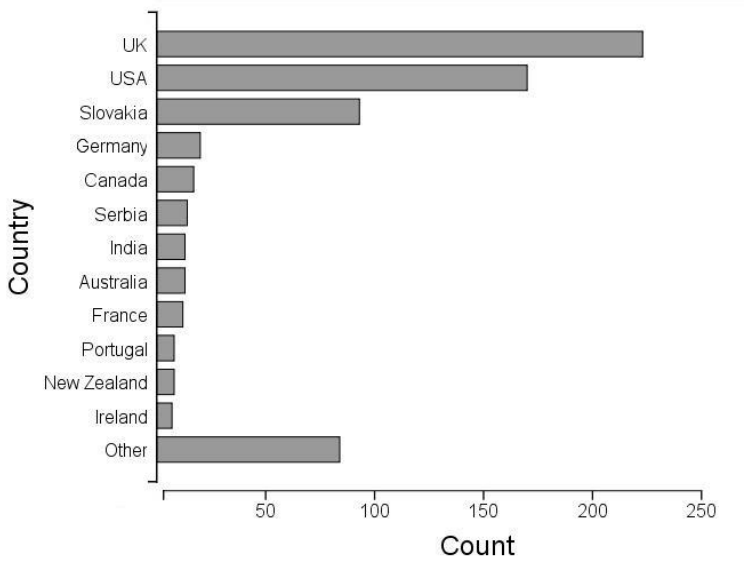

Figure 4.1. Distribution of participants by country.

4.2.2. Materials

A battery of questionnaires was administered in the following order. The wording of the items can be found in Appendix B. We also used other measures not analysed in the present study. Their description is provided in the following chapters.

Demographic data

Standard demographic items including gender (including an additional non-binary response option), country of origin, age, and years of formal education completed were taken. Furthermore, participants were asked to indicate how they found out about the study, whether through social networks (Facebook, Twitter, etc.), interest group, website, or community, from a family member, or through word of mouth. Participants who selected the 'interest group/website/community' option were asked to specify the area of interest (see Appendix B.1).

Attitudes towards dreams

A 21-item questionnaire was used to assess attitudes towards dreams. Nineteen items originated from the 'Dream significance', 'Dream positivity', and 'Dream

guidance' subscales of the 50-item Inventory of Dream Experiences and Attitudes (IDEA, Beaulieu-Prévost, Charneau Simard, & Zadra, 2009). Items were rated on a 7-point Likert scale (1 = *Completely disagree*, 7 = *Completely agree*). Although we used items from three subscales in the study, when factor analysed, all but two of them loaded primarily on one of two factors, namely 'Dream significance' (the importance ascribed to dreams in general) and 'Dream positivity' (positive affect towards one's dreams). Furthermore, the 'Dream guidance' and 'Dream significance' factors were strongly correlated (r =.58). For these reasons, we collapsed these two factors into a single factor (referred to henceforth as 'Dream significance'. A subsequent confirmatory factor analysis (CFA) of the two-factor model using weighted least square mean and variance adjusted estimation (WLSMV) showed an acceptable fit (CFI = .966, TLI = .962, RMSEA = .076, 90% CI [.070; .080]). The two resulting subscales exhibited high reliability (α = .92, 95% CI* [.90, .94] for 'Dream significance' and α = .84, 95% CI* [.80, .87] for 'Dream positivity'). For the wording of the items, see Appendix B.3.

Sleep characteristics

Seven items related to sleep quality addressing usual sleep duration, frequency of day-time naps and night-time wake-ups, use of sleep medication, history of sleep disorders, usual dream recall, and overall subjective sleep quality were used. A '*Prefer not to say'* response option was provided for the item related to diagnosed sleep disorders. The items were adapted from the Pittsburg Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The items can be found in Appendix B.2.

Precognitive dream belief and experiences

Belief in precognitive dreams was assessed using a 4-item Likert scale with response options ranging from 1 (*Completely disagree*) to 7 (*Completely agree*). This was a modified

version of the scale used in studies 2 and 3. Internal consistency of this scale was high, α = .92.

An additional item inquired into the source of information underlying participants' belief into the existence, or otherwise, of precognitive dreams. Five response options were provided: *Scientific evidence*, *Popular print or broadcast media*, *Knowledge of another person's experience*, *Direct personal experience*, and *Other (please specify)*.

Precognitive dream experience was measured using two further items. The first was, just like the items in the belief section, a 7-point Likert item worded "I have had at least one dream that came true and which (I believe) was precognitive." The second item related to precognitive dream frequency and was identical to that described in the previous chapter. Again, precognitive dreams were defined as "dreams that foretell the future" and Bender's (1966) criteria for what constitutes a precognitive dream were included before the precognitive dream section of the questionnaire battery. The questionnaire can be found in Appendix B.4.

4.2.3. Procedure

The battery of questionnaires was administered online and hosted on Google Drive. Participants read a description of the study and gave consent by proceeding with filling in the questionnaire. Upon completion, participants who reported having experienced a precognitive dream were asked to complete a separate questionnaire whose development is described in Chapter V and is not included in the present analysis. Participants were then thanked for completing the study and debriefed.

4.2.4. Hypotheses

H1. Precognitive dream belief and experience are related to demographic variables (gender, age, and education).

H2. Precognitive dream belief and experience are related to significance ascribed to one's dreams as well as emotional appraisal of them.

H3. Precognitive dream experience is related to sleep characteristics (sleep quality and nocturnal awakening and diurnal nap frequency).

H4. Precognitive dream experience is related to sleep medication use.

4.3. Results

4.3.1. Descriptive analysis

The mean number of completed years of formal education in the sample was 16.45 (*Mdn* = 17, *SD* = 3.35) ranging from 8 to 25. Table 4.1 provides a summary of descriptive statistics of the dream attitude subscales.

Table 4.1

Descriptive statistics for attitudes towards dreams variables

Variable	*M*	*Mdn*	*SD*	Min	Max
Dream Significance	4.15	4.23	1.42	1.08	7
Dream Positivity	4.19	4.29	1.15	1	7

The majority of participants reported sleeping on average 7-8 hours a day (62.7%) with only 4.5% of participants sleeping fewer than 5 or more than 10 hours a day. The mean overall sleep quality rated on a 7-point Likert scale (1 = *Very bad*, 7 = *Very good*) was 5.1 (*Mdn* = 5, *MAD* = 1.48). Forty-two participants (6.9%) reported having been diagnosed with a sleep disorder. Items related to frequencies of daytime naps, night time waking up, use of sleep medication and dream recall are summarised in Table 4.2. Due to extremely skewed distribution of responses to the sleep medication item (80.1%

reported never taking sleep medication) we decided to dichotomise the variable for further analysis.

The mean score on the precognitive dream belief index, derived from the four items measuring belief in the reality of precognitive dreams, was 3.5 (*Mdn* = 3.5, *SD* = 2.01). The median response to the item addressing precognitive dream experience was 2, with 39.2% of the sample having scored above the mid-point. Furthermore, 56.2% of participants reported never having remembered a precognitive dream, 17.8% remembered them less often than once a year, 6.2% about once a year, 12.1% about once in six months, 5.2% reported having precognitive dreams about once a month, and 2.5% about once a week.

Table 4.2

Descriptive statistics for sleep variables

Variable	*Mdn*	Min	Max
Daytime nap frequency	2	0	6
Night time wake-up frequency	3	0	6
Sleep medication use frequency	0	0	6
Dream recall frequency	4	0	7

4.3.2. Relationship between precognitive dream belief and experience

Belief in precognitive dreams was strongly related to both precognitive dream experience (r_s = .812, 95% CI* [.780, .841], $p < 2 \times 10^{-16}$) and frequency of precognitive dreams (r_s = .730, 95% CI* [.692, .764], $p < 2 \times 10^{-16}$). Figure 4.2 shows the distribution of precognitive dream belief scores with respect to precognitive dream recall frequency. As is apparent from the plot, the bulk of participants who never have precognitive dreams do not hold belief in the existence of such dreams (*M* = 2.25, *Mdn* = 1.75, *SD* = 1.43, *N* = 343), those who report having precognitive dreams infrequently (once a year

or less often) belief in the reality of these phenomena with moderate conviction (M = 4.87, Mdn = 5.00, SD = 1.31, N = 166), and those who have these dreams frequently believe in their reality more strongly (M = 5.64, Mdn = 6.00, SD = 1.13, N = 162). These differences were statistically significant, $F(2, 668) = 437.7$, $p = 2 \times 10^{-16}$ with difference between first two groups of 2.61, 95% CI [2.32, 2.92] and the difference between the latter two groups being 0.77, 95% CI [2.32, 2.92] (both p's $< 10^{-6}$ for Tukey's HSD test). Conversely, out of the participants who scored above the median on the precognitive dream belief measure, only 13.7% reported never having had a precognitive dream experience, as opposed to 82.5% of those below the median value.

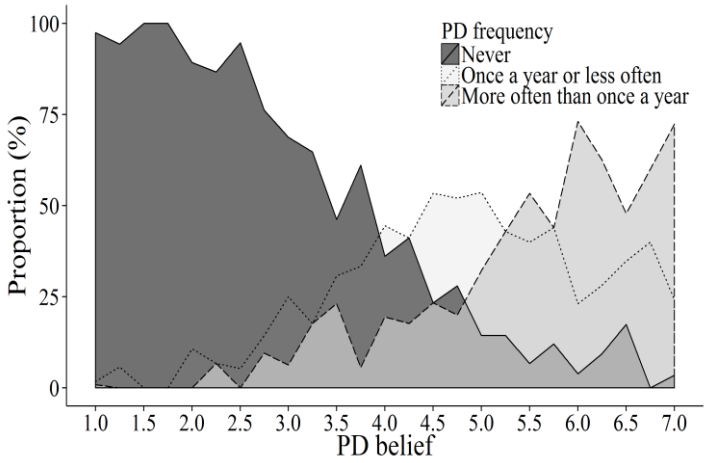

Figure 4.2. Area plot showing relative proportions of precognitive dream experience categories with respect to precognitive dream belief.

4.3.3. Hypothesis testing

Demographic variables and precognitive dream belief and experience

First, we explored the role of demographic variables in precognitive dream belief and experience (H1). A sequence of linear regression models predicting PD belief was built with gender, age, and years of formal education completed added, one at a time in

order to assess the individual contributions of the predictor variables. Education was added to the model last in order to account for potential relationship with age and gender. The final model including these three variables accounted for 22.5% of the variance in precognitive dream experience, with all variables having a significant effect on PD belief (see Table 4.3 and 4.4). This result was supportive of H1. Men exhibited lower PD belief, while age was positively related to the outcome variable. Furthermore, PD belief diminished with increasing number of years of formal education completed. Comparable results were obtained from a multiple ordinal regression of PD experience on the same predictor variables (see Table S1 in Appendix C).

Table 4.3

Summary of hierarchical regression models of PD belief

Model	R	ΔR^2	ΔF	df	p
1	.095	.009	2.017	1, 670	.014
2	.415	.164	132.22	1, 669	$< 2 \times 10^{-16}$
3	.475	.053	45.493	1, 668	3×10^{-11}

Note. Predictors for model: 1) gender; 2) model 1 + age; 3) model 2 + education.

Table 4.4

Details of the final regression model predicting PD belief

Predictor	b	β [95% CI*]	t	p
Gender	−0.449	−0.109 [−0.174, −0.039]	−3.203	.001
Age	0.072	0.416 [0.350, 0.475]	12.169	$< 2 \times 10^{-16}$
Education	−0.139	−0.230 [−0.291, −0.162]	−6.745	3×10^{-11}

Precognitive dream experience and attitudes towards dreams

Next, we tested the hypothesis that precognitive dream variables are related to individuals' attitudes towards dreams (H2). Table 4.5 shows zero-order correlation between each of the PD variables on the one hand and dream significance and dream positivity on the other. There were strong positive relationships between Dream significance and each PD variable. As for Dream positivity, however, the correlations were much weaker, albeit still statistically significant.

Table 4.5

Zero-order Spearman's rank correlations between PD and dream attitude variables

	Dream significance		Dream positivity	
PD variable	r_s [95% CI*]	*p*	r_s [95% CI*]	*p*
Belief	.683 [.642,.719]	$< 2 \times 10^{-16}$	.154 [.072, .227]	6×10^{-5}
Experience	.615 [.587, .678]	$< 2 \times 10^{-16}$	.148 [.064, .221]	10^{-4}
Frequency	.634 [.567, .662]	$< 2 \times 10^{-16}$	.145 [.072, .222]	2×10^{-4}

Because of the strong correlations between PD variables, we used partial correlations to explore the unique contributions to the variance shared between PD and dream attitude variables. Controlling for both PD experience and PD frequency, the correlation between PD belief and Dream significance dropped to a moderate size, $r_s =$ .355, 95% CI* [.289, .421], $p < 2 \times 10^{-16}$.

However, partialling out PD belief reduced the sizes of the correlations of PD experience and PD frequency with Dream significance to small, $r_s =$ .189, 95% CI* [.107, .266], $p = 10^{-6}$ and $r_s =$ .233, 95% CI* [.158, .308], $p = 10^{-9}$, respectively. Thus, H2 was partially supported by the data.

Precognitive dream experience and sleep characteristics

In order to ascertain the relationship between precognitive dream experience and sleep characteristics (H3), a hierarchical cluster analysis using Ward's minimum variance method (Ward, 1963) was first conducted on the five standardised sleep variables (sleep duration, frequency of nocturnal awakenings and diurnal naps, dream recall frequency, and subjective overall sleep quality). Due to extremely small variance of the sleep medication variable as well as the binary nature of the sleep disorder variable, these were excluded from the cluster-analysed set, in order to avoid homogenisation of the sample. Based on visual inspection of the resulting dendrogram (Fig. S1 in Appendix C), three clusters of similar sizes were identified. The individual 'sleep profiles' of these clusters is depicted in Fig. 4.3. As can be seen in the figure, Cluster 1 was characterised by a rather erratic sleep pattern with high frequency of both nocturnal awakenings and diurnal naps, high dream recall, and a low subjective overall sleep quality. Cluster 2 differed from Cluster 3 mainly in terms of sleep duration and dream recall. Thus, these two clusters were interpreted as representing high and low dream recallers respectively. Table 4.6 shows the descriptive statistics for the measured variables with respect to the three sleep clusters as well as tests of differences between the clusters.

There were no significant differences between the sizes of the clusters, χ^2 (2) = 3.723, p = .155, however, there was a preponderance of men in Cluster 3 compared to Cluster 2, χ^2 (2) = 7.790, p = .020. The mean age of Cluster 1 was furthermore significantly higher in comparison to the other two clusters, Mean diff_{2-1} = −3.29, 95% CI* [−5.90, −0.69], p = 0.009; Mean diff_{3-1} = −4.37, 95% CI* [−7.00, −1.74], p = 3×10^{-4}. Importantly, the three clusters also differed significantly from one another in the proportion of participants who have used sleep medication, with Cluster 1 having the highest and Cluster 3 the lowest proportion, χ^2 (2) = 28.396, $p = 7 \times 10^{-7}$. To see if this

relationship remained significant after controlling for age, the variables were entered into a logistic regression with age and sleep clusters as predictors and sleep medication use as a binary outcome. As shown in Table 4.7, participants in Cluster 2 were 58% less likely to have used sleep medication than Cluster 1 participants. Those in Cluster 3 were 67% less likely to report sleep medication use compared to Cluster 1. However, when the model was refitted with sleep cluster as ordinal variable in order to compare Clusters 2 and 3, there was no longer a significant difference between them (see Table S2 in Appendix C).

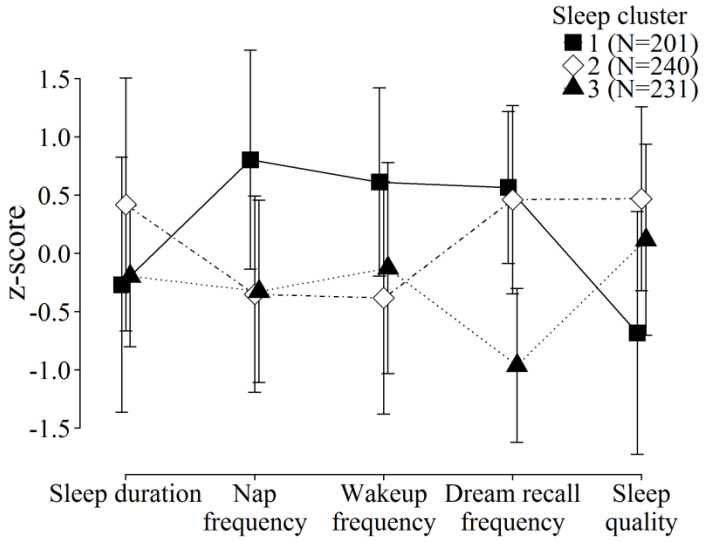

Figure 4.3. Sleep variable profiles of three identified sleep clusters. Error bars represent ± 1 *SD*.

Next, we investigated the relationship between sleep patterns and reported PD frequency. As reported in Table 4.6, there was a significant difference in PD frequency between each pair of sleep clusters. Table 4.8 shows a more detailed breakdown of proportion of responses on the PD frequency item within individual clusters. Within Cluster 1, 36.32% of participants reported having precognitive dreams more often than once a year, compared to 27.62% of Cluster 2 and 9.96% of Cluster 3 participants.

Furthermore, the proportion of participants without a precognitive dream experience rose from 36.82% in Cluster 1 to 62.77% in Cluster 3.

Table 4.6

Descriptive statistics and test of between group differences for measured variables with respect to sleep clusters

Variable	Cluster 1	Cluster 2	Cluster 3	χ^2 (2)
N (%)	201 (29.9)	240 (35.7)	231 (34.4)	3.723
Gender (% male)	42.3	35.0[3]	47.6[2]	7.790*
Sleep meds (% use)	32.3[2,3]	16.3[1,3]	13.0[1,2]	28.396***
Sleep disorder (%)	11.00[2,3]	4.6[1]	4.3[1]	9.910**
	M (SD)	*M (SD)*	*M (SD)*	*F* (2,669)
Age	34.14 (13.22)[2,3]	30.85 (11.02)[1]	29.77 (10.7)[1]	8.125***
Years of education	16.31 (3.39)	16.39 (3.47)	16.64 (3.20)	0.564
Dream significance	4.61 (1.36)[2,3]	4.31 (1.37)[1,3]	3.57 (1.32)[1,2]	34.390***
Dream positivity	4.01 (1.21)[2]	4.37 (1.17)[1]	4.16 (1.07)	5.501**
PD belief	4.17 (2.02)[3]	3.76 (2.05)[3]	3.27 (1.90)[1,2]	10.990***
	Mdn (MAD)	*Mdn (MAD)*	*Mdn (MAD)*	*H* (2)†
Sleep duration	3 (0.00)[2]	3 (0.00)[3]	3 (0.00)[1,2]	65.313***
Nap frequency	5 (1.48)[2,3]	2 (1.48)[1]	2 (1.48)[1]	168.269***
Wakeup frequency	6 (1.48)[2,3]	4 (2.97)[1,3]	4 (2.97)[1,2]	114.984***
Dream recall	6 (1.48)[3]	6 (1.48)[3]	4 (1.48)[1,2]	333.306***
Sleep quality	4 (1.48)[2,3]	6 (1.48)[1,3]	5 (1.48)[1,2]	139.745***
PD experience	5 (2.97)[2,3]	3 (2.97)[1]	2 (1.48)[1]	25.631***
PD frequency	2 (1.48)[2,3]	1 (0.00)[1,3]	1 (0.00)[1,2]	40.407***

Note. MAD = median absolute deviation.
Superscripts in individual cells indicate a significant difference from given cluster according to Tukey HSD-corrected *t*-test for continuous variables and Bonferroni corrected Mann-Whitney *U*-test for ordinal variables.
† Kruskal-Wallis ANOVA due to ordinal variable.
* < .05; ** < .01; *** < .001

In order to control for demographic variables, a multiple ordinal regression model was fit with PD frequency as outcome and demographic variables and sleep cluster as predictors. The results are summarised in Table 4.9. Sleep cluster remained a significant predictor even after accounting for the significant effects of age and education.

However, as was the case with the model predicting sleep medication use, when Sleep cluster was treated as an ordinal variable, the odds ratio for Cluster 3 was not significantly different from Cluster 2, $b = -0.076$, SE= 0.13, $p = .557$, OR = 0.93, 95% CI [.74, 1.23].

Table 4.7

Summary of logistic regression predicting sleep medication use

Predictor	*b*	*SE*	*p*	OR [95% CI]
Age	0.012	0.01	.118	1.01 [1.00, 1.03]
Cluster 2	−0.862	0.23	2×10^{-4}	0.42 [0.27, 0.66]
Cluster 3	−1.112	0.25	8×10^{-6}	0.33 [0.20, 0.53]

Table 4.8

Proportion of PD frequency levels by sleep clusters and sleep medication use categories

	PD frequency (%)					
Sleep cluster	0	1	2	3	4	5
1	36.82	19.40	7.46	20.90	9.45	5.97
2	51.88	16.74	3.77	14.23	8.79	4.60
3	62.77	18.61	8.66	7.36	1.73	0.87
Sleep medication use						
No	54.56	17.69	6.7	12.1	5.77	3.17
Yes	37.31	20.15	5.97	20.9	9.7	5.97

Note. Cells within rows add up to 100%.

The relationship between the presence of a sleep disorder diagnosis and PD frequency was investigated using another multiple ordinal regression with a categorised PD frequency as outcome variable. The categories were the same as the ones depicted in Fig. 4. 1. The reason for this treatment of the variable was the small number of participants who reported having been diagnosed with a sleep disorder. Reducing the number of outcome variable categories thus increases the number of cases per cell. Sleep disorder was a significant predictor of PD frequency category, even after accounting for the effects of demographic variables and sleep cluster, $b = 0.752$, SE=

0.33, p = .021, OR = 2.12, 95% CI [1.12, 4.04]. This result provides further support for H3 that sleep characteristics are related to experience of precognitive dreams[7].

Precognitive dream experience and sleep medication

Finally, we investigated the role of sleep medication in precognitive dream experience (H4). In order to do this, we first compared the distributions of responses on the PD frequency variable between those who reported having used sleep medication and those who did not. The distributions differed significantly, χ^2 (5) = 17.454, p = .003. Table 4.8 shows the proportions of responses within the individual sleep medication use groups.

Secondly, we controlled for the effects of demographic variables and sleep cluster by including them, along with the binary sleep medication variable into a multiple ordinal regression with PD frequency included in the model as outcome. As shown in Table 4.9, the effect of sleep medication, as well as sleep cluster, on PD frequency remained significant. This result was consistent with H4.

Table 4.9

Summary of ordinal regression of demographic variables, sleep cluster and sleep medication use on PD frequency

Predictor	*b*	*SE*	*p*	OR [95% CI]
Gender	−0.169	0.16	.279	0.84 [0.62, 1.15]
Age	0.041	0.01	2×10^{-11}	1.04 [1.03, 1.06]
Education	−0.163	0.02	10^{-12}	0.85 [0.81, 0.89]
Cluster 2	−0.393	0.18	.033	0.68 [0.47, 0.97]
Cluster 3	−0.973	0.19	4×10^{-7}	0.38 [0.26, 0.55]
Sleep meds	0.446	0.19	.016	1.56 [1.08, 2.24]

[7] We acknowledge that the reported analysis does not address the question of how much of the variance in PD frequency accounted for by the sleep clusters is due to dream recall frequency.

4.4. Discussion

The present study investigated the relationships between the belief in, and experience of, putatively precognitive dreams and various demographic as well as sleep and dream related variables. As expected, precognitive dream belief and experience were strongly positively related to each other. The magnitudes of detected correlations were somewhat larger than those reported by previous studies exploring paranormal belief and experience (Glicksohn, 1990; Lawrence *et al.*, 1995), in the .7 – .8 range as opposed to .5 – .6. This discrepancy may be attributed to the differences in samples used. The present sample consisted of members of the general population rather than mostly undergraduate students and school children. Furthermore, some participants were recruited from interest groups. This could have led to distributions of the precognitive dream variables that exaggerated the relationships between belief and experience. The causal nature of the relationship between PD belief and experience is difficult to tease apart. It seems natural that if a person encounters an event they perceive as fulfilling a dream they previously had, such experience can lead to espousing of belief in the precognitive power of dreams. On the other hand, it could be argued that at least a certain propensity to paranormal belief is necessary for attributing such experience to precognition rather than dismissing it as a mere quirk of probability or explaining it away in less extraordinary terms. Furthermore, the fact that there exist individuals who believe in PD without a prior experience suggests that even if belief may be, in cases, sufficiently caused by an experience, such experience is not a necessary condition of belief. This issue of causality would be best addressed by a longitudinal study. Such a study could, for example, track participants' beliefs and experiences and assess the

temporal order of their first instance. It might be also feasible to induce a higher level of belief in participants and then see whether their reported frequency of PD changes. However, this approach might be ethically problematic. Until an appropriately designed study has been conducted, we believe it is prudent to embrace a middle ground position of a likely bidirectional relationship between PD belief and experience with potential positive feedback mechanisms.

Besides the mutual relationship of precognitive dream belief and experience, the study explored several hypotheses. Firstly, we hypothesised that there would be a relationship between PD belief and experience on the one hand and demographic variables on the other. Consistent with previous literature (Haraldsson, 1985), women were more likely to embrace belief in the reality of dream precognition as well as to report a first-hand experience of it than men. Furthermore, both PD belief and experience were positively related to age, running contrary to some previous findings (Schredl, 2009, Blagrove *et al.*, 2006). It could be argued that this is not surprising because a longer life means a greater chance of subjectively experiencing an ostensibly precognitive dream and, by extension, a greater likelihood of espousing PD belief. However, this interpretation does not account for the significant positive relationship between age and reported PD frequency (see Table 4.9), unless one is prepared to admit that this kind of self-report is at least partly driven by belief. Since attitudes have been shown to inflate self-reported dream recall frequency (Beaulieu-Prévost, & Zadra, 2005), this is certainly a possibility and further research should address this issue. Interestingly, we also found that the number of completed years of education was negatively related to both PD belief and experience, even after controlling for age. This result is consistent with those of Musch and Ehrenberg, (2002), who found that paranormal belief is negatively related to cognitive ability, as well as those of Blagrove and colleagues (2006),

who found a negative relationship between belief in PD and education. Viewed through the lens of the cognitive deficit hypothesis of paranormal belief (Alcock, 1981), this result may be taken to suggest that more educated people are more likely to scrutinise their experiences. This interpretation is certainly plausible; cognitive ability has been shown to be positively related to critical thinking and negatively to biases in probability judgement (Liberali, Reyna, Furlan, Stein, & Pardo, 2012; West, Toplak, & Stanovich, 2008; but see Stanovich & West, 2008) and education has been shown to correlate with general cognitive ability (Ritchie, Bates, Der, Starr, & Deary 2013). On the other hand, using a measure of formal education as a proxy for cognitive/critical thinking ability is potentially problematic (Deary & Johnson, 2010). Therefore, even though interesting, this result should be treated with caution when used as support for the cognitive deficit hypothesis. However, we would argue, it provides a good basis and rationale for future research using more direct measures of cognitive ability and critical thinking skills. Future investigation of the relationship between these variables and specific paranormal experiences may help to disentangle the inconsistent results obtained from studying a conceptually ill-differentiated composite of general paranormal belief and experience (French & Wilson, 2007).

Secondly, we hypothesised that PD belief and experience would be related to attitudes towards dreams, namely perceived personal significance of dreams in general and positive affect towards one's dreams. There was a strong positive relationship between PD variables and dream significance. When the shared variance between PD belief and experience was partialled out, the size of the relationship dropped to moderate for belief but only small for experience and frequency. For the above-mentioned reasons, it is difficult to determine what the shared variance between the PD variables represents, whether it is closer to ontological (*e.g.* belief in the existence of

precognitive dreams) or 'experiential' belief (conviction that one has experienced such dreams). However the relatively small unique contribution of PD experience and frequency compared to belief points at the primacy of the latter when it comes to the relationship with personal significance ascribed to one's dreams. As was the case before, the causality of this relationship cannot be unambiguously interpreted based on the present result. It is possible that belief in precognitive dreams (and experience thereof) causes an individual to ascribe a greater personal significance to their dreams. However, it is equally plausible that an a priori tendency to consider dreams as personally significant creates a propensity to belief in, and experience of, precognitive dreams.

As for positive affect towards one's dreams, we found a small positive relationship with the PD variables. The unique contribution of neither of them reached statistical significance. This finding will become relevant further in the discussion.

Thirdly, we hypothesised a relationship between the frequency of precognitive dream experience and an individual's sleep pattern. We identified three clusters of participants based on their responses on sleep-related variables. One of the clusters exhibited a rather erratic sleep pattern with a relatively high frequency of nocturnal awakenings and diurnal naps and a lower subjective overall sleep quality. Consistent with a high frequency of awakenings, this cluster also reported a high dream recall frequency. Dream recall was also a main characteristic that distinguished the other two clusters, although there were smaller yet statistically significant differences in most of the measured sleep variables. The results showed that, controlling for demographic variables, participants in the 'erratic' cluster reported the highest PD frequency and those in the low dream recall cluster reported having these kinds of dreams least often. This was further supported by the finding that the presence of a sleep disorder diagnosis was a significant predictor of PD frequency.

Finally, we hypothesised a relationship between PD experience and sleep medication use. We found that participants who reported having used sleep medication in the past were more likely to report a higher frequency of precognitive dream experiences than those who have not used sleep medication. Furthermore those in the 'erratic' sleep cluster were more likely to have used sleep medication than participants in the other two clusters. This finding validates the interpretation of the extracted clusters since it can be expected that people with disturbed sleep are more likely to use sleep medication. However, our findings suggest that sleep medication use has an additive effect beyond that of the sleep clusters.

These results are consistent with the hypothesis that precognitive dream experience may arise as a result of an individual's processing external stimuli, such as news reports on the television or radio, during hypnagogic and hypnopompic states (Alcock, 1981). An erratic sleep pattern and associated increased likelihood of sleep medication use means more frequent hypnagogic and hypnopompic states and thereby a heightened likelihood of external stimuli being processed. Such stimuli can then figure in the narrative of one's dreams. If one is then confronted again with the same stimuli after awakening, this can lead to the impression that one dreamt about the future.

Alternatively, given that the present study relies on self-report measures, it is also possible that these results reflect a tendency of certain people to exaggerate their sleep difficulties as well as to over-report extraordinary experience. If this is the case, one would expect to find a relationship between precognitive dream experience and variables such as anxiety, depression, and narcissism. To the best of our knowledge, there has been only one study that explored the role of neuroticism in precognitive dream frequency and it did not find a significant result (Schredl, 2009). As for the other traits, there appears to be no research linking them to precognitive dream experience.

There are, however studies looking at more general paranormal belief/experience. For instance, Agorastos and colleagues (2012) found no differences in belief in precognition or other paranormal phenomena between groups of participants with obsessive-compulsive disorder or anxiety disorder compared to healthy controls. However, Sharps, Matthews, and Asten (2006) found that depression, among other variables was a significant predictor of paranormal belief and Dudley (2000) found an association between paranormal belief and negative affect. Research into the relationship between paranormal belief and narcissism has also yielded somewhat mixed findings. Tobacyk and Mitchell (1987) found a positive relationship between the two, however, Auton, Pope, and Seeger (2003) did not find a relationship between narcissistic personality characteristics and paranormal belief. Moreover, the findings of Roe and Morgan (2002) were mixed; they found a positive relationship between narcissism and the Extrasensory perception and Psychokinesis subscales of the Australian Sheep-Goat Scale but no relationship between the former and paranormal belief in general as assessed by the Paranormal Belief Scale. More research is therefore needed. Including the above-mentioned variables in future studies could help to adjudicate between the two alternative interpretations of the link between precognitive dream experience and sleep characteristics. Different still, it may be the case that, by virtue of sheer probability, the more one recalls one's dreams, the higher the likelihood that a real-life event will, at least to some extent, thematically overlap with the content of any of the dreams. This interpretation, even though plausible, is probably not amenable to objective testing.

It could be also argued that the above-mentioned interpretations misidentify the causal direction of the relationship between sleep patterns and PD experience and that, in fact, it is the subjective experience of upsetting precognitive dreams that disturbs one's sleep. However, as pointed out, the present results show that tendency to PD

experiences is associated with a small increase in positive affect towards one's dreams. This would not be the case if precognitive dreams were responsible for disturbed sleep and a lower sleep quality.

Finally, it is also possible that both PD experiences and a disturbed sleep pattern share a common cause without the one causing the other. Since many psychological disorders are associated with sleep disturbances and some also list various "extraordinary" experiences among their symptoms, future research should also explore psychopathology as a factor in the experience of precognitive dreams. This would, at the same time, contribute to the clarification of the inconclusive results of research focusing on the link between paranormal beliefs and experiences on the one hand and depression, anxiety, and narcissism on the other, as discussed above.

There are some limitations to our findings that should be discussed. Firstly, the sample used in the study may not be representative of the general population and was not obtained using random sampling. However, an effort was made to recruit a broad range of participants of differing backgrounds and beliefs. Despite this effort, possible biases in the sample may have occurred. There was, for instance, a preponderance of males in one of the sleep clusters, even though males were slightly underrepresented in the sample as a whole. Since the cluster in question included the most disbelievers in precognitive dreams, this gender distribution may be reflecting the fact that some of the strong disbelievers were recruited via online forums dedicated to scepticism. These kinds of forums tend in general to be rather male-dominated. Moreover, using online forums and interest groups dedicated to the paranormal may have led to overrepresentation of PD believers/experiencers in comparison to the general population. Thus, the frequency of PD belief and experience obtained in the present

study should not be viewed as informative of the distribution of these beliefs and experiences in the general population.

In addition to already mentioned difficulties related to the interpretation of causality, it is also difficult to disentangle the complex network of relationships between the individual measured variables. Since no hypotheses were made about potential relationships between, *e.g.*, sleep characteristics and dream attitudes, the present study did not attempt to ascertain them. Should such relationships be hypothesised, advanced multivariate methods such as structural equation modeling might be of use in testing more complex models. We believe that the present findings provide a useful empirical basis for their specification.

In conclusion, the present study identified several correlates of precognitive dream belief and experiences, some of which had, to the best of our knowledge, not been previously explored. The most notable findings are that precognitive dream belief and experience are negatively related to education and that a more frequent PD experience is associated with somewhat erratic sleep patterns and a heightened likelihood of sleep medication use. We also found evidence of the link between attitudes towards dreams in general and precognitive dream belief and, to a lesser extent the frequency of PD experience. This finding suggests that people's attitudes towards their precognitive dreams may be a relevant psychological factor contributing to these beliefs and experiences. The next chapter will therefore focus on exploring the structure of attitudes towards precognitive dreams.

Chapter V

Attitudes towards precognitive dreams

5.1. Study 5 Introduction

Considering the prevalence of precognitive dream belief and experience in the general population (Blackmore, 1997; Moore, 2005), there has been little rigorous investigation into their phenomenological nature. Research in the topic of paranormal belief and experience, whether from a clinical or cognitive psychological perspective, tends not to focus on how the experiencers of paranormal phenomena perceive and construe their experiences. As we will argue in this chapter, addressing this dearth of research interest by focusing on attitudes towards precognitive dreams in particular can provide useful new insights into the psychology of these beliefs and experiences.

There are a number of scales addressing paranormal (sometimes labelled supernatural, superstitious, or magical) beliefs. These come mainly from two research traditions. Firstly, paranormal beliefs and experiences have long been a focus of clinical psychology and psychiatry, since this kind of belief and experience has been linked to psychosis and sub-clinical levels of psychotic-like perception and behaviour. From this tradition comes the concept of schizotypy, a trait whose high levels have been associated with elevated risk of schizophrenia (Kwapil *et al.*, 2014). The Magical Ideation scale of the Wisconsin-Madison scales (Chapman, Chapman, & Kwapil, 1995), which is frequently used as a measure of schizotypy, contains items inquiring into what can be described as paranormal experience. The second tradition is embodied within the fields of parapsychology and anomalistic psychology. There have been several measures of

paranormal belief and experience developed within these fields, the Revised Paranormal Belief Scale (R-PBS, Tobacyk, 2004) and the Australian Sheep-Goat Scale (ASGS, Thalbourne & Delin, 1993) being the most widely used ones (Goulding & Parker, 2001). The development of these scales has prompted numerous studies in both of the above-mentioned traditions.

Given the above, we believe there is a gap in the scientific literature investigating various paranormal experiences in the general non-clinical population. Moreover, as discussed in section 1.3.3.3, there is also a dearth of literature focusing on teasing apart of the various paranormal phenomena and their psychological correlates. These gaps can be filled with measurement instruments that would focus on specific types of paranormal experiences. While it is true that the individual levels of endorsement of different paranormal beliefs tend to correlate (Lange, Irwin, & Houran, 2000), it is nonetheless plausible, as we argue, that individual forms of paranormal experiences have different underlying psychological mechanics (Irwin, 1993). Measures that are able to provide a more fine-grain access to the individual paranormal experiences could help to uncover these potential differences.

Further reasons why we feel such a measure would be helpful stem from a different aspect of the current state of scientific exploration of paranormal belief and experience. As mentioned above, the currently available measures, such as the R-PBS, mostly focus on the assessment of ontological beliefs, *i.e.* beliefs about the existence of paranormal phenomena, while precious little attention is paid to more experiential aspects, such as phenomenology or attitudes.

The aim of this chapter is therefore the development of a scale that would assess attitudes towards precognitive dreams. As discussed in the introductory chapter, this topic has previously received substantial academic attention. However, when it comes to

experiential aspects of precognitive dreams, the scientific literature on the topic is rather sparse. Stowell (1997a; 1997b) provides a qualitative analysis of interviews with five self-proclaimed precognitive dreamers, in which she explores, among other things, the phenomenological characteristics that, according to the interviewees, set precognitive dreams apart from the mundane ones. These characteristics included exceptional vividness, clarity, and emotional intensity of the dream imagery, feeling of impact and significance upon awaking from the dream, and a sense of lack of completeness while awaiting the fulfilment of the dream coupled with feeling of distress when the confirmatory event does not come to pass. Although qualitative research, such as Stowell's, can undoubtedly provide potentially interesting information, we believe that a quantifiable measure exploring similar aspects of precognitive dream experience (*e.g.*, attitudes) that could be administered to a larger number of people could prove useful, for instance for identifying the psychological correlates of different attitudes.

Yet another reason for this kind of measure is the possibility that precognitive dream experience might be a multi-faceted phenomenon. There might exist different profiles of precognitive dreamers, each with its own underlying psychological mechanics, which are unlikely to be teased apart using the available measures. Exploring individual differences in attitudes towards precognitive dream experiences can help shed light on these processes. For instance, it is conceivable that people with experience of precognitive dreams differ on how central or important this experience is to their self-image and world-view. Some may regard it as a minor event in their lives while for others this kind of experience may play a significant role in the way they think of themselves and act towards their environment. Given the existing evidence of the interplay between the strength and importance of convictions and desirability of outcome on the one hand and various cognitive biases on the other (Sanitioso, Kunda,

& Fong, 1990; Bastardi, Uhlmann, & Ross, 2011), it is feasible that self-relevance of these kinds of experiences could facilitate potential motivational and cognitive factors, leading to higher subjective incidence of precognitive dreams (see Chapter VI). A measure assessing various components of people's attitudes towards their precognitive dream experiences would allow for the exploration of relationships such as the one suggested.

Finally, a measure of attitudes towards precognitive dream experience will also make it possible to investigate individual differences in experiencers in terms of well-established psychological constructs, such as the 5-factor model of personality and IQ. That is especially interesting given the current situation of inconclusive findings from research into the relationship of cognitive ability and paranormal belief (see Wiseman and Watt, 2006 for a review). This situation might be a result of treating belief in diverse paranormal phenomena as a unitary construct as well as of the potential multi-faceted nature of paranormal belief and experience. To illustrate this point within the context of precognitive dreams, there is a possibility that precognitive dreamers with positive emotions towards their dreams are less neurotic than those with negative emotions. Failing to assess these differences and looking for a relationship between subjective precognitive dream experience and neuroticism could lead to inconclusive results.

For these reasons we believe that there is a need for a measure of attitudes towards specific paranormal experiences. This chapter reports on the development and validation of one such measure.

5.2. Method

5.2.1. Participants

Participants (N = 330) were selected from the sample described in Chapter IV on the basis of their reported prior precognitive dream experience. There were 124 (37.58%) males and 203 (61.52%) females. Three participants (0.91%) did not identify as either male or female. Mean age of the sample was 35.17 years (Mdn = 31.5, range = 18-69, SD = 13.13). There was no age difference between males and females in the sample (M_{male} = 35.55, SD = 14.18, M_{female} = 35.09, SD = 12.49, $t(235.158) = -0.297$, 95% CI [−3.505, 2.585], p = .766). The majority of participants found out about the study on social networks such as Facebook, Twitter, or Reddit (55.5%), from a family member (2.1%), or through word of mouth (3.0%), while the rest of the sample (39.4%) came across the research through their interest in topics of psychology, dreams, scepticism, and the paranormal.

5.2.2. Materials

For the purposes of this study, we used participants' data on the demographic questionnaire, attitudes towards dreams questionnaire, and precognitive dream belief and experience questionnaire described in Chapter IV.

Attitude towards Paranormal Experience Scale

In addition to the above-mentioned measures, a 63-item Attitude towards Paranormal Experience Scale – Precognitive Dreams version (APES-PD) was devised in order to assess attitudes towards precognitive dreams. A 7-point Likert scale (1 = *Completely disagree*, 7 = *Completely agree*) was used in order for the participant to express their endorsement of the individual statements. The items were designed to address 9 a priori factors with 7 items (3-4 reverse-scored) per factor. The factors along with sample

items are listed in Table 5.1 and the full list of items can be found in Appendix B.5. The a priori factors were not assumed to be orthogonal and the number of items per factor was selected to allow for potential dropping of variables with unsatisfactory metric characteristics. Prior to the administration of the scale, face and content validity of the items were assessed in a group discussion with researchers in parapsychology, personality psychology, and psychometrics at the University of Edinburgh.

Table 5.1

List of a priori *factors illustrated by sample items*

Factor *Sample item*
1. Centrality *My precognitive dreams, for better or worse, are a part of who I am.*
2. Privacy *My precognitive dreams are a private matter.*
3. Credit seeking *Society would greatly benefit from exploring the potential of precognitive dreamers.*
4. Exclusivity *To have precognitive dreams is a rare thing.*
5. Emotion towards precognitive dream *If I could I would give up my precognitive dream ability.*
6. Conative component *My actions are often informed by my precognitive dreams.*
7. Alienation *Society mocks people who have precognitive dreams because it fears what it doesn't understand.*
8. Internal/external source *Precognitive dreams are an ability which can be cultivated.*
9. Reliability/clarity *Sometimes it takes a bit of hindsight to realise the dream had been precognitive.*

5.2.3. Procedure

The study followed the procedure described in Chapter IV.

5.2.4. Analysis

Model fit was assessed using the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA). As criteria of good fit, we chose CFI and TLI > .9 and RMSEA < .08.

5.3. Results

5.3.1. Factor analysis of APES-PD

First, we fit a confirmatory factor analytic (CFA) model to the data with 9 factors based on the hypothesized structure. Due to the polytomous nature and distributions of the variables, we used the weighted least squares means and variance adjusted (WLSMV) estimation, since it provides more accurate and reliable estimates when the variables are ordinal and skewed, as is the case with the present data (Flora & Curran, 2004). The model, however, did not converge.

In order to arrive at the latent variable structure, we conducted an exploratory factor analysis (EFA). Parallel analysis on a matrix of polychoric correlations suggested a 9 factor solution (see Fig 5.1 for scree plot). We then employed the following algorithm. First, we dropped all items with communalities below .3. Next we ran an EFA using the weighted least squares (WLS) estimation and Geomin rotation and explored the factor structure. We dropped any additional items with factor loadings on all factors below .3. This process was then iterated until there remained no items that did not meet the communality and loading criteria. Finally, we inspected the resulting factor structure and assessed its interpretability. The 9 factor solution was not interpretable, with only one item loading primarily on the 9th factor. We therefore repeated the above-mentioned

algorithm with 8, 7, and 6 factor solutions. The resulting factor structures, however, suffered from the same issues as the first solution.

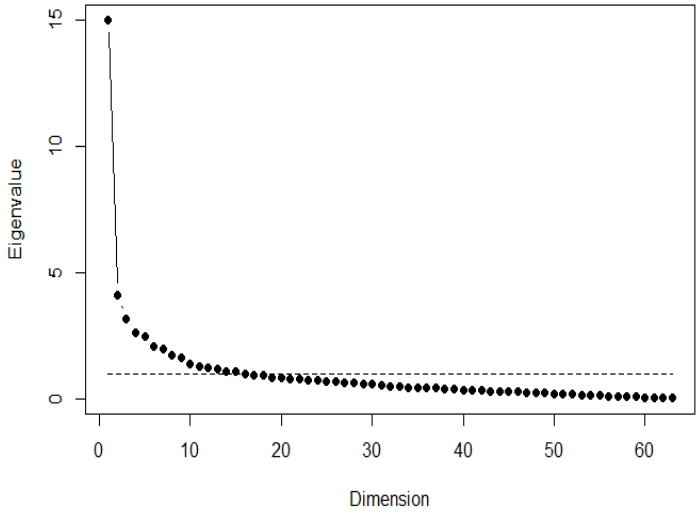

Figure 5.1. A scree plot of the unrotated factor solution of the original 63 APES-PD items.

Finally, after retention of 5 factors and applying the item-dropping algorithm, and excluding complex items (with equivalent cross-loadings on multiple factors), a satisfactory factor structure with sufficient interpretability emerged from the resulting set of 31 items (see Table 5.2 for a list of loadings). We labelled the factors 'Benefit' (perceived benefit derived from one's precognitive dream experience), 'Importance' (personal significance and reliability one ascribes to this experience), 'Negative emotion' (towards one's precognitive dreams), 'Credit' (desire for acknowledgement for one's precognitive dream ability), and 'Privacy' (tendency to keep one's precognitive dreams to oneself). The eigenvalues of the extracted factors prior to rotation were 9.65, 3.38, 2.12, 1.73, and 1.55 respectively and the five factors accounted for 52% of the total variance in the data. As shown in Table 5.3 the factors were intercorrelated, as a result of using an oblique rotation method.

Table 5.2

Factor loadings for the 5-factor solution based on WLS estimation

Item	Benefit	Importance	Neg Emo	Credit	Privacy
01			**−0.562**	0.393	
02			**−0.329**		**−0.394**
03		**0.397**			
05			**−0.546**	**0.505**	
06	**0.738**				
10	**0.368**				
11		**−0.5597**			
16					**−0.753**
17		**−0.555**			
21		**−0.584**			
22	**0.734**				
24					**0.748**
30					**0.588**
33		**0.478**			
36		0.409	**0.531**	0.321	
37	**0.511**		**0.488**		
40				**−0.638**	
41		0.423	**0.550**		
42	0.408	**0.469**			
44	**0.751**				
45	**0.852**				
46		**0.493**			
47	**0.434**				**−0.545**
48				**0.588**	−0.304
50			**0.705**		
52	**0.339**				
54				**0.582**	
56			−0.416	**0.613**	
59		**−0.595**			
61	**0.449**				
62	−0.318	**−0.581**			

Note. Neg Emo = negative emotion. Loadings of less than .3 omitted. Salient items in boldface.

Table 5.3

Matrix of inter-factor correlations for the WLS and WLSMV solutions

Factor	1	2	3	4	5
1 Benefit	−	.645	−.286	.416	−.328
2 Importance	.467	−	−.336	.423	−.135
3 Negative emotion	−.040	−.168	−	−.291	.173
4 Credit	.514	.398	.001	−	−.268
5 Privacy	−.148	−.130	.228	−.205	−

Note. Bottom half – WLS, Top half – WLSMV.

As previously stated, the most appropriate method of estimation for skewed ordinal data is the WLSMV estimation. To date, however, this method has not been implemented into any EFA R package. For that reason we fit a 5-factor EFA model in the CFA framework (also known as an exploratory structural equation model, eSEM) using the lavaan package (Rosseel, 2012) – which does provide the WLSMV estimation – to the reduced dataset arrived at by the process described above. This was achieved by fixing the variance of a single indicator per factor and allowing the other variables to estimate. The choice of the fixed indicator for each factor was informed by the EFA reported above; items 45, 59, 50, 40, and 16 were fixed, respectively, for factors one to five. The resulting model showed a good fit to the data, $\chi^2(320) = 705.166$, $p < .001$, CFI = .952, TLI = .931, RMSEA = 0.06, 90% CI [0.054, 0.067]. The factor structures obtained by the two estimation methods were comparable although there were a few items whose loadings were substantially different across the two solutions (see Table S3 in Appendix D).

The amount of agreement between the two factor solutions was ascertained by comparing of two scoring methods across the models. Firstly, we derived individual participant scores on five scales corresponding to the five extracted factors separately

for either solution. These scores were calculated as average response value on salient items (see Table 5.2). Secondly we extracted ten Berge scores (ten Berge *et al.*, 1999) for each factor. These scores are appropriate for non-orthogonal solutions, as they preserve the factor correlations. A set of individual ten Berge scores for each participant was obtained for both the WLS and the WLSMV solutions. Subsequently, we examined the correlations between: 1. the two sets of scale scores; 2. the two sets of ten Berge scores; 3. the scale and ten Berge score from the WLS-derived solution, and 4. the scale and ten Berge score from the WLSMV-derived solution. The correlations were satisfactorily high, M_r = .948 (.868 - .976), SD = .029. The correlation matrices can be found in Table S4 (Appendix D).

5.3.2. Reliability

In order to assess the reliability of the questionnaire, we calculated the Cronbach's α coefficient of each scale separately for the WLS and WLSMV models. The reliability of the scales ranged from acceptable (Negative emotion, α = .65, 95% CI [.55, .72]) to high (Benefit, α = .84, 95% CI [.80, .89]) and the two models yielded similar results. The only exception to this was the Credit scale, whose reliability dropped from α = .74 to α = .68, as a result of a reduction of the number of items in the scale. The complete list of scale reliability indices along with item-level analysis of the WLS model can be found in Table 5.4. For comparison, the data for the WLSMV solution are included in Table S5 in Appendix D.

5.3.3. Convergent and divergent validity

For the purpose of testing the convergent and divergent validity of the APES-PD, we made use of several variables collected on the sample. These were the two subscales of the IDEA questionnaire, namely Dream significance and Dream positivity.

Furthermore, the participants completed a 4-item Precognitive Dream (PD) Belief

Table 5.4

Item-level analysis of WLS-based scales

Benefit	*M* = 3.44, SD = 1.35, *a* = .84, 95% CI [.80, .89]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
06	.82	.03	.75	4.40	2.11
10	.84	.02	.59	3.44	2.14
22	.83	.03	.69	3.40	2.05
37	.84	.03	.61	2.55	1.82
44	.81	.03	.81	3.29	1.83
45	.80	.03	.82	3.43	1.92
52	.84	.03	.61	3.71	1.90
61	.83	.03	.66	4.00	1.84
Importance	*M* = 4.73, SD = 1.19, *a* = .83, 95% CI [.79, .88]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
03	.81	.03	.64	2.8	1.82
11	.82	.02	.57	3.66	1.90
17	.82	.02	.58	2.73	1.63
21	.81	.03	.64	3.06	1.65
33	.82	.02	.60	2.88	1.75
42	.80	.03	.72	3.37	2.04
46	.81	.03	.70	2.67	1.76
59	.81	.03	.66	3.59	1.82
62	.80	.03	.74	4.05	2.01
Negative emotion	*M* = 3.19, SD = 1.08, *a* = .65, 95% CI [.58, .73]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
01	.62	.04	.56	3.67	1.92
02	.64	.04	.53	2.95	1.81
05	.61	.04	.59	3.46	1.74
36	.62	.04	.57	3.48	2.00
37	.65	.04	.49	2.55	1.82
41	.61	.04	.59	3.83	2.18
50	.58	.05	.67	2.37	1.71
Credit	*M* = 3.61, SD = 1.26, *a* = .74, 95% CI [.66, .82]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
05	.68	.05	.72	4.54	1.74
40	.70	.05	.68	3.75	1.92
48	.69	.05	.71	3.80	1.82
54	.72	.05	.65	2.30	1.75
56	.68	.05	.73	4.40	1.79
Privacy	*M* = 4.35, SD = 1.31, *a* = .75, 95% CI [.68, .82]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
02	.76	.04	.60	5.50	1.81
16	.67	.05	.78	3.67	2.09
24	.67	.05	.78	3.70	1.85
30	.71	.05	.70	3.39	1.73
47	.72	.05	.67	2.45	1.75

questionnaire and a single item measure of previous precognitive dream experience. Descriptive statistics for the variables are summarized in Table 5.5. Firstly, we expected a positive relationship between dream significance and the Importance scale, as well as between dream positivity and Benefit. Secondly, Importance was expected to relate to the strength of one's belief that one has previously experienced PD. Moreover, we predicted a negative relationship between dream positivity and the Negative emotion scale. Finally, the Importance and Credit scale were assumed to correlate significantly with PD belief.

We also identified relationships that should not be present amongst the variables. Dream positivity was expected to be independent of Importance, Credit, and Privacy and neither Privacy nor Negative emotion was assumed to relate to PD belief or PD experience.

Table 5.5

Descriptive statistics and gender comparisons

	M	*SD*	SE_{mean}	*Mdn*	Range	Skew	Kurtosis
Dream significance	5.00	1.06	0.06	5.15	2 – 7	−0.447	−0.398
Dream positivity	4.33	1.09	0.06	4.43	1 – 7	−0.290	−0.072
PD belief	5.25	1.28	0.07	5.50	1 – 7	−0.787	0.471
PD experience[a]				7	1 – 7		

	Gender					
	Male		Female		$t_{male-female}$ (df)	*p*
	M	*SD*	*M*	*SD*		
Dream significance	4.76	1.13	5.15	0.98	−3.13 (232.093)	.002
Dream positivity	4.49	1.06	4.23	1.10	2.01 (267.323)	.037
PD belief	5.26	1.37	5.24	1.23	0.17 (239.937)	.865
	Mdn		*Mdn*		$W_{male-female}$	*p*
PD experience[a]	7		7		12690.500	.886

Note. PD = precognitive dream. a = variable is ordinal, hence only the median and range are reported and the Wilcoxon signed-rank test used for group comparison.

Table 5.6 shows the correlations between the ten Berge factor scores on the individual APES dimensions and the above-mentioned variables. Because of the moderate correlations between some of the APES factors, we examined the individual contributions of each of the factors in predicting the four outcome variables. This was done by entering all factors simultaneously into four multiple linear and ordinal (for PD experience) regression models. Because of the significant gender differences in Dream significance and Dream positivity scores, we also included gender in the two models predicting these variables. The results of the regression analyses are summarised in Table 5.7. All the predicted relationships were found to be highly statistically significant ($p < .001$), but, contrary to expectations, several predictions of no relationship were not supported by the data. In line with the predictions, Benefit was only related to Dream positivity. Importance was positively related to Dream significance and both PD belief and experience, and unrelated to Dream positivity. There was a negative relationship between Negative emotion and Dream positivity and no relationship between the factor and PD experience. There was also an unpredicted significant negative relationship between Negative emotion and PD belief, however, the effect size was small ($\Delta R^2 = .023$, compared to .13 for Importance). As predicted, Credit was related to PD belief but not to Dream positivity. Finally, in accordance with the prediction Privacy was not related to either Dream positivity or PD experience. Unexpectedly, there was a small but significant negative relationship between Privacy and PD belief ($\Delta R^2 = .033$).

5.4. Discussion

This chapter reported on the construction and validation of the Precognitive dream version of the Attitudes towards Paranormal Experiences Scale (APES-PD). This

measure fills a gap that currently exists in research focusing on paranormal experience as it allows for assessment of attitudes towards precognitive dreams in people who report having had them. Exploring these attitudes has the potential of providing insight into the psychological mechanisms underpinning paranormal experiences. Furthermore, by addressing a specific type of paranormal experience, the scale avoids the pitfall of conflating several qualitatively distinct, albeit correlated, kinds of experience that may each have its own underlying psychological causation.

Originally, a 63-item questionnaire tapping into nine putative factors of attitudes towards precognitive dream experience was administered. After dropping items with unsatisfactory psychometric properties and conducting an EFA, five interpretable factors emerged from the reduced 31-item questionnaire. The model fit the data well (CFI = .952, TLI = .931, RMSEA = 0.06). Having inspected the primary loadings of the items, we labelled these factors Benefit, Importance, Negative emotion, Credit, and Privacy. Inter-factor correlations ranged from .001 to .645 which reflects the intended oblique nature of some of the dimensions.

Table 5.6

Correlations between APES dimensions and additional variables

	Dream significance	Dream Positivity	PD experience[a]	PD belief
Benefit	.425***	**.279***	.374***	.412***
Importance	**.436***	.191***	**.492***	**.604***
Neg. emotion	−.224**	**−.367***	−.270***	−.401***
Credit	.416***	.122	.351***	**.508***
Privacy	−.389***	−.032	−.179**	−.317***

Note. Boldface indicates predicted significant relationships. * $p < .05$, ** $p < .01$, ***, $p < .001$. p-values Bonferroni-corrected for multiple comparisons. a = polyserial correlations due to polytomous variable.

Table 5.7

Multiple regressions of additional values on APES factors

	b	SE	*p*	Beta	95% CI	
					Low	High
Dream significance						
Gender	−0.325	0.097	<.001	−0.150	−0.517	−0.133
Benefit	0.090	0.066	.171	0.086	−0.039	0.220
Importance*	0.258	0.065	<.001	0.245	0.130	0.386
Neg. emotion	−0.008	0.051	.877	−0.008	−0.108	0.093
Credit	0.218	0.055	<.001	0.206	0.109	0.326
Privacy	−0.277	0.051	<.001	−0.263	−0.378	−0.176
Dream positivity						
Gender	0.263	0.113	.021	0.117	0.040	0.485
Benefit*	0.295	0.077	<.001	0.270	0.144	0.446
Importance†	−0.070	0.075	.352	−0.064	−0.219	0.078
Neg. emotion*	−0.368	0.059	<.001	−0.338	−0.485	−0.252
Credit†	−0.035	0.064	.584	−0.032	−0.161	0.091
Privacy†	0.101	0.059	.091	0.093	−0.016	0.218
PD belief						
Benefit	−0.158	0.070	.024	−0.124	−0.296	−0.021
Importance*	0.638	0.069	<.001	0.497	0.502	0.774
Neg. emotion†	−0.210	0.054	<.001	−0.163	−0.317	−0.103
Credit*	0.319	0.058	<.001	0.249	0.205	0.434
Privacy†	−0.251	0.055	<.001	−0.196	−0.359	−0.144
PD experience				Odds ratio		
Benefit	0.030	0.176	.866	1.030	0.727	1.453
Importance*	1.041	0.184	<.001	2.832	1.994	4.105
Neg. emotion†	−0.182	0.135	.178	0.834	0.640	1.087
Credit	0.116	0.139	.402	1.123	0.856	1.476
Privacy†	−0.259	0.139	.063	0.772	0.585	1.012

Note. PD = precognitive dream. Ordinal regression parameters reported for PD experience. * = significant relationship predicted. † = absence of significant relationship predicted.

The five scales, created by scoring of salient items, had reliabilities ranging from acceptable (α = .65 for the Negative emotion scale) to very good (α = .84 for the

Benefit scale). However, in order to best preserve the factor structure, we used ten Berge factor scores for further analysis. We would encourage potential users of the APES-PD questionnaire to do likewise (the factor weights can be found in Table S6 (Appendix D).

The questionnaire showed good convergent and discriminant validity. According to expectations, Importance scores were positively related to Dream significance but not to Dream positivity, as measured by IDEA, after controlling for the other APES factors. These results show that the factor does indeed measure how much importance experiencers of precognitive dreams attribute to their experiences, regardless of whether or not they find them pleasant. The reverse was true for the Negative emotion factor, which showed a negative correlation with Dream positivity but was not related to Dream significance. Although the latter result was not explicitly predicted, it serves to further support the validity of the factor. The Benefit factor also showed relationships that confirmed our predictions, correlating positively with Dream positivity. Since all the other factors were controlled for, this relationship represents an individual contribution of perceived benefit derived from subjective precognitive dreams to the general positive emotion towards dreams in general, independent of that of the Negative emotion factor. Scores on the Credit factor were, in line with the prediction, positively related to belief in the existence of precognitive dreams but independent of Dream positivity. Finally, we predicted that the Privacy factor would be orthogonal to Dream positivity as well as both belief in the possibility and the strength of conviction regarding the experience of precognitive dreams. Two of these predictions were supported by the data, however, we found Privacy to be weakly but significantly negatively related to belief in precognitive dreams, even after controlling for the other APES factors. It is currently not clear whether the result constitutes evidence against the divergent validity of the factor, or

whether it points to the existence of a genuine relationship between the strength of belief in precognitive dreams and the extent to which the experiencer is vocal about his or her dreams, or still whether it is a spurious finding. In the same vein, we are unable to provide a conclusive interpretation of the negative relationship between PD belief and the Negative emotion factor.

Apart from the findings discussed above, the analysis also revealed some relationships we had not predicted (see Table 5.7). Since we made no prediction regarding these relationships, we can only offer post-hoc interpretations. Regarding the positive relationship between Dream significance and Credit, a plausible explanation seems to be that if a person feels deserving of credit for their ability to have precognitive dreams, they will have a vested interest in them. This will naturally lead to them ascribing greater significance to their dreams. Similarly, with respect to the negative relationship between Dream significance and Privacy, we would suggest that if someone perceives dreams as significant, they may be likely to talk about them with others. This tendency might apply to precognitive dreams as well as mundane ones. As for the negative relationship between Benefit and PD belief, we can provide no explanation whatsoever. It is not clear why greater perceived benefit derived from one's precognitive dreams should be associated with lower belief in the existence of such dreams. Given the small effect size of this relationship as well as the fact that its direction is opposite that of the zero-order correlation between these two variables (see Table 6), we are inclined to consider it a statistical artefact. It is however crucial to stress that all these interpretations have been made *post hoc* and that these relationships need to be replicated before they should be given too much weight. However, we would like to offer the above-mentioned results as proof of concept of the heuristic potential of APES.

Some discussion of strengths and limitations of the present study is in order. Firstly, we believe that the APES questionnaire has a potential to further the knowledge in the field of psychology of paranormal belief and experience. It shows good psychometric qualities and has been developed on a sufficiently large sample. It also reveals a substantial variability of attitudes towards these experiences in people who report them which has been overlooked by previous research. Future research should focus on the relationship between the APES factors and well-established personality dimensions, such as the ones within the Five Factor Model of personality. Particularly, the relationships between Negative emotion and Benefit on one hand (APES) and Neuroticism (FFM) on the other and between Privacy (APES) and Extroversion (FFM) seem like a natural starting point. Other APES factors, such as Credit, appear, at face value, less directly related to basic personality traits. Exploring the link between this factor and measures of narcissism may be worthwhile but we would certainly encourage all effort to relate the APES factors to the FFM as well as other trait, such as general cognitive ability.

Another interesting line of inquiry would be to examine the relationship between the APES dimensions and the frequency of paranormal experience. There have been several psychological mechanisms put forwards as explanation for this kind of experience (Alcock, 1981; Blagrove *et al.*, 2006; Houran & Lange, 1998; Watt *et al.*, 2014) but the causal factors are likely to vary based on the frequency with which a person experiences these phenomena. For instance, it may be the case that most people will have an experience that resembles a previous dream with startling accuracy just by coincidence. After all, there are countless events happening and dreams being had and some of them are bound to coincide. Assuming an independent 1 in 10,000 chance of a coincidence between a dream and a subsequent even, Paulos (1988) estimated that 3.6%

of all people who dream every night should experience such a coincidence within a one-year period. A person's belief in precognitive dreams and the underlying psychological mechanics of this belief based on such an impressive yet perhaps unique experience are however very different from those of another person who experiences precognitive dreams on a weekly basis. Understanding the differences in attitudes towards such experiences between people can elucidate potential motivational factors underpinning frequent paranormal experience.

A further advantage of the APES questionnaire is both its specificity and flexibility. By focusing on a specific kind of phenomenon, APES avoids the potential pitfall of conflating qualitatively different experiences that can be caused by different psychological factors. On the other hand, the questionnaire can potentially be co-opted, with minor modifications in the wording of the items, to address other kinds of paranormal experiences. This makes it possible to compare the various forms of experiences and identify associated psychological factors that are common to a number of them as well as specific to each.

One potential limitation of the present study is, as is the case with most studies, the sample. Although sufficiently large for the purpose of factor analysis, it needs to be pointed out that the sample was not recruited randomly. However, we took precautions to minimise self-selection by not stating explicitly that the study explores precognitive dream experiences when advertising; potential volunteers were only told the study focuses on "dreams (and more)". There was also a preponderance of females in the sample (61.5%) which may reflect the differences in interest in dreams between the genders (*e.g.*, Schredl & Piel, 2008; Wolcott & Strapp, 2002). Nevertheless, we would argue that a sample of more than three hundred participants, the use of robust analytical methods (WLMSV), and the good model fit obtained make the resulting factor structure

likely to be stable. Future studies should aim to replicate the present findings using independent samples.

Another limitation concerns the range restriction of the precognitive dream experience variable. There was very little variability in the scores, with the majority of participants expressing the highest possible degree of endorsement of the item. Although this state follows naturally from the characteristics of the sample, it is likely to distort the results of analyses involving the variable in question. The findings related to PD experience should therefore be treated with caution.

In conclusion, this chapter presents a new measure of attitudes towards precognitive dreams that has been missing from the arsenal of methods commonly employed in research in the area. The APES questionnaire has a well-interpretable factor structure and shows satisfactory validity and reliability. These characteristics, along with the potential modifiability of this questionnaire, give us a reason to believe that its future use will prove fruitful in gaining novel insights into the psychology of precognitive dream belief and experience. In the next chapter, we illustrate the utility of the APES-PD by applying it to the issue of attitudes and motivation and their role with respect to memories related to precognitive dreams.

Chapter VI

Precognitive dreams and memory

6.1. Study 6 Introduction

In the previous chapter, we argued that some PD believers may overestimate the frequency of their experiences. We proposed that, in line with the findings of Beaulieu-Prévost and Zadra (2005), this overestimation may be a result of personal significance attributed to precognitive dreams. Considering this line of argument leads to the question of what the mechanism behind this over-reporting of PD frequency is. Two alternatives are on offer: wilful deception and motivational bias. Regarding the former, it is certainly possible that people who ascribe great importance to the notion of themselves being precognitive dreamers should intentionally misreport the frequency with which they experience PDs. However, even if true in some cases, this explanation bears little appeal for further discussion. Firstly, embracing it naturally leads to the rather dismissive position that everyone who claims to experience, or have experienced precognitive dreams and, by extension, other paranormal and religious occurrences, is simply lying. Since there is a vast body of evidence showing that a mismatch between reality and people's perception of and beliefs about it often arises and that people can sincerely believe they experienced things that did not, in reality, happen (e.g Loftus, 2003a; 2003b; 2005), assuming that all reports of precognitive dreams are fraudulent is not only unhelpful but, most likely, also incorrect. Secondly, there simply is no way of testing this unfalsifiable hypothesis and, as such, it is not scientific. For these reasons, it will not be further discussed in this chapter.

If wilful deception is discarded as an explanation of the tendency of PD believers to overestimate the frequency of their experiences, the topic of motivational bias in recall moves into the spotlight. In order to further develop this argument, it is desirable to first discuss the state of relevant knowledge in the field of human episodic memory.

Over the past eighty years, there has accumulated a vast body of scientific literature which is in accordance with the notion that episodic memories are not static recordings of past events but rather reconstructed narratives based around schematic knowledge-like structures. Bartlett (1932) in his seminal work on memory accuracy found that people's memories are likely to be reconfigured in a way that tends towards brevity, preservation of gist, and personal belief. Memory thus constitutes only a 'skeleton' to which elaborate details dependent upon personal belief, context (Sharps *et al.*, 2006) and social interaction (McGregor & Holmes, 1999) can be attached.

The malleability and potential unreliability of memory is perhaps best illustrated by research in eyewitness testimony employing the misinformation paradigm (Loftus, Miller, & Burns, 1978). This paradigm consists of three basic steps: presentation of a scene to participants; misinformation which can be achieved, *e.g.* by using leading questions or story transcript; and recollection, where participants report what they remember of the original scene. Loftus and her colleagues have, over the past forty years, found that it is relatively easy to use leading questions or misinformation to plant false memories into the minds of witnesses, so that they misremember important details, such as the colour of cars involved in an accident (Loftus, 1977). This paradigm succeeded in making people remember screwdrivers instead of hammers, give way signs instead of stop signs or a bar where there was none (Loftus, 2005). She and her associates even went as far as planting memories of getting lost in a supermarket as a child (Loftus & Pickrell, 1995), witnessing exorcism (Mazzoni, Loftus, & Kirsch, 2001),

or experiencing impossible scenarios, such as meeting Bugs Bunny, a Warner Bros. character, in Disneyland (Braun, Ellis, & Loftus, 2002). These studies provide overwhelming evidence of the capability of this paradigm to induce memories of things that never happened (for review, see Loftus, 2005).

Studies into characteristics of false memories have also yielded some interesting findings. Laney and Loftus (2008) concluded that true and false memories are virtually indistinguishable in most assessed emotional characteristics. Furthermore, even though false memories are usually held with somewhat lower confidence and coherence and are less vivid than true memories (Loftus & Pickrell, 1995; Loftus, 2003; Laney & Loftus, 2008), the reported levels of vividness and confidence can still be substantially high (Koriat, Goldsmith, & Pansky, 2000). The relationship between accuracy of a memory and its vividness is also rather interesting. It has been found that even in the so-called 'flashbulb memories', *i.e.* extremely vivid memories of highly significant events, the relationship between vividness and confidence on the one hand and accuracy on the other (Koriat *et al.*, 2000; Talarico & Rubin, 2003; Phelps & Sharot, 2008) is far from straightforward.

There is a modest amount of research into individual differences in susceptibility to this kind of memory implantation. It has been shown that those participants with lower cognitive abilities are more prone to being susceptible to misinformation (Zhu *et al.*, 2010a). Furthermore, it has been found that some personality characteristics, such as certain coping strategies, self-directedness, depression, or fear of evaluation are also related to proneness to false memories (Zhu *et al.*, 2010b).

During the course of false memory research, other successful paradigms have been developed. In the "crashing memory paradigm" the participants are asked whether or not they recall seeing a non-existent record of a well-publicised event (plane crashes,

assassinations, bombings, etc.; Smeets, Telgen, Ost, Jelicic, & Merckelbach, 2009). In the Deese-Roediger-McDermott (DRM) paradigm, participants are presented lists of words such as 'crown', 'George', 'throne', 'palace', and so on and then asked to recall as many as they can. During this recall task they tend to remember the critical semantically associated lure 'king', although it was not presented in the original study list (Roediger & McDermott, 1995). Both of these approaches display robust effects eliciting high levels of false recall. Gallo (2010) provides a summary of the findings over the past 15 years of the DRM paradigm while Koriat and colleagues (2000) and Smeets, Merckelbach, Horselenberg, and Jelicic (2005) review the concepts, methods and models developed in the study of recollection inaccuracies as well as the findings in false memory research.

There also exists a substantial tradition of research into autobiographical memory dedicated to uncovering the mechanisms by which memories are constructed and factors that affect this construction. For instance, Conway and Pleydell-Pearce (2000) focused on the interaction between autobiographical memories and the self. According to their model, individual memories are constructed and accessed in a way that serves to maintain a coherent self, a system of goals, beliefs, and motivations. Others, such as Sanitioso and colleagues (1990) have conducted research into motivational influences on memory recollection and found, in accordance with Conway and colleagues' broader notion of memory as a self-supporting constructive system, that the tendency to remember specific episodes from one's life can be influenced by manipulating people's goals and motives. Study 6 looks at the relationship between relevance of precognitive dreams to one's self-concept and the features of the earliest PD experience. The rationale for this study stems from, and builds upon, research by Conway and his colleagues (Conway, 2005; Conway & Holmes, 2004; Conway & Pleydell-Pearce, 2000) discussed to a greater extent below. In order to formulate hypotheses concerning the

relationship between importance of PDs and their reported frequency, some discussion of the literature on self-concept and autobiographical memory, as well as their mutual relationship is desirable. In the framework of social cognition, self-concept is a broad term encompassing several components whose treatment lies outside the scope of this chapter or, indeed, thesis. However, the definition relevant to the topic at hand is that of self-concept as a dynamic system of descriptive and evaluative beliefs about the self that informs and regulates behaviour, providing incentives and motivation (Markus & Wurf, 1987). The relevance of the particular beliefs to the stability and integrity of the self-concept varies: some of them, the core beliefs, are highly self-relevant and thus tend to be highly accessible, salient and stable, whereas others, the peripheral beliefs, are less crucial for maintaining of a coherent self-concept and can therefore be more fluent (Markus & Wurf, 1987). It would then follow that the more self-relevant a belief is, the stronger its effect in behaviour regulation and motivation is. Given the above-mentioned constructive character of memories as well as evidence that memory can be influenced by motivation (Sanitioso *et al.*, 1990), it is plausible that those whose belief in their ability to have precognitive dreams is self-relevant, tend to construct their memory of past PD experiences in a manner consistent with this belief. This line of argument is consistent with the findings reported in the previous chapter.

Furthermore, there is ample evidence of an interactive relationship between the self and autobiographical memory, so much so that authors such as Conway and Pleydell-Pearce (2000) refer to a fully-integrated Self-Memory System (SMS). The SMS consists of the working self, a currently active set of goals and self-relevant beliefs, and the autobiographical memory knowledge base, a set of statements about one's autobiographical history held to be true. These two parts of the system interact in order to produce the recall of autobiographical memories. The function of this interaction is

twofold (Conway, 2005): to maintain self-coherence on the one hand and verisimilitude on the other. Conway argues that autobiographical memories of the distant past tend to prioritise self-coherence over correspondence with reality. If a memory is not coherent with self, its recall is inhibited, whereas the accessibility of a self-coherent memory will be strengthened. Exploring memories of early PD experience thus may provide interesting insights into the psychological mechanics of these experiences.

Conway and Holmes (2004) expanded on the work of Erikson and Erikson (1998) on psychosocial development and showed that, in accordance with Erikson's theory, themes pertaining to the developmental task relevant for a given stage are most likely to figure in autobiographical memories from times when a person was going through said developmental stage. In other words, when people recall autobiographical memories featuring themes of, for example, identity, they tend to date these memories to when they were adolescents, which is a period in an individual's psychosocial development when, according to Erikson, forming a stable identity is the main developmental task one is faced with. Thus, if being a precognitive dreamer is a highly self-relevant belief which forms a part of the dreamer's identity, it could be argued that earliest memories of PD experiences should date to the period of one's identity formation, i.e., adolescence.

Besides the age associated with the memory of the earliest PD experience, it may be interesting to look at the vividness of these memories. Although, as reviewed above, memory vividness has generally been shown to correlate positively with certainty that the event really took place, which has in turn been shown to predict memory accuracy (Loftus & Pickrell, 1995; Loftus, 2003; Laney & Loftus, 2008), other research has demonstrated that even false memories can be recalled with high levels of vividness (Koriat *et al.*, 2000). Moreover, rehearsing stories can lead to imagination inflation (see

Sharman & Calacouris, 2010), where imagining a situation leads to it being believed to have happened. The tendency to this kind of imagination inflation has been linked with traits such as suggestibility and hypnotic suggestibility (Heaps & Nash, 1999; Paddock *et al.*, 1998). These characteristics have also been found to relate to paranormal belief and experience (Hergovich, 2003; Wagner & Ratzeburg, 1987). French (2003) provides a review of research into false memories and its relevance for anomalistic psychology. Since, as mentioned above, memories coherent with highly self-relevant beliefs are rendered more accessible by the workings of the Self-Memory System, if belief in the reality of one's PD experience is highly self-relevant, the identity-defining earliest memories are likely to be rehearsed in both intrapersonal and interpersonal contexts. This rehearsal would then lead to inflated levels of vividness of such memories. Beaulieu-Prévost and Zadra (2005) have shown that a higher tendency to attribute significance to one's dreams in general leads to an inflated estimate of dream recall frequency. Following that argument, it is plausible that the more self-relevant PD experiences are, the higher the perceived frequency of PDs will be. This leads to two predictions: people who report a higher frequency of PD experiences will also have a more vivid recollection of their early PD experiences and that the reason for this is the self-relevance of PD belief, which leads to an inflated assessment of both PD frequency and early PD experience vividness.

In summary, the present study tests three hypotheses: that the earliest memories of people's PD experiences date to the times of their adolescence (roughly the middle of the second decade), that people who report having PDs more frequently will remember their earliest PD experience as more vivid, and that this relationship will be accounted for by the importance one ascribes to one's PD experiences.

6.2. Method

6.2.1. Participants

The sample described in Chapter V was used in the present study. This was a PD dreamer-only subset of a larger sample (N=693, see section 5.2.1 for details). Out of the 330 participants, there were 124 (37.58%) males and 203 (61.52%) females. Three participants (0.91%) did not identify as either male or female and their data were not used. Data from 36 further participants were excluded due to missing values on the earliest PD experience variables. Mean age of the resulting sample (N=291) was 35.55 years (Mdn = 32, range = 18-69, SD = 13.10). There was no age difference between males and females in the sample (M_{male} = 36.59, SD = 14.55, M_{female} = 34.95, SD = 12.19, t(189.005) = −0.985, 95% CI [−4.950, 1.653], p = .326). Participants who recalled their earliest PD experience differed from those who did not (36 excluded participants) on only one of the measured variables; they scored slightly higher on PD experience (Mdn = 7 vs 6, W = 6268, p = .01).

6.2.2. Materials

The wording of the items used can be found in Appendix B. First, a demographic questionnaire was administered, followed by a measure of attitudes towards dreams as well as of PD belief and experiences. The details of the individual measures are given in Chapter 4.2.2. Participants who reported having had a PD experience then went on to complete two further measures.

6.2.2.1. Earliest precognitive dream experiences

Two items addressed the earliest remembered precognitive dream. The first one asked about the age at which the dream occurred and the second one asked participants

to rate the vividness of this dream on a 7-point Likert scale from 1 (*Not at all vivid*) to 7 (*As vivid as real life*).

In order to provide the age of the earliest PD experience a free-answer field was provided for participants. This led to a variation in the kinds of answers provided which necessitated a degree of post-collection editing. We applied the following rules: responses indicating the participant did not remember as well as any other statements (*e.g.*, "like anyone is going to remember this") were designated as missing values. 'Early teens' was substituted by the value of 14, 'mid teens' by 16, and 'late teens' by 18. If two adjacent ages were given, *e.g.* 15-16, the response was replaced with a value equal to the higher of the two numbers. If a wider range was given, *e.g.* 15-17, the integer in the middle of the range was inputted (16, in case of the given example).

6.2.2.2. Attitude towards paranormal experience scale - Precognitive dreams

The APES-PD measure whose development and validation are reported in Study 5 was used. This is a 31-item scale addressing 5 aspects of attitudes towards one's precognitive dreams: Benefit (α = .84), Importance (α = .82), Negative emotion (α = .65), Credit (α = .68), and Privacy (α = .76). Individual scores on these dimensions were standardised ten Berge scores based on WLSMV-derived factor structure. For more detail on the scale's content and factor analysis, see Chapter V.

6.2.3. Procedure

The procedure is described in Chapter IV (see section 4.1.3).

6.2.4. Hypotheses

H1. The distribution of the age of the earliest PD has a mean of 15 with the bulk of the distribution falling within the 10-20 range.

H2. Vividness of the first PD dream is positively related to reported PD frequency.

H3. The relationship predicted by H2 is fully accounted for by the Importance factor of APES-PD.

6.3. Results

6.3.1. Descriptive analysis

Table 6.1 shows the descriptive statistics for the measured variables as well as the *p*-values of differences in the variables between genders. Descriptive statistics for APES factor scores are not included as these are standardised scores and there were no gender differences in the scores. As shown in the table, the only variables exhibiting gender differences were Dream significance with females scoring higher than males (M_{diff} = 0.39, 95% CI [0.13, 0.65], $t(197.98) = 2.93$, $p = .004$) and Dream positivity with males scoring higher than females (M_{diff} = 0.29, 95% CI [0.03, 0.55], $t(223.29) = 2.19$, p = .030).

6.3.2. Hypothesis testing

The distribution of the Age of 1st PD experience variable is depicted in Fig. 6.1 (panel A). In order to make sure that the mean value of the variable is not artificially lowered by younger participants due to range restriction of possible values, we divided the sample into two subsamples with respect to an age cut-off point of 35 years. The means of the Age of 1st PD experience variable of the resulting groups were significantly different with the older group having a higher mean, M_{diff} = 5.24, 95% CI [2.98, 7.51], $t(173.41) = 4.55$, $p = 10^{-5}$. However, as can be seen on panels B and C of Fig. 6.1, there was a substantial overlap between the bulks of the distributions.

Furthermore, 20% trimmed means of the groups were 16.30 and 12.95 for the older and younger group respectively, compared to untrimmed means of 18.66 and 13.42. The relatively large difference between untrimmed and trimmed means of the older group suggests a greater influence of positive skew on the mean, compared to the other group.

Table 6.1

Summary of descriptive statistics of the variables measured in Study 6

Variable	*M* (*SD*)	Range	*p* gender diff
Education	15.77 (3.60)	8 – 25	.474
Dream significance	5.01 (1.06)	2 – 7	.004
Dream positivity	4.34 (1.10)	1 – 7	.030
PD belief	5.34 (1.28)	1 – 7	.936
Age of 1st PD	15.71 (9.37)	2 – 56	.714
	Mdn (*MAD*)		
PD experience	7 (0)	1 – 7	.833
PD frequency	2 (1.48)	1 – 5	.063
Vividness of 1st PD	4 (1.48)	1 – 5	.544

The mean age of 1st PD across all participants was not significantly different from 15, 95% CI of mean [14.63, 16.79], $t(290) = 1.29$, $p = .199$, thus supporting H1 about the distribution of the Age of 1st PD experience variable.

In order to test H2 and H3, several ordinal regression models were specified. Firstly, vividness of the 1st PD was regressed on PD frequency which was treated as a continuous variable. Secondly, Importance was added as a predictor to the first model. Model 3 extended the first model by including demographic variables as well as Dream significance. This was done in order to control for potential confounds. Similarly to Model 2, the final model included Importance in addition to the variables in the previous model. The significance of the effect of PD frequency on the vividness of 1st PD in models 1 and 3 was used to test H2.

H3 predicts a lack of this effect coupled with a significant effect of Importance. This was tested by models 2 and 4.

Table 6.2 provides a summary of the four models. The analysis showed that PD frequency was a significant predictor of vividness of 1st PD experience regardless of whether or not demographic variables and Dream significance were controlled for, thus supporting H2.

However, when Importance was added as a predictor to the models, the effect of PD frequency became non-significant, while Importance itself predicted vividness of 1st PD significantly. As before, this held true both with and without the additional variables included in the models. These findings were supportive of H3.

6.3.3. Exploratory analysis

Figure 6.1 shows that a substantial proportion of participants reported having had their first PD experiences rather early in their lives. Twenty-four percent reported having been younger than 10 and 8% reported being five years old or younger at the time of their experience. The peak was more prominent in participants aged 35 and older (see Fig. 6.1, panels B and C). We decided to explore this unexpectedly high frequency of childhood memory of PDs further.

First we looked at the relationship between vividness and age of 1st PD, expecting to find a positive relationship, as events that happened more recently should elicit more vivid recollection. However, there was a small negative correlation between the variables, $r_s = -.12$, $p = .046$. In order to ascertain the vividness of PDs experienced in childhood, we divided the age of 1st PD experience into 4 categories (<10, 10-20, 20-30, >30) and used the resulting categorical variable to predict vividness of 1st PD experience in an ordinal regression model, controlling for gender and age. As can be seen in Table

6.3, participants who reported having had their first PD experience between ages 10 and 20 were 46% more likely to report a lower vividness of this experience. Those who had their first PDs later in life showed the same trend, however, these trends were not statistically significant.

Next we explored the differences in PD frequency according to the categories pertaining to age of 1st PD. Another ordinal regression model was specified, predicting the frequency of PD by the 1st PD age category, again controlling for gender and age. The results are summarised in Table 6.4. As the table shows, participants who reported having had their earliest PD experience aged 10-20 were 57% more likely to report a lower PD frequency. Those whose first remembered PD occurred at age between 20 and 30 were 51% more likely and those who reported having their first PD after the age of 30 were 87% more likely to report a lower PD frequency than those who had their first PD experience before the age of 10.

Finally we investigated the relationship between the categorised age of 1st PD experience and importance of such experiences. An ordinal regression of the age category on Importance revealed no significant relationship between the two, OR = 0.83, 95% CI [0.66, 1.03], $p = .093$.

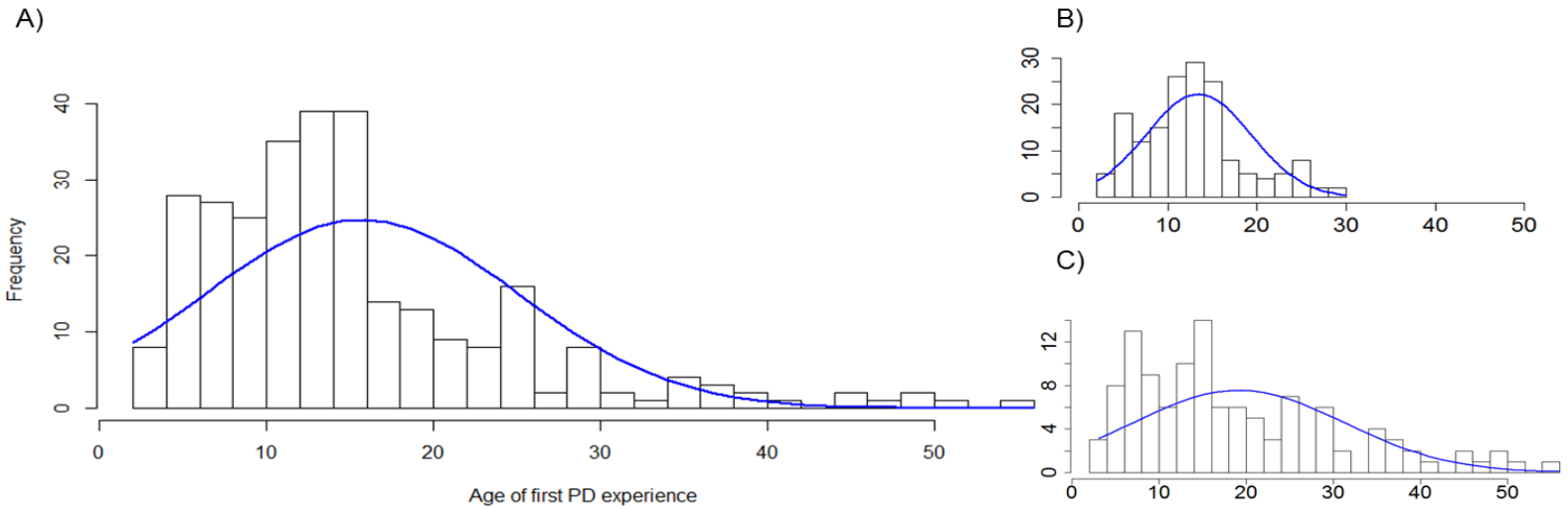

Figure 6.1. Distribution of age of first PD experience for A) all participants; B) those younger than 35; C) those aged 35 and older.

Table 6.2

Summary of the four ordinal regression models predicting vividness of 1st PD used to test H2 and H3

Predictor	Model 1		Model 2		Model 3		Model 4	
	OR [95% CI]	*p*	*OR* [95% CI]	*P*	*OR* [95% CI]	*p*	*OR* [95% CI]	*p*
PD frequency	1.37 [1.18, 1.60]	4×10^{-5}	1.10 [0.93, 1.29]	.272	1.31 [1.11, 1.55]	.002	1.07 [0.90, 1.29]	.406
Importance			2.21 [1.76, 2.79]	2×10^{-11}			2.32 [1.76, 3.07]	3×10^{-9}
Gender					0.72 [0.47, 1.09]	.124	0.73 [0.47, 1.12]	.145
Age					1.02 [1.01, 1.04]	.004	1.00 [0.98, 1.02]	.842
Education					0.95 [0.90, 1.00]	.059	0.95 [0.90, 1.00]	.059
Dream significance					1.12 [0.92, 1.37]	.267	0.91 [0.73, 1.13]	.388

Table 6.3

Summary of ordinal regression of Vividness on the listed variables

	b	*SE*	*p*	OR [95% CI]
Gender	−0.198	0.22	.378	0.82 [0.53, 1.27]
Age	0.016	0.01	.067	1.02 [1.00, 1.03]
Age of 1st PD category				
10-20	−0.621	0.25	.013	0.54 [0.33, 0.87]
20-30	−0.514	0.35	.139	0.60 [0.30, 1.18]
>30	−0.582	0.44	.185	0.56 [0.24, 1.33]

Note. Parameters of Age of 1st PD categories refer to change with respect to the first category (<10).

Table 6.4

Summary of ordinal regression of PD frequency on the listed variables

	b	*SE*	*p*	OR [95% CI]
Gender	0.447	0.23	.048	1.56 [1.00, 2.44]
Age	−0.005	0.01	.575	0.98 [0.98, 1.01]
Age of 1st PD category				
10-20	−0.838	0.25	7×10^{-4}	0.43 [0.26, 0.70]
20-30	−0.721	0.33	.028	0.49 [0.25, 0.92]
>30	−2.063	0.58	3×10^{-4}	0.13 [0.04, 0.37]

Note. Parameters of Age of 1st PD categories refer to change with respect to the first category (<10).

6.4. Discussion

The present study focused on the exploration of memories of earliest PD experiences. We formulated three hypotheses. Firstly, based on the work of Erikson (Erikson & Erikson, 1998) and Conway and colleagues (Conway & Pleydell-Pearce, 2000; Conway & Holmes, 2004; Conway, 2005), we argued that if the belief that an experience of PDs is relevant to one's self-concept, the distribution of age of the earliest such experience should be similar to the one consistently associated to identity-relevant memories (Conway & Holmes, 2004). This hypothesis was supported by the data.

Dividing the sample into younger and older participants and comparing the two distributions of the variable revealed that older participants tended to report having their first PD experience later in life than younger participants. However, a visual inspection of the plotted distribution, as well as comparison of trimmed and untrimmed means of the groups suggested that this difference is inflated by a small number of extreme cases where participants reported having the earliest PD experience around the age of 50.

Secondly, we hypothesised that there would be a positive relationship between vividness of the earliest PD and the frequency with which one reports to experience these dreams. This hypothesis was also supported even when controlling for additional variables such as demographic characteristics and significance one ascribes to dreams in general.

Finally, we hypothesised that the vividness one associates with one's earliest PD experience is a function of how important these experiences are to one's self-concept and that it is this importance that accounts for the relationship between PD frequency and vividness of 1st PD.

This prediction also found support in the data. These results provide evidence that self-relevance of precognitive dream experiences motivates both reported PD frequency and construction of PD-related autobiographical memories. This claim is consistent with the theoretical framework of autobiographical memories as products of the Self-Memory System (Conway & Pleydell-Pearce, 2000) as well as the empirical findings that significance ascribed to dreams inflates reported dream recall (Beaulieu-Prévost & Zadra, 2005) and that the recall of autobiographical memories can be influenced by manipulating people's motivation to view themselves as possessing certain qualities (Sanitioso *et al.*, 1990; Sanitioso & Niedenthal, 2006).

Furthermore, given the rather large number of participants reporting their first PD experiences at a very early age (24% reported having been younger than 10 and 8% reported being only five years old or younger when they had their first PD), we decided to explore the relationship between the age of the earliest PD and its vividness, as well as reported PD frequency. We expected a positive relationship between age and vividness of 1st PD since memories of more recent events should be more vivid. However, we found that, contrary to this expectation first PD experiences reported from childhood were rated as more vivid than those from other periods of life; however this relationship was only significant for the 10-20 year old category. In addition, we found that a categorised age of 1st PD was a significant predictor of PD frequency, with participants who remembered having had their first PD experience before the age of 10 reporting a higher PD frequency than the other categories. Taken together, these findings suggest that memories going back to childhood may be more likely to be influenced by motivational biases and perhaps even be confabulated. Due to the exploratory nature of these analyses, this evidence is, however, rather circumstantial and tentative and should be regarded as such. On the other hand, the assumption that the childhood memories are likely to be confabulated raises an issue: If it is true that these memories are constructed by the SMS as self-coherence maintaining evidence of one's identity as a precognitive dreamer, why would people date these confabulations to a period prior to the one where identity is the most salient topic? This would seem at odds with the work of Conway and Holmes (2004). Granting validity to the findings of these authors, we suggest three ways of reconciling our results with theirs: firstly, it is possible that one's identity as a precognitive dreamer develops as a consequence of a series of experiences construed as precognitive dreams, as opposed to the earliest one. This would make the first precognitive dream experience less self-relevant, which

would, in line with our hypothesis, allow for a wider interval in which to place the memory of such experience. This interval, however, should not stretch beyond the identity-formation period, which agrees with the general trend observed in the present study. If this is the case, asking participants to date their memory of their most impactful, rather than the earliest PD, might prove a better option. Alternatively, a future study could ask participants whether or not they consider themselves to be precognitive dreamers and if so, at what age they began identifying as such.

Secondly, some people may be inclined to date their earliest PD experience to a very young age, motivated by the notion that the further back in one's history such experiences reach, the stronger the claim of one's precognitive dreamer identity is.

Thirdly, it is also possible that these memories are not reconstructed in a biased way, nor confabulated. They might be true and accurately dated memories of subjectively extraordinary dream-related experiences that were construed as precognitive. Having had such experiences from an early age might, perhaps reinforced by adult authority figures sympathetic to the notion of the paranormal, make it more likely that a person would identify as a precognitive dreamer. This scenario may also explain the association between age and vividness of the earliest precognitive dream, the latter either being boosted by childish fantasy or rehearsal-induced imagination inflation. Both the second and the third explanations are, on the one hand, consistent with the relationship between age of 1st PD and general PD frequency but, on the other hand, they are not supported by the lack of a significant relationship between age of 1st PD and importance of PDs. More research into this topic is therefore required.

This study is, naturally, not free of its limitations. Since the study used a subsample of a larger dataset used in Chapters IV and V, points regarding the recruitment method used as well as the overrepresentation of females in the sample raised in these chapters

also apply for the present study. Two further issues need to be addressed. Firstly, as mentioned above, the use of memories of the earliest PD experiences may have, for the reasons stated earlier in the section, confounded the relationship we aimed to explore. It may be the case that the potential effects of motivational mechanisms brought about by the self-relevance of belief in one's tendency to have precognitive dreams are more visible in memories of the most impactful or salient PD experience. Using items assessing these experiences in future studies might thus be worthwhile. Alternatively, or in addition to such items, asking participants whether they identify as precognitive dreamers, and if so, when they began doing so, could be equally useful. We hypothesised that PD experiences are either a result of misattribution of paranormal quality to subjectively unlikely or otherwise extraordinary parallels between one's dreams and life events or a result of biased recall of one's dreams after a significant event has taken place, in both cases caused by motivational mechanisms. In line with this hypothesis, we would predict that the age of most impactful PD experience or of self-identification as a precognitive dreamer would fall within the period of adolescence, when identity is formed. Similarly, the vividness item in our study may have somewhat blurred the distinction between the vividness of the experience itself versus the vividness of the memory of this experience. There may be important differences in the representation of these two pieces of information: the former may be stored and recalled in terms of a knowledge-like proposition (*e.g.*, "I know my first PD experience was a very vivid one"), while the latter may be retrieved by recalling the experience and assessing the vividness of the recalled memory. It is not clear whether there would be any measurable differences between an item assessing the vividness of the experience and one inquiring into the vividness of the memory of such experience, nor is it clear which of the two proposed strategies participants in the present study employed when

retrieving the relevant information, however, we suggest that it would be prudent for future studies exploring this issue to include both items.

A second issue is that, just like with any study using a correlational design, interpreting the results in terms of causality is problematic. We discussed our findings through the prism of the mechanism we proposed in the introduction. Alternative interpretations are, however, possible and there are no means of adjudicating between several competing explanations. In order to do so, an experimental approach needs to be employed.

Chapter VII
General discussion and conclusion

The aim of this dissertation was to examine the topic of belief in and experience of precognitive dreams and to provide novel insight into potential psychological mechanisms underlying these phenomena. Since a large proportion of the general population endorses the belief in all sorts of paranormal and supernatural phenomena, whose existence is implausible and the evidence for it highly debatable, and since these convictions can have significant real-life consequences, understanding the origins of these beliefs and experiences is important. We chose precognitive dreams from amongst the wide array of supposed paranormal phenomena because it is one of the most widely believed and experienced of such phenomena. Furthermore, as we argued, there is a good reason to believe that paranormal beliefs and experiences are not a homogeneous entity but that various kinds of belief and experience can have different underlying psychological mechanics. Similarly we proposed that belief and experience be treated in their own right since, although often strongly related, they describe two distinct constructs which, despite it often being the case, should not be confounded.

In the five empirical chapters, we presented studies investigating three possible explanations of precognitive dreams: that they are a genuine paranormal phenomenon; that dreams can and do contain information indicative of future events which one can be unaware of having obtained, even though this information has been gained through normal means; and that precognitive dream experiences are a result of various cognitive and motivational biases.

Prior to delving into various proposed psychological explanations of precognitive dream belief and experience, our first study, presented in Chapter II, addresses the topic of precognitive dreams from the point of view of testing the Psi hypothesis. We used this study to not only provide a dispassionate treatment of the valid, if largely unsupported, hypothesis that dreams actually contained information of unknown origin pertinent to future events, but also to give an example of standard research practices within the field of parapsychology and to discuss some of their potential theoretical and methodological pitfalls.

Study 1 yielded a significant result: the video clips designated as targets by the random number generator were ranked by the judges as the most similar, compared to the decoy videos, to participants' dream reports from the previous week more often than could be expected under the null hypothesis. However, since a significant result such as the one we found can be taken as supportive of the psi hypothesis only after accounting for any plausible normal explanations, we engaged in a thorough exploratory analysis of the findings. This analysis showed that one group of video clips was significantly more likely to receive a high similarity rating from the judges regardless of whether or not the given video was a target or a decoy, while the video clips in another group were relatively unlikely to be rated as similar to participants' dream reports. Furthermore, targets that scored a hit were on average no more similar to the dream reports than those that did not. These findings suggest there was no qualitative difference between hits and misses, which is difficult to reconcile with the psi hypothesis. Additionally, when we explored the content of the dream reports and the least scoring group of video clips, we found that while the former contained relatively few references to animal imagery, there was a preponderance of such imagery in the latter. This could explain the low hit rate scored for the particular group of videos.

While we acknowledged that the above-mentioned analyses were exploratory and their extent may seem unusual in a hypothesis-driven research, we argued that the negative definition of the subject of study as stated by the psi hypothesis makes this kind of post hoc exploration necessary. This being the case, we concluded that Study 1 did not show evidence of any anomalous cognition within participants' dreams. It did, however, illustrate the potential theoretical and methodological issues with the psi hypothesis and the way it is habitually assessed. We recommend that future research in this area employ multiple levels of randomisation and a control condition rather than theoretical control in the form of the mean chance expectation.

In Chapter III, we investigate the hypothesis that precognitive dreams arise as a product of unconscious inferences about salient information processed outside of awareness. In two studies, we tested some of the predictions of this hypothesis, which we dubbed the implicit processing hypothesis of precognitive dreams (IPH). Although the idea behind the IPH was first formulated by Aristotle, these studies constitute, to the best of our knowledge, the first and thus far the only empirical test of the hypothesis in the published literature. The first of these studies, Study 2, tested the prediction that, if precognitive dreams arise by the above-mentioned process, people who experience them relatively frequently should exhibit superior implicit perception compared to people who either don't have precognitive dreams at all or experience them only rarely. This would mean that salient subtle cues from the environment, that carry information about events that are likely to occur in the future, have a higher likelihood of being picked up on by good "implicit perceivers" and subsequently making their way into their dream imagery. However, we did not find a significant relationship between a measure of precognitive dream experience – or belief – and the performance on an implicit learning task. Following these null findings we designed Study 3 to test another

prediction of the IPH, that is, that in the absence of a relationship between implicit processing ability and precognitive dream experience, it may be the case that a poorer ability to process environmental stimuli explicitly allows for more implicit perception to take place. Thus, precognitive dreams would be more likely to be experienced by people who do not tend to notice subtle cues explicitly. To test this, we employed a variation on a change detection task used in change blindness research that allowed for the assessment of both implicit and explicit detection performance. The results of Study 3 did not support this prediction as the measure of explicit change detection was not related to precognitive dream experience. They did, however, provide a conceptual replication of the findings of Study 2, since we found, once again, no relationship between implicit detection and precognitive dream experience. Taken together, these results provide evidence against the IPH, although we proposed several hypotheses that could reconcile the broader premise of the IPH with our findings. Testing of these hypotheses would, however, necessitate a well-funded sleep laboratory study which is currently beyond our means. The difficulties, both logistical and methodological, associated with whis kind of research are illustrated by a recent study by Watt and colleagues (in press) that did not achieve the required statistical power to detect the hypothesised effect, even though the correlation found between prior precognitive dream experience and incorporation of external stimuli into dream narrative was .630. For this reason we decided to progress to focusing on the third explanation (see above) of precognitive dream experience, namely, that these phenomena are a result of misattribution of paranormal cause due to various cognitive and motivational biases.

Chapter IV provides a bridge between these two families of explanations. On a moderately large sample, we explored several hypotheses. Firstly, following the second of the three proposed explanations of precognitive dream experiences, we hypothesised

that an increased subjective frequency of these experiences will be associated with more erratic sleep behaviour. This hypothesis stems from the notion that such sleep behaviour, characterised by a higher frequency of nocturnal awakening and diurnal nap-taking, leads to a higher incidence of borderline sleep states, during which people's dream-like imagery is more sensitive to influence from external environmental stimuli. Thus, information about events that did not take place until after one went to sleep can figure in one's dreams. Consistent with this hypothesis, we found that a higher subjective frequency of precognitive dreams was associated with more nocturnal awakenings, higher dream recall, lower overall sleep quality, and a higher likelihood of using sleep medication. Secondly, the sample size used in Study 4 was appropriate for exploring the previously discussed but seldom examined relationship between precognitive dream belief and experience. Although, as could be expected, we found these two to be strongly positively related, we argued that this relationship is not sufficient to gloss over the conceptual distinction between these constructs and that there was a need for researchers to consider them separately. Thirdly, the exploration of demographic data revealed that women were more likely to believe in the reality of precognitive dreams as well as experience them. This finding is in line with those of previous studies. There was also a negative relationship between completed years of formal education and the precognitive dream variables. Taken as a rough proxy measure of cognitive ability, this result too has some support in past research, although controversy remains on this issue. Somewhat more surprising was the finding that frequency of these experiences was positively related to age. Since we were not able to explain why this would be the case, we argued that subjective frequency may be susceptible to biases.

Finally, we predicted that both precognitive dream belief and experience would be positively related to the subjective importance ascribed to one's dreams in general. We found support for this hypothesis. Given the correlational nature of the study, there was no means of unambiguously disentangling the individual contributions of belief and experience to any of the detected relationships, nor of assessing the causal nature behind these associations. However, we cautiously argued that belief in precognitive dreams might be the primary factor driving experience of such dreams and that personal significance ascribed to these dreams may lead people to inflate their estimate of the frequency with which they experience them. This line of argument, which is in line with research on subjectively reported dream frequency, led us to the exploration of personal attitudes towards precognitive dream experiences.

Since relatively little scientific attention has been focused on attitudinal and motivational aspects of paranormal belief and experience as well as the relationship between such attitudes and the frequency of paranormal experience, we dedicated the final two empirical chapters of the thesis to these topics.

Firstly, a measure of attitudes towards precognitive dream experiences was needed. In Chapter V, we describe the development and validation of such a measure. We administered the new Attitudes towards Paranormal Experiences Scale (APES) to a subsample from the previous study, consisting exclusively of participants with prior precognitive dream experience. After eliminating items with unsatisfactory psychometric properties, we identified five dimensions of these attitudes with acceptable reliability. We then used additional variables in the data set to validate the derived dimensions. Overall, the predicted relationships were confirmed by the analyses, which indicates both convergent and divergent/discriminant validity of the questionnaire. Importantly, we found that personal significance of one's precognitive dreams was related to the

frequency with which they are experienced. Furthermore, we argued that the presence of unpredicted relationships in the data provides evidence of the heuristic potential of this instrument. We were thus able to use it to further explore the relationship between attitudes towards precognitive dreams and other variables of interest.

The APES provided a means of expanding upon the findings regarding subjective importance of both general and precognitive dreams and precognitive dream belief and frequency discussed in chapters IV and V. Following the argument that personal significance of these dreams leads to inflated estimates of their frequency, in Study 6, the first study of the final empirical chapter of this thesis, we tested the hypothesis that the belief in one's precognitive dream experiences tends to be self-relevant. Building on the literature on self-defining memories, we predicted that the earliest memories of PD experience usually date back to the period of identity formation. This prediction was supported by the data. In line with this argument, we also hypothesised that there would be a relationship between vividness of the memories of the earliest precognitive dreams and the frequency with which these phenomena are experienced in later life. Furthermore, we predicted that this relationship would be accounted for by the personal significance of precognitive dreams. We found evidence for both of these hypotheses. We interpreted these findings as evidence for the claim that reports of precognitive dream experiences are inflated by the effect of personal significance on the tendency to remember events in accordance with self-relevant attitudes. However, given the observational design of the study, this evidence is only circumstantial.

In summary, this dissertation addressed several lines of research on precognitive dreams, providing novel findings in the field of psychology of paranormal belief and experience. Moreover, we are convinced that some of the findings and methods used in our studies are highly relevant to other areas within psychology, such as attention and

perception or cognitive and social psychology of memory. Last but not least, this thesis contributed to the ongoing debate regarding important conceptual and methodological issues in parapsychology.

Specifically, from a methodological point of view, we contributed novel tools applicable both in and outside of the area of precognitive dream belief and experience. Firstly, we constructed an attitude-focused questionnaire with a well-interpretable factor structure, which is both valid and reliable, and has a demonstrable heuristic potential. It explores important aspects of precognitive dream experiences that have not been previously addressed. Given the likely multi-faceted underlying psychology of these experiences, a more fine-grained picture of the structure of an individual's attitude towards them is undoubtedly useful. A further advantage of the APES is that, provided appropriate modifications to the wording of its items, it can be co-opted to assess other types of paranormal experience. Doing this would, apart from providing insights into the attitudinal structure of the experience in question, allow for the comparison of different types of paranormal experiences. Any such differences could inform further hypotheses about potential psychological factors of these sorts of experiences.

Secondly, our modification of Rensink and colleagues' (1997) flicker paradigm provides a novel way of assessing perception without awareness, a topic that has attracted both considerable attention and controversy. This task eschews the pitfalls of '*mindsight*' research pointed out by Simons and colleagues (2005), since, as we show in Study 3, the implicit detection part of the task is not conflated with a liberal decision criterion (see section 3.2.3 for more detail). Thus, we believe this task could prove useful for research into the topics of perception, attention, and awareness.

Thirdly, in our online dream precognition study (Study 1), we demonstrated the crucial importance of exploratory analysis in psi research. We showed how, without a

high level of scrutiny, results likely attributable to methodological or statistical artefacts can be mischaracterised as supportive of the psi hypothesis. Moreover, we made a case for the use of multiple randomisation on several levels of the experimental procedure. We recommended that, in addition to random selection of targets, it is important to randomise the presentation order of the stimuli in the judging stage. We also pointed to the possible effect of stimulus content on hit rate. We suggest that, if target pools are designed to include thematically orthogonal stimuli – a practice which is commonplace yet the justification for which is debatable – due care be taken to ensure that the individual themes are equally likely to figure in participants' mentation. Finally, we advocated the use of a control condition in psi research as opposed to the reliance on the mean chance expectation. Doing so reduces the number of assumptions that are implicit in the analysis of this kind of experimental design. Many of the points we raised here are not novel and some of them have been brought to attention multiple times in the history of psi research (*e.g.,* Kennedy, 1979). However, we believe that a repeated effort to raise consciousness of these issues is of value.

The research reported in this thesis also yielded novel findings relevant for various areas of psychology. We conducted studies that constitute the first published empirical test of the implicit processing theory of precognitive dream experience. The findings of these studies suggest that individual differences in implicit processing ability or the propensity to implicit perception as a result of suboptimal explicit perception are not likely to be a strong factor in precognitive dream experience. We also proposed other testable predictions based on the IPH and would encourage any efforts to test them in the future. We will return to these research suggestions later on in this section.

Other novel findings came from exploring the links between attitudes towards precognitive dreams, as measured by our new APES questionnaire, and memories of the

earliest precognitive dream experience. The results suggest that personal significance of one's experiences leads to inflated reports of vividness of one's first PD experience as well as the frequency of these experiences. Furthermore, we found that the earliest memories of PD experience tend to be dated to a period in individual development associated with identity-formation. This finding is consistent with the hypothesis that the self-relevance of the belief in one's precognitive dreams exerts motivational pressure towards the above-mentioned memory inflation. It is also worth pointing out that, to the best of our knowledge, the exploration of the earliest precognitive dream is a novel way of approaching the topic of paranormal experiences. As we demonstrated, it is a potentially fruitful one.

Finally, our Study 3 provided evidence of implicit change detection. The signal detection analysis showed that participants were, on average, able to detect the presence of a change in the stimulus, even though they had reported not having consciously noticed one with a greater accuracy that could be expected by chance. Furthermore, this ability to implicitly detect change could not be attributed to a liberal decision criterion, which is an objection that has been previously levied against studies in this area (Simons *et al.*, 2005). Provided these findings stand up to replication, we believe they could contribute to the resolution of the ongoing debate regarding the existence of implicit perception (Destrebecqz & Cleeremans, 2001; Mitroff *et al.*, 2002; Simons *et al.*, 2005).

Throughout this dissertation we also raised several theoretical points we believe deserve to be emphasised. We highlighted the importance of considering different kinds of supposed paranormal phenomena individually as opposed to treating them as a single homogenous concept of the paranormal as is often the case in psychological literature (see section 1.3.3.3). The reason for this, as we argued in line with others (*e.g.*, Irwin, 1993; Lindeman & Aarnio, 2006; Perkins & Allen, 2006), is that particular forms of

paranormal beliefs and experiences are likely to be underpinned by distinct psychological mechanisms. Addressing a general factor of the paranormal thus necessarily confounds these potential factors. We would certainly agree that it is of interest to look for general correlates of paranormal belief and experience but examining the issue in the way we suggest is equally important for a fuller understanding of these phenomena.

Another point stressed in the thesis is that of a conceptual distinction between belief and experience. Although measures, such as the Australian Sheep-Goat scale contain items inquiring into both paranormal beliefs and experiences, this distinction is seldom made use of in a systematic way in psychological literature (see section 1.3.3.3). We believe that a focused effort should be made to explore the relationship between these concepts beyond that of a mere correlation. The research presented in this thesis suggests that apart from the intuitive causal relationship, where an experience of a phenomenon leads to the belief in its existence, the actual nature of the relationship between paranormal belief and experience may be more complex (see also Glicksohn, 1990; Lawrence *et al.*, 1995; Rattet & Bursik, 2001). In the face of our findings, it is plausible that there exists a feedback relationship where each of these things causes the other. It is even possible that it is belief, not experience, that is the driving force behind this relationship and that a pre-existing belief in the reality of a given paranormal phenomenon leads to the experience of it. Further research is thus needed to elucidate the mechanics of the interplay of paranormal belief and experience. We hope that our emphasis on the conceptual distinction between them will serve as a catalyst to this kind of research.

Apart from the above-mentioned suggestion, the studies we conducted produced several directions for future studies in psychology of paranormal belief and experience

as well as more general areas in the field. Based on the findings reported in Chapter III, two lines of research appear potentially interesting. Firstly, we hypothesised, in line with the IPH, that, in the absence of differences in either implicit or explicit perception ability between those who experience precognitive dreams and those who do not, these experiences may be a result of the tendency of some people's dream imagery to be influenced by external stimuli. Alternatively, it could be argued that the important difference lies in the tendency of the dream content to reflect previously gathered information as well as implicit insights. These predictions can be tested in a sleep laboratory setting. However, a relatively large sample size would be required in order to capture any relationships between the measure in question and precognitive dream experience (see Watt *et al.*, in press). Given the constraints and demands posed by sleep laboratory research, conducting such a study may be rather costly.

Secondly, in the discussion to Study 3, we consider the possibility that participants' responses to implicit trials reflected situations when they were aware of a change having taken place but could not identify precisely what it was that changed. Setting aside the philosophical issue of what it means to notice a change if not noticing a point of discrepancy between two stimuli, it could be argued that these situations are possible due to a dual processing of global versus specific features. There is some evidence that in humans the processing of global and specific features is differentiated with respect to cerebral hemispheres (Han *et al.*, 2002; Kimchi & Merhav, 1991, but see Blanca, & López-Montiel, 2009). It should thus be possible to test the dual processing account of our findings. Participants would complete our modified flicker task while fixating at the middle of the screen. In change trials, the position of the element of change would be randomised to appear either in the right or the left visual field. It would follow from the dual processing account of our findings that a change should be more likely to be

implicitly detected in trials, where the element of change appears in the half of the visual field that is primarily processed by the cerebral hemisphere associated with the processing of general features.

In the discussion to the development of the APES questionnaire, we suggested that future research in the psychology of precognitive dream experiences would benefit from exploring the potential relationships between personality characteristics, such as narcissism or neuroticism and attitudes toward these experiences (Auton *et al.*, 2003; Roe, & Morgan, 2002; Tobacyk & Mitchell, 1987). Given the variability we found in people's attitudes toward their precognitive dreams, it is possible that the currently inconclusive findings from studies correlating personality traits and paranormal belief and experience (*e.g.*, Dag 1999; Dudley, 1999; McGarry & Newberry, 1981; Newby & Davis, 2004) are a result of confounding different types of experiencers. The type of research we propose would disentangle these confounds.

Finally, in the previous chapter, we proposed a study design for testing the hypothesis that a belief in precognitive dreams is capable of exerting motivational influence acting on a person's recollection of their prior dreams, making them match supposedly confirmatory events more closely than they originally did. A study such as this one could also yield novel findings in the broader area of motivational biases affecting memory. It is therefore an avenue we aim to pursue in the future.

In conclusion, we believe that this thesis provides novel theoretical, methodological, and empirical developments that contribute to the current state of knowledge in psychology and hope that it will inform and direct future research in the field.

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Appendix

Appendix A: Study 1 materials

A.1 Initial questionnaire

1) Participant ID code

2) Sex
    a. Male
    b. Female

3) Frequency of Dream Recall
"How often have you recalled your dreams recently (in the past several months)? (check one)"
    a. Almost every morning
    b. Several times a week
    c. About once a week
    d. Two or three times a month
    e. About once a month
    f. Less than once a month
    g. Never

4) "Do you believe that some individuals have dreams that predict future events, and that are not just coincidence?"
A precognitive dream is defined as a dream that 'comes true' and meets the following 5 criteria (Bender, 1966):
1. the dream must be recounted or recorded before its fulfilment (*e.g.*, was it written down or described to another person before it 'came true'?)
2. the dream must include enough details to render chance coincidence unlikely
3. the possibility of inference from actual knowledge must be excluded (i.e., the dream must refer to an unexpected or unpredictable event)
4. self-fulfilling prophecies must be excluded (i.e., the person could not make the dream 'come true' through their own actions after the dream)
5. telepathic influences should not be able to explain the occurrence of the precognitive dream (i.e., no one else could know the information in the dream at the time that the person had the dream)
    a. Yes
    b. No
    c. Unsure

5) Frequency of Precognitive Dream Experience
Based on the five criteria above, please indicate approximately how often you have had a precognitive dream over the last few years (check one)
    a. About once a week
    b. About once a month

c. About once in six months
d. About once a year
e. Less than once a year
f. Never

Thank you for completing this initial questionnaire. You can now begin to record your personal dream diary for Trial 1. Over the next 5 mornings, please keep a detailed note of any dreams that you can remember on awakening. After 5 days, we will send you a link to a questionnaire that will ask you to type in an anonymous summary description of your week's dreams. Remember that after we have received your dream summary you will be sent a "target" video clip to view. Every night, before you go to sleep, please take a few moments just to gently remind yourself that your dreams during the night will be linked to the target clip you are going to watch after we have received your dream summary. Sweet dreams!
To exit, please click the following link, which will take you to the KPU home page:
http://www.koestler-parapsychology.psy.ed.ac.uk/

A.2 Dream Summary

1) Participant ID code

2) Summary
   Please type in the space below an anonymous summary (max 300 words) of your remembered dreams over the past 5 days. Include not only descriptions of main content and themes that emerged in your dreams, but details such as emotional tone and the impact of the dream. You do not need to write anything that you would find embarrassing or that would make you uncomfortable to write. Please don't provide any personally identifying details.
   [open response]

3) Confidence rating
   Please rate how confident you are that your dreams over the past 5 days will relate to the target video clip that you will shortly be sent. (check one)
   a. Completely confident
   b. Very confident
   c. Somewhat confident
   d. Not very confident
   e. Not at all confident

4) Please explain briefly the reason why you chose this particular level of confidence
5) [open response]

Thank you for submitting your dream summary and confidence rating. Next, you will be sent (drum roll…..) your target clip for this week. Good luck!
To exit, please click the following link, which will take you to the KPU home page:

A.3 Dream Similarity Rating Form

1) Participant ID code

2) Similarity Rating
   If you have not already done so, please view your target video clip. Now, please type in a number from 1-100 to indicate how much similarity you feel there is between your submitted dream summary for this week and your target video clip for this week. Please bear in mind not just dream content, but also associated themes and emotions. A rating of 1 indicates No Similarity, 100 indicates Complete Similarity.

Thank you for submitting your Similarity rating. In a day or two, you will be sent a reminder to start your personal dream diary for the next week of the study. Thank you for your continued involvement in the study!
To exit, please click the following link, which will take you to the KPU home page: http://www.koestler-parapsychology.psy.ed.ac.uk/

Appendix B: Materials for Studies 4-6

B.1 Demographic questionnaire

First, please answer these few questions about yourself.

1) Please indicate your gender:
    a. Female
    b. Male
    c. Other [free response]

2) Where are you from?
   Please write down the name of the country in which you were raised.
   [free response]

3) What is your age?
   [free response]

4) How many years of formal education (school, college, university) have you completed?
   [list 8-25]

5) How did you find out about this study?
    a. Social networks (Facebook, Twitter, etc.)
    b. Interest group/website/community
    c. From a family member
    d. Word of mouth

6) If you answered 'Interest group/website/community' in the previous question, please write down the area of interest. For example spirituality, skepticism, psychology, paranormal phenomena, gardening etc.
   [free response]

B.2 Sleep characteristics questionnaire

Here are a few questions about the quality of your everyday sleep. Please read each one carefully and respond accordingly. There are no right or wrong answers, so please answer as accurately as possible.
(Items adapted from the Pittsburg Sleep Quality Index; Buysse *et al.*, 1988)

1) How long do you usually sleep?

a. Fewer than 5 hours
b. 5 to 6 hours
c. 7 to 8 hours
d. 9 to 10 hours
e. More than 10 hours

2) How often do you tend to have naps during the day?
   a. Never
   b. Less than once a month
   c. About once a month
   d. A few times a month
   e. About once a week
   f. A few times a week
   g. Almost daily

3) How often do you wake in the middle of the night (or too early in the morning)?
   a. Never
   b. Less than once a month
   c. About once a month
   d. A few times a month
   e. About once a week
   f. A few times a week
   g. Almost every night
   h. Once or several times every night

4) How often do you take medicine (prescribed or "over the counter") to help you sleep?
   a. Never
   b. Less than once a month
   c. About once a month
   d. A few times a month
   e. About once a week
   f. A few times a week
   g. Almost daily

5) Have you been diagnosed with a sleep disorder?
   We realise this might be a sensitive topic but please bear in mind the questionnaire is completely anonymous. However, for your peace of mind, we included a 'I prefer not to say' option.
   a. Yes
   b. No
   c. I prefer not to say

6) How would you rate your overall quality of sleep?
Very bad 1 2 3 4 5 6 7 Very good

7) How often have you recalled your dreams recently (in the past several months)?
   a. Never
   b. Less than once a month

c. About once a month
d. Two or three times a month
e. About once a week
f. Several times a week
g. Almost every morning.

B.3 Attitudes towards dreams scale

The following section asks about your dreams. Please read carefully each statement and indicate the extent to which you agree or disagree with it. Again, there are no right or wrong answers, so please answer as accurately as possible.

(all items except for #6 and #20 selected from Inventory of Dream Experience and Attitudes; Beaulieu-Prévost, Charneau Simard, & Zadra, 2009)

[7-point Likert scale from *Completely disagree* to *Completely agree*]

1) My dreams do not seem to have a deeper meaning.
2) In my dreams, I experience failure more often than success.
3) Dreams are random products of the brain.
4) I believe that dreams and spirituality are closely connected.
5) In general, I feel safe in my dreams.
6) Dreams don't tell us anything important about ourselves.
7) In my dreams, I am often running away or being followed.
8) If I am affected by a dream, I try to find its meaning.
9) If the opportunity presents itself, I would like to work on my dreams with an expert in order to find their meaning.
10) I attach a lot of significance to my dreams.
11) My dreams are more often pleasant than unpleasant.
12) On occasion, I will consult a book to help interpret my dreams.
13) I pay close attention to my dreams.
14) In my dreams, I tend to be anxious more often than calm.
15) I tend to read about dreams.
16) Dream interpretation should NOT be part of psychology training.
17) The most intense emotions I have experienced in my dreams are positive emotions.
18) I feel that my dreams are about nothing in particular.
19) In my dreams, I am more likely to be lucky than unlucky.
20) I tend to analyse my dreams.

B.4 Precognitive dream belief scale

The following section asks about your beliefs about precognitive dreams, i.e. dreams that foretell the future. Please read carefully the criteria below as well as each question and respond accordingly.

The following five criteria have been suggested as helping to define what is meant by a 'precognitive' dream.

[Bender's (1966) criteria we included here; see Appendix A.1.]

Based on these criteria, please indicate how much the following statements apply to you.

[7-point Likert scale from *Completely disagree* to *Completely agree*]

1) Some individuals have dreams that can only be described as precognitive.
2) It is NOT possible to predict the future through precognitive dreams. (reversed)
3) Sometimes, dreams can provide information about the future that couldn't have been received from any waking life source.
4) Any information received from dreams can be explained without invoking precognition. (reversed)
5) I have had at least one dream that came true and which (I believe) was precognitive.

6) Please indicate which of these options has been the most relevant to you in forming your opinion on the existence, or otherwise, of precognitive dreams (choose one).
    a. Direct personal experience
    b. Knowledge of another person's experience
    c. Popular print or broadcast media
    d. Scientific evidence
    e. Other

7) Approximately how often do you tend to have precognitive dreams?
    a. Never
    b. Less than once a year
    c. About once a year
    d. About once in six months
    e. About once a month
    f. About once a week

B.5 APES-PD

Precognitive dreams are a fascinating topic. Unfortunately, very little is known about what people think about their precognitive dream experience. People like you can provide valuable information about this interesting yet under-explored area. We would really appreciate if you completed this final section of the questionnaire.

This is the most important part of the study, so please try your best to focus.

This questionnaire asks about your experience with precognitive dreams and your attitude towards them. First, please answer these three introductory questions.

1) What age were you when you had your first precognitive dream?
   <Free response>

2) How vivid is your recollection of this first dream?
   a. As vivid as real life
   b. Very vivid
   c. Fairly vivid
   d. Not very vivid
   e. Not at all vivid

3) Which area of life did the dream concern?
   a. Personal pertaining to myself
   b. Personal pertaining to a significant other
   c. Local event/person
   d. National event/person
   e. International event/person

Now, please read carefully each item and respond by indicating how much you agree or disagree with the given statement. Just like before, there are no right or wrong answers so please reply as accurately and truthfully as possible but do not ponder the items too much.

[7-point Likert scale from *Completely disagree* to *Completely agree*]

1) In a way, I feel blessed because of my precognitive dreams. (reversed)[8]
2) People who have precognitive dreams need not hide them. (reversed)
3) Society greatly benefit from exploring the potential of precognitive dreamers.
4) Precognitive dreams run in my family.
5) I am proud to have precognitive dreams. (reversed)
6) I have previously benefited from heeding my precognitive dreams.

[8] Items retained in the final version of APES-PD appear in boldface.

7) Everybody has precognitive dreams during their lives even though some people don't know it or deny it. (reversed)
8) I can always recognise a dream is precognitive shortly after waking up.
9) I am a person who is sometimes able to predict the future by extraordinary means.
10) I have in the past ignored my precognitive dreams and afterwards came to regret it.
11) A precognitive dream, as strong as it may be, is no reason to change your plans. (reversed)
12) To have precognitive dreams is a rare thing.
13) I believe that everyone has the potential to be a precognitive dreamer. (reversed)
14) It is not for us to decide whether or not we will have precognitive dreams. (reversed)
15) People who are too vocal about their precognitive dreams shouldn't be taken seriously. (reversed)
16) I often share my precognitive dreams with others. (reversed)
17) My precognitive dreams rarely come true. (reversed)
18) Discovering I had precognitive dreams didn't change how I see myself. (reversed)
19) I don't act upon my precognitive dreams. (reversed)
20) To have precognitive dreams is an innate ability.
21) Precognitive dreams shouldn't be very important for a person who has them. (reversed)
22) Many of my relationships are connected to my having precognitive dreams in some way.
23) When I have an alarming precognitive dream about someone close, I warn them.
24) I like to keep the fact that I have precognitive dreams to myself.
25) Only my closest friends and family know about my precognitive dreams.
26) Sometimes it takes a bit of hindsight to realise a dream was precognitive. (reversed)
27) My precognitive dreams come to me from some external source. (reversed)
28) Precognitive dreamers don't deserve any special credit for having their dreams. (reversed)
29) Ever since I've been having precognitive dreams, I've felt a bit 'different' because of them.
30) My precognitive dreams are a private matter.
31) Only a few people know how to make use of their precognitive dreams.
32) Precognitive dreaming is an ability that can be cultivated.
33) Society mocks people who have precognitive dreams because it fears what it doesn't understand.
34) People who don't have precognitive dreams just can't appreciate what it's like.
35) I know many people who have precognitive dreams. (reversed)
36) To have precognitive dreams is a heavy burden.
37) Sometimes my precognitive dreams get me in trouble.
38) I know more people who respect my precognitive dreams than those who don't. (reversed)
39) After my dream has come true I have usually little doubt about the connection between it and the event.

40) I would NOT call precognitive dreams a special ability. (reversed)
41) I have felt distressed because of my precognitive dreams.
42) I would describe myself as someone who has precognitive dreams.
43) People who have precognitive dreams will carry on having them, even if they don't want to. (reversed)
44) My actions are often informed by my precognitive dreams.
45) I have a lot to thank my precognitive dreams for. (reversed)
46) My precognitive dreams, for better or worse, are a part of who I am.
47) All my friends know I have precognitive dreams. (reversed)
48) It would be nice if people could acknowledge my precognitive dreams.
49) I don't care what people think about my precognitive dreams. (reversed)
50) If I could I would give up having precognitive dreams.
51) If others knew about my precognitive dreams, they would think I am crazy.
52) I can often accurately tell the meaning of my dream before it comes true.
53) The message of the precognitive dream is often unclear until the dream comes true. (reversed)
54) Sometimes I just want to make everyone see that my dreams can predict the future.
55) Our materialist culture has no appreciation for precognitive dreamers.
56) To have precognitive dreams is a gift. (reversed)
57) If I had a strong dream about a plane crash, it would not make me cancel a flight. (reversed)
58) You can get better at making use of your precognitive dreams.
59) My precognitive dreams aren't very reliable. (reversed)
60) I get ridiculed by closed-minded people.
61) People close to me have trust in my precognitive dreams. (reversed)
62) I don't take my precognitive dreams too seriously. (reversed)
63) Most people I talk to about my precognitive dreams seem genuinely interested. (reversed)

Appendix C: Study 4 supplementary material

Table S1

Summary of ordinal regression analysis of precognitive dream experience

	b	*SE*	*p*	OR [95% CI]
Gender	−0.374	0.15	.012	0.69 [0.51, 0.92]
Age	0.063	0.01	$< 2 \times 10^{-16}$	1.06 [1.05, 1.08]
Education	−0.155	0.01	5×10^{-12}	0.86 [0.82, 0.89]

Table S2

Summary of logistic regression predicting sleep medication use with sleep clusters treated as ordinal.

	b	*SE*	*p*	OR [95% CI]
Age	0.012	0.01	.118	1.01 [1.00, 1.03]
Cluster 2	−0.786	0.18	8×10^{-6}	0.46 [0.32, 0.64]
Cluster 3	0.250	0.18	.153	1.28 [0.92, 1.82]

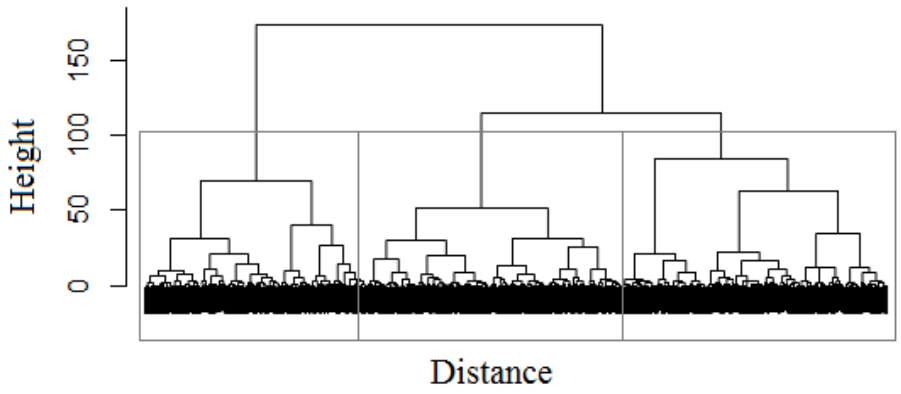

Figure S1. Dendrogram showing the results of a hierarchical cluster analysis using Ward's minimum variance method and the three extracted sleep clusters.

Appendix D: Study 5 supplementary material

Table S3

Comparison of factor loadings between the WLS and WLSMV-derived factor solutions

Item	Benefit	Importance	Neg. Emotion	Credit	Privacy
01	**(0.480)**		**−0.562** (−0.462)	0.393 (0.311)	
02			**−0.329** (−0.364)		**−0.394 (−0.418)**
03		**0.397**		(0.332)	(**−0.391**)
05	(0.397)	(−0.307)	**−0.546 (−0.441)**	**0.505** (0.394)	
06	**0.738 (0.703)**				
10	**0.368 (0.321)**				
11		**−0.559 (−0.626)**			
16					**−0.753 (−0.789)**
17		**−0.555 (−0.592)**			
21		**−0.584 (−0.567)**			
22	**0.734 (0.755)**				
24					**0.748 (0.815)**
30					**0.588 (0.654)**
33		**0.478 (0.435)**		(0.329)	
36		0.409 (0.461)	**0.531 (0.628)**	0.321 (0.490)	
37	**0.511** (0.436)		**0.488 (0.641)**		
40				**−0.638 (−0.669)**	
41		0.423 (0.571)	**0.550** (**0.629**)		
42	0.408	**0.469 (0.515)**			
44	**0.751 (0.718)**				
45	**0.852 (0.913)**				
46		**0.493 (0.459)**			
47	**0.434** (0.328)				**−0.545 (−0.581)**
48				**0.588 (0.578)**	−0.304 (−0.348)
50			**0.705 (0.732)**		
52	**0.339**	**(0.336)**			
54			(0.376)	**0.582 (0.584)**	
56	(0.346)		−0.416	**0.613 (0.558)**	
59		**−0.595 (−0.712)**			
61	**0.449 (0.339)**	(0.317)			
62	−0.318	**−0.581 (−0.650)**			

Note. WLSMV factor loadings in brackets. Salient loadings in boldface.

Table S4

Correlations between scale indices and factor scores based on WLS and WLSMV solutions

A. Scale indices

WLSMV	Factor	WLS 1	2	3	4	5
1	Benefit	**.976**	.467	−.040	.514	−.148
2	Importance	.645	**.966**	−.168	.398	−.130
3	Neg. emotion	−.286	−.336	**.973**	.001	.228
4	Credit	.416	.423	−.291	**.972**	−.205
5	Privacy	−.328	−.135	.173	−.268	**.976**

B. Factor scores

WLSMV	Factor	WLS 1	2	3	4	5
1		**.974**	.619	.128	.477	−.222
2		.664	**.932**	−.045	.494	−.317
3		.039	.046	**.970**	−.263	.368
4		.486	.458	−.101	**.924**	−.382
5		−.342	−.349	.268	−.396	**.970**

C. Scale indices x factor scores (WLS)

Factor	1	2	3	4	5
1 Benefit	**.959**	.528	−.022	.539	−.098
2 Importance	.576	**.943**	−.192	.444	−.235
3 Neg. emotion	.058	−.022	**.943**	.018	.308
4 Credit	.469	.427	−.238	**.929**	−.347
5 Privacy	−.271	−.219	.318	−.230	**.959**

D. Scale indices x factor scores (WLSMV)

Factor	1	2	3	4	5
1	**.952**	.653	−.162	.445	−.368
2	.642	**.934**	−.325	.575	−.332
3	−.106	.099	**.868**	−.099	.156
4	.466	.248	−.167	**.888**	−.434
5	−.320	−.183	.342	−.283	**.954**

Note. Scale indices derived as the average response on salient items.

Table S5

Item-level analysis of the WLSMV solution

Benefit	*M* = 3.51, SD = 1.35, *a* = .84, 95% CI [.80, .89]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
01	.84	.03	.59	4.33	1.92
06	.81	.03	.77	4.04	2.11
10	.84	.03	.59	3.44	2.14
22	.82	.03	.69	3.04	2.05
37	.84	.03	.57	2.55	1.82
44	.80	.03	.81	3.29	1.83
45	.80	.03	.85	3.43	1.92
61	.83	.03	.65	4.00	1.84
Importance	*M* = 4.63, SD = 1.18, *a* = .82, 95% CI [.78, .87]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
11	.82	.02	.56	3.66	1.90
17	.81	.03	.58	2.73	1.63
21	.81	.03	.62	3.06	1.65
33	.81	.03	.58	2.88	1.75
42	.79	.03	.72	3.37	2.04
46	.81	.03	.57	4.29	1.90
52	.80	.03	.69	2.67	1.76
59	.80	.03	.70	3.59	1.82
62	.79	.03	.77	4.05	2.01
Negative emotion	*M* = 3.22, SD = 1.13, *a* = .65, 95% CI [.55, .72]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
01	.62	.05	.54	3.67	1.92
05	.60	.05	.58	3.46	1.74
36	.59	.05	.60	3.48	2.00
37	.62	.05	.53	2.55	1.82
41	.58	.05	.63	3.83	2.18
50	.54	.05	.69	2.37	1.71
Credit	*M* = 3.38, SD = 1.30, *a* = .68, 95% CI [.59, .78]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
40	.63	.06	.71	3.75	1.92
48	.59	.06	.74	3.08	1.82
54	.62	.06	.71	2.30	1.75
56	.63	.06	.70	4.40	1.79
Privacy	*M* = 4.01, SD = 1.25, *a* = .76, 95% CI [.70, .83]				
Item	*a* if deleted	SE of α	Item-total *r*	M_{Item}	SD
02	.75	.04	.61	5.05	1.81
03	.75	.04	.61	5.20	1.82
16	.7	.04	.76	3.67	2.09
24	.71	.04	.73	3.70	1.85
30	.72	.04	.68	3.39	1.73
47	.74	.04	.65	2.45	1.75

Table S6

Factor weights for deriving ten Berge factor scores for the WLS solution

Item	Benefit	Importance	Negative emo	Credit	Privacy
01	0.050	−0.063	−0.218	0.107	0.021
02	0.021	0.038	−0.072	−0.022	−0.136
03	−0.037	0.108	−0.080	0.076	−0.140
05	0.012	−0.057	−0.171	0.217	0.023
06	0.157	0.027	−0.073	−0.049	−0.000
10	0.078	0.041	0.006	0.065	−0.031
11	0.004	−0.154	−0.020	0.006	0.034
16	0.018	−0.007	0.031	−0.023	−0.372
17	0.019	−0.160	0.037	0.116	−0.026
21	0.068	−0.162	0.054	0.005	0.014
22	0.149	−0.065	−0.012	−0.004	0.021
24	0.060	0.008	0.052	0.134	0.327
30	0.025	−0.005	−0.009	−0.020	0.176
33	−0.018	0.125	0.068	0.039	0.017
36	−0.003	0.137	0.203	0.208	0.005
37	0.137	−0.050	0.236	0.078	0.030
40	0.037	−0.067	−0.021	−0.233	−0.031
41	0.051	0.129	0.179	0.025	0.011
42	0.065	0.118	−0.038	−0.053	−0.019
44	0.164	−0.040	0.127	−0.005	0.051
45	0.365	−0.095	−0.084	0.030	0.016
46	0.045	0.199	−0.100	−0.010	0.005
47	0.133	−0.032	−0.022	0.023	−0.257
48	−0.025	−0.040	0.074	0.190	−0.093
50	−0.031	−0.193	0.325	0.016	−0.010
52	0.040	0.026	0.022	0.042	0.048
54	0.079	−0.030	0.126	0.317	−0.084
56	−0.040	0.013	−0.097	0.248	0.098
59	−0.020	−0.147	0.029	0.103	−0.072
61	0.061	0.058	−0.006	−0.017	0.024
62	−0.011	−0.207	−0.016	0.007	−0.013

Note. Values rounded down to 3 decimal places

Appendix E: List of publications

The following papers were written and/or published during the period in which the thesis was written:

Published

Valášek, M., Watt, C., Hutton, J., Neill, R., Nuttall, R., & Renwick, G. (2014) Testing the implicit processing hypothesis of precognitive dream experience. *Consciousness and Cognition, 28*, 113-125. [9]

Watt, C., Valášek, M., Cawthron, S., & Almanza, A. (2015). In the eye of the beholder: Uncovering the characteristics of prospectively reported spontaneous precognitive dreams. *Journal of the Society for Psychical Research, 918*(79.1), 18-33.

Watt, C. (2014). Precognitive dreaming: Investigating anomalous cognition and psychological factors. *Journal of Parapsychology, 78*(1), 115-125.[10]

Under review

Valášek, M., Watt, C. (under review) Creation of APES: Construction and validation of the Attitude towards Paranormal Experiences Scale. *European Journal of Psychological Assessment.*[11]

Valášek, M., Watt, C. (under review) Individual differences in prophetic dream belief and experience: Exploring demographic, attitudinal, and sleep-related correlates. *Personality and Individual Differences.* [12]

In preparation

Valášek, M. (in preparation) Nocturnal wakeup frequency and dream significance as partial mediators of gender differences in dream recall

[9] Includes Studies 2 and 3.
[10] Includes Study 1; I was originally the second author but due to differences in opinions between the journal editor and myself, I decided to withdraw my authorship.
[11] Includes Study 5.
[12] Includes Study 4.

Appendix F: List of R packages used for statistical analyses

bda; Wang, B. (2014). bda: Density Estimation for Binned/Weighted Data. R package version 3.1.3-2. http://CRAN.R-project.org/package=bda.

boot; Canty, A. & Ripley, B (2012). boot: Bootstrap R (S-Plus) Functions. R package version 1.3-4.

car; Fox, J. & Weisberg, S. (2011). An {R} Companion to Applied Regression, Second Edition. Thousand Oaks CA: Sage.

CTT; Willse, J. T. (2014). CTT: Classical Test Theory Functions. R package version 2.1. http://CRAN.R-project.org/package=CTT.

doBy; Højsgaard, S., Halekoh, U., Robison-Cox, J., Wright, K., & Leidi, A. A. (2013). doBy: doBy - Groupwise summary statistics, general linear contrasts, population means (least-squares-means), and other utilities. R package version 4.5-9. http://CRAN.R-project.org/package=doBy.

ez; Lawrence, M. A., (2013). ez: Easy analysis and visualization of factorial experiments. R package version 4.2-0. http://CRAN.R-project.org/package=ez.

ggm; Marchetti, G. M., Drton, M., & Sadeghi, K. (2014). ggm: A package for Graphical Markov Models. R package version 2.0. http://CRAN.R-project.org/package=ggm.

ggplot2; H. Wickham, H (2009). *ggplot2: elegant graphics for data analysis*. Springer: New York.

Hmisc; Harrell Jr, F. E., Dupont, C., et al. (2014). Hmisc: Harrell Miscellaneous. R package version 3.14-3. http://CRAN.R-project.org/package=Hmisc.

lavaan; Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software, 48*(2), 1-36.

lme4; Bates, D., Maechler, M., Bolker, B. & Walker, S. (2013). lme4: Linear mixed-effects models using Eigen and S4. R package version 1.0-4. http://CRAN.R-project.org/package=lme4.

lmSupport; John Curtin (2013). lmSupport: Support for Linear Models. R package version 1.07.1. http://CRAN.R-project.org/package=lmSupport.

lmtest; Zeileis, A. & Hothorn, T. (2002). Diagnostic Checking in Regression Relationships. *R News 2*(3), 7-10.

ltm; Rizopoulos, D. (2006). ltm: An R package for Latent Variable Modelling and Item Response Theory Analyses. *Journal of Statistical Software, 17*(5), 1-25.

MASS; Venables, W. N. & Ripley, B. D. (2002) *Modern Applied Statistics with S*. Fourth Edition. Springer, New York.

MBESS; Kelley, K. & Lai, K. (2012). MBESS: MBESS. R package version 3.3.3. http://CRAN.R-project.org/package=MBESS.

nFactors; Raiche, G. (2010). nFactors: an R package for parallel analysis and non-graphical solutions to the Cattell scree test. R package version 2.3.3. http://www.cran.r-project.org/package=nFactors/.

nlme; Pinheiro, J. & Bates, D., DebRoy, S., Sarkar D., & the R Development Core Team (2012). nlme: Linear and Nonlinear Mixed Effects Models. R package version 3.1-104. http://www.cran.r-project.org/package=nlme/.

ordinal; Christensen, R. H. B. (2013). Ordinal: Regression Models for Ordinal Data R package version 2013.9-30 http://www.cran.r-project.org/package=ordinal/.

pastecs; Grosjean, P. & Ibanez, F. (2014). pastecs: Package for Analysis of Space-Time Ecological Series. R package version 1.3-18. http://CRAN.R-project.org/package=pastecs.

plyr; Wickham, H. (2011). The Split-Apply-Combine Strategy for Data Analysis. *Journal of Statistical Software, 40*(1), 1-29.

polycor; Fox, J. (2010). polycor: Polychoric and Polyserial Correlations. R package version 0.7-8. http://CRAN.R-project.org/package=polycor.

psych; Revelle, W. (2014) psych: Procedures for Personality and Psychological Research, Northwestern University, Evanston, Illinois, USA. R package version = 1.4.3. http://CRAN.R-project.org/package=psych.

psychometric; Fletcher, T. D. (2010). psychometric: Applied Psychometric Theory. R package version 2.2. http://CRAN.R-project.org/package=psychometric.

QuantPsyc; Fletcher, T. D. (2012). QuantPsyc: Quantitative Psychology Tools. R package version 1.5. http://CRAN.R-project.org/package=QuantPsyc.

reshape; Wickham, H. (2007). Reshaping data with the reshape package. *Journal of Statistical Software, 21*(12), 1-20.

WRS; Wilcox, R.R., & Schönbrodt, F.D. (2013). The WRS package for robust statistics in R (version 0.20). http://r-forge.r-project.org/projects/wrs/.