



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Dream Precognition and Sensory Incorporation: A Controlled Sleep Laboratory Study

Citation for published version:

Watt, C, Wiseman, R & Vuillaume, L 2015, 'Dream Precognition and Sensory Incorporation: A Controlled Sleep Laboratory Study', *Journal of Consciousness Studies*, vol. 22, no. 5-6, pp. 172-190.
<<http://www.ingentaconnect.com/content/imp/jcs/2015/00000022/F0020005/art00008>>

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Journal of Consciousness Studies

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Caroline Watt,
Richard Wiseman
and Laurène Vuillaume

Dream Precognition and Sensory Incorporation

A Controlled Sleep Laboratory Study

Abstract: *Controlled research into alleged psychic functioning can aid our understanding of the nature and limits of consciousness. Some commentators have suggested that the decline in positive results from dream precognition studies might be due to the early experiments being carried out in sleep laboratories whilst later studies tested participants in their own homes. The present study assessed this argument. Twenty participants were selected for prior precognitive dream experience, and were invited to a sleep laboratory. Participants were asked to dream about a target video they would later view. A judge rated participants' dreams against the target and decoys. No evidence was found for dream precognition. The study also tested the hypothesis that precognitive dream experiences may occur when a person subconsciously incorporates sensory information into their dream. A sound clip was played to sleeping participants and a judge rated the target and decoy clips against the participants' dream transcripts. The correlation between degree of sensory incorporation and prior precognitive dream experience was non-significant. Suggestions for future research in this area are discussed.*

Correspondence:
Dr Caroline Watt, Koestler Parapsychology Unit, University of Edinburgh, 7
George Square, Edinburgh, EH8 9JZ, Scotland.
Email: caroline.watt@ed.ac.uk

Introduction

The study of ostensible psychic functioning may throw some light on the nature and limits of human consciousness. For example, claims of veridical perceptions during near-death experiences (Parnia *et al.*, 2014) have led some researchers to call for an expanded understanding of consciousness (van Lommel *et al.*, 2001). Hameroff has argued that apparent evidence of precognition speaks to the issue of time symmetry and quantum brain biology, which he relates to conscious free will (Hameroff, 2012; 2014). Spontaneous precognitive experiences are frequently reported, but controlled studies are relatively rare. The present paper reports an investigation of the precognition hypothesis that was conducted in a sleep laboratory.

Approximately one third of people in the UK and US believe that they have experienced a precognitive dream (Haraldsson, 1985; Van de Castle, 1977). For over a century, researchers have investigated the possible existence of this phenomenon. Much of the early work in the area was carried out by the Society for Psychical Research, and involved collecting and collating case reports of the alleged precognitive dreaming (Gurney, Myers and Podmore, 1886). In the 1960s advances in sleep science allowed researchers to carry out laboratory-based experiments into the topic, with probably the best-known of this work being conducted at the Maimonides Medical Center in New York (Ullman, Krippner and Vaughan, 1973). Most of the Maimonides studies adopted a telepathy design, however three tested dream precognition. The precognition studies involved waking participants after a period of REM sleep and asking them to describe their dreams. The goal was to dream about a 'target' (such as a themed slide and sound sequence) that they would see the following morning. The participants' dream reports and associations were then compared with the target material, and a 'hit' was awarded if the actual target was ranked in the top half of the target pool.

Child (1985) cautioned against reporting figures for statistical significance of the Maimonides dream precognition studies because the judging method risked violating statistical assumptions of independence, however the studies obtained an impressive sixteen hits out of eighteen trials. However, later dream precognition studies failed to replicate the Maimonides results, and in their review Sherwood and Roe (2013) speculated that this may have been due to procedural differences in the post-Maimonides studies. In particular, all the recent studies involved non-EEG testing of participants in their homes and so

elicited fewer and poorer quality dream reports. The primary goal of the present study was to assess this argument by conducting a precognitive dream study that utilizes the type of EEG-based methodology associated with the original Maimonides studies.

A second aspect of the study investigated a non-parapsychological hypothesis that is frequently advanced to explain instances of alleged precognitive dreaming. The 'sensory incorporation' hypothesis suggests that individuals may have precognitive dream experiences because their dreams have incorporated sensory information that they have been exposed to without their awareness. For example, a person's dream may incorporate fragments of an overheard television or radio news bulletin. Upon awakening and consciously becoming aware of the news for the first time, the individual may mistakenly label the dream as precognitive. According to this line of argument, these experiences are not based upon extrasensory processes but upon normal, albeit subtle, sensory processes (Alcock, 1981). Previous research does suggest that it is possible for the content of dreams to be influenced by external stimuli (Corning, 1899; Berger, 1963; Koulack, 1969; Schredl *et al.*, 2009). However, the present study is the first to attempt to explore whether there is any relationship between the propensity to incorporate sensory stimuli into dreams, and precognitive dream experience and belief.

Precognitive Dream Study

Method

Participants

Participants (N = 20) were members of the general public recruited according to three selection criteria: having had at least one prior precognitive dream experience, being able to remember their dreams, and having normal hearing.

Role of experimenters and independent judges

CW (Experimenter 2) was primarily responsible for study design, participant recruitment, judge recruitment and liaison during the study, and overall study coordination. LV (Experimenter 1) was primarily responsible for participant scheduling, meeting participants, and conducting the testing sessions. RW contributed to the study design. There were two independent judges (Judge 1 and Judge 2) who did not know each other and had no contact with one another or with any of

the study participants. Judge 1 was a staff member of the Koestler Parapsychology Unit (KPU) at the University of Edinburgh. The psi outcome was based on Judge 1's ratings; Judge 2's ratings were used as an indicator of judging agreement.

Materials

Precognitive Dreaming Questionnaire: This six-item questionnaire measured participants' belief in, and alleged experience of, precognitive dreaming (see Appendix). Participants rated each item on a 5-point scale between '1' (strongly disagree) and '5' (strongly agree), with higher scores indicating greater levels of belief and alleged experience.

Target material: The target for each trial was randomly selected from 40 video clips. Each clip lasted approximately 2 minutes, and contained footage from a film, documentary, home video, television show, or animation. Each clip was linked to an object that the participant could handle while viewing the clip (e.g. a clip containing a drum solo at a rock concert was paired with some drumsticks). These 40 clips were grouped into 10 pools of 4 clips, with the investigators ensuring that the clips in each pool were maximally different. For judging, a photo was taken of each prop and this was provided to the judge along with the target clip.

EEG monitoring equipment: Recordings of electrophysiological signals were obtained using an Alice 5 Polysomnography system. Electroencephalographic (EEG) signals were recorded with silver-chloride cup electrodes attached using collodion, and electrooculographic (EOG) and electromyographic (EMG) signals were recorded using disposable self-adhesive wet-gel electrodes. Twelve channels of EEG were recorded from electrode positions Fp1, Fp2, F3, F4, C3, C4, T3, T4, P3, P4, O1, and O2, with each channel referenced to the contralateral ear and sampled at 500 Hz. Two channels of EOG activity were recorded using electrodes placed near the left and right eyes (1 cm out and 1 cm below the left outer canthus, and 1 cm out and 1 cm above the right outer canthus respectively); each channel was referenced to the contralateral ear and sampled at 200 Hz. One bipolar channel of EMG activity was recorded using two electrodes placed below the chin, sampled at 200 Hz. All channels were band-pass filtered between 0.2–100 Hz and a bandstop (notch) filter was set at 50 Hz; impedances were kept below 10 Kohms.

Randomization

The same random source was used throughout the study whenever a random selection needed to be made. This was the RNG function of the website RANDOM.ORG which generates numbers based on global atmospheric noise and is therefore a live true random source. The random source was used to select the video target pool (1 of 10), the video target clip (1 of 4), and the order in which the judges were asked to view the 4 clips in the target pool.

Procedure

Each participant spent two consecutive nights at the Edinburgh Sleep Centre. The first night was primarily intended to familiarize the participant with the sleep laboratory (although the sensory incorporation study was conducted during the last dream of the session — see below). Experimenter 1 greeted the participant and showed them to a bedroom in the basement of the Sleep Centre. The technician applied EEG and EOG electrodes, and the participant was left to sleep. Throughout the night the participant's EEG was monitored in the adjoining technician's room.

The second night was used to collect data for the precognitive dreaming study. Experimenter 1 showed the participant to the 'feedback room' on the first floor of the Centre, and explained that they would be shown the target video clip in this room the following morning. The participant was then shown to a bedroom in the basement, and the technician applied EEG and EOG electrodes. Before sleep, the participant was invited to make a gentle wish that their dreams would relate to the target video. Towards the end of each REM period, Experimenter 1 gently woke the participant, and recorded their dream reports and associations using a hand-held digital recorder. Experimenter 1 transcribed the dream reports while the participant slept.

In the morning, Experimenter 1 reviewed all the night's dream reports with the participant, and recorded any further associations made by the participant. The technician removed the electrodes whilst Experimenter 1 transcribed the final dream report and associations.

Experimenter 1 then randomly selected the target pool and emailed the participant's dream reports and associations, and target pool identity, to Experimenter 2 (CW). Experimenter 1 then randomly selected the target, took the participant to the feedback room, briefly reminded them of their dream reports, and gave the participant the appropriate prop to handle. Participants were seated in front of a large

screen, wore headphones, and watched the target video (4 repeats, more if the participant requested). The participant then rated their dream reports (as a whole) for the degree of similarity to the target clip, using a 1–100 scale.

Judging

Prior to the study's commencement, the judges were given free-response ESP judging guidelines (Delanoy, Morris and Watt, 2004).

Experimenter 2 forwarded Experimenter 1's email (containing the participant's transcript and target pool) to Judge 1 within two hours of receiving it. Judge 1 rated the dreams and associations (as a whole) against the four target possibilities on a 100-point scale between 1 (no correspondence) to 100 (total correspondence). Judge 1 then emailed these ratings back to Experimenter 2, who recorded them on a spreadsheet. The judging of each trial was usually completed by mid-afternoon on the same day as the participant viewed the target video. Only after judging was completed did Experimenter 1 inform Experimenter 2 of the target identity.

Judge 2 was also given the free-response ESP judging guidelines, was emailed the dream transcript by Experimenter 2, and rated each trial as soon as possible after the trial, and before receiving judging material for the subsequent trial.

Hypotheses and planned analyses

The procedure, hypotheses, and planned analyses were lodged at the KPU study registry¹ prior to the start of the study, and the study design and procedures received ethical approval from the University of Edinburgh's ethics panel. The primary psi outcome measure was based on the judgments of Judge 1. H1 was the only confirmatory hypothesis; the others were pre-planned exploratory hypotheses.

H1: The target video clips will receive significantly higher rankings than chance (where rank 1 = direct hit). Analysis by sum-of-ranks based on Judge 1's target rank (1-t).

H2: Prior precognitive dream experience will correlate with the target ranking. Analysis by Spearman correlation (2-t).

¹ <https://koestlerunit.wordpress.com/study-registry/>.

H3: Prior precognitive dream belief will correlate with the target ranking. Analysis by Spearman correlation (2-t).

Results

Participant characteristics

The 20 participants (10 female, mean age 36 years, SD = 10.33, range 22–69) reported high levels of belief in precognitive dreaming (mean Belief score 10.85, SD = 1.93, theoretical range of scoring 3–15), and of experience of precognitive dreaming (mean Experience score 11.8, SD = 2.12, theoretical range 3–15). All participants had experienced at least one precognitive dream; 50% less than once per year, 35% once per year, 10% once in six months, and 5% once per month approximately. Most (80%) participants reported recalling their dreams at least several times a week. Therefore these participants clearly met the study inclusion criteria. The mean age at which participants reported having their first precognitive dream experience was 14.9 years (SD = 6.02), and just over half of the participants (50%) characterized this as a very vivid dream, with an additional 5% indicating they felt it was as vivid as real life. The majority (80%) of participants reported that the topic of their first precognitive dream was personal pertaining to themselves or a significant other, and the majority attributed their views on precognitive dreaming either to personal experience (73.75%) or to hearing about another person's experience (11.25%).

Participants' dream characteristics. Every participant reported at least one dream during the study, and most (70%) participants recalled from 4 to 7 dreams (modal response = 4). The transcripts of the participants' dreams and associations ranged in length from 153 words to 2,073 words (mean transcript word length = 1035.4, SD = 574.3).

Participants' ratings. No correlation was found between participants' prior precognitive dream belief and experience and the rating that they gave to the target (Belief Spearman's $\rho = 0.169$, $p = 0.475$; Experience Spearman's $\rho = 0.067$, $p = 0.779$).

Judge agreement. Judge 2's ratings were used to provide a measure of inter-judge agreement. On the seven trials where at least one judge scored a direct hit, both identified the same target on three trials. If we adopt the definition of a 'hit' that was used in the Maimonides studies, the judges agreed on 14 out of 20 trials (70%).

Precognitive dreaming. Judge 1 scored 6 direct hits in 20 trials (30% hitrate). As planned, to assess Hypothesis 1 a CR(z) statistic was

calculated based on the summed target rankings for Judge 1. The summed target ranks equalled 50 (= MCE) therefore $CR(z) = 0$, giving no support for Hypothesis 1 that the participants' dream transcripts and associations would resemble the randomly-designated target to a degree greater than chance expectation.

There was no significant correlation between the judge's target ranking and participants' prior precognitive dream experience (Hypothesis 2) and belief (Hypothesis 3), although the correlation² was in the expected direction with greater target–dream similarity corresponding with greater precognitive dream belief and experience: Experience Spearman's $\rho = 0.334$, $p = 0.150$; Belief $\rho = 0.239$, $p = 0.309$.

Sensory Incorporation Study

Method

Participants and Judge

The same participants ($N = 20$) were used in this study. A third independent judge (Judge 3) was used, who only had contact with Experimenter 2.

Materials

Precognitive Dreaming Questionnaire: The study hypotheses were tested using the same Precognitive Dreaming Questionnaire (see Appendix).

Audio target pool: A single pool of four 50-second sound clips was used, each depicting contrasting sounds of a city, grassy meadow, comedy club, and stream.

Randomization

The RNG function of the website RANDOM.ORG was used to select the audio target clip (1 of 4).

² For convenience, the sign of the correlation is reversed whenever target rank is being correlated, because numerically lower target ranks indicate greater target–dream correspondence.

Procedure

During the last REM period of the familiarization night,³ the technician played the target clip to the participant for approximately one minute using a portable MP3 player wired to the bedroom speaker.

The participant's dream report was recorded and transcribed by Experimenter 1. Experimenter 1 emailed Experimenter 2 each participant's night dream and association transcript, and Experimenter 2 emailed these to Judge 3.

Judging

Prior to the study's commencement, Judge 3 was given the same free-response judging guidelines as had been given to Judges 1 and 2. Judge 3 was asked to rate each transcript for degree of similarity to the four sound clips on a 1–100 scale. Judge 3 emailed her ratings back to Experimenter 2, who recorded them in a spreadsheet. Only after judging of one trial was completed did Experimenter 1 inform Experimenter 2 of the target for that trial. Judging took place one trial at a time.

Hypotheses and planned analyses

The procedure, hypotheses, and planned analyses for this study were lodged at the KPU study registry, and the study design and procedures received ethical approval from the University of Edinburgh's ethics panel.

H1: Prior precognitive dream experience will correlate with measure of the incorporation of sound-track into the participant's dreams (based on Judge 3's target rank). Analysis by Spearman correlation (2-t).

H2: Prior precognitive dream belief will correlate with measure of the incorporation of sound-track into the participant's dreams (based on Judge 3's target rank). Analysis by Spearman correlation (2-t).

H3: Sensory incorporation and precognitive dreaming — Judge 3's target rank (sensory incorporation trial) will correlate with Judge 1's

³ A judgement on this was made by the technician based on the participant's usual waking time.

target rank (precognitive dreaming trial). Analysis by Spearman correlation (2-t).

Results

Data was unavailable for 11 sensory incorporation trials because the participants were woken by the sound (5 trials), had no dream recall (2 trials), remembered hearing the sound (1 trial), were awoken prior to final REM period (2 trials), or technical problems meant no sound was played (1 trial). The analyses, based on the remaining nine trials, are under-powered.

Precognitive dream experience did not significantly correlate with the target clip rank (Spearman's $\rho = 0.630$, $p = 0.069$, two-tailed), though the correlation was in the expected direction (greater sensory incorporation associated with greater precognitive dream experience). Hypothesis 1 was therefore not supported.

Precognitive dream belief did not significantly correlate with the target clip rank (Spearman's $\rho = 0.247$, $p = 0.523$, two-tailed). Hypothesis 2 was therefore not supported.

The audio clip target ranking did not significantly correlate with the video clip target ranking (Spearman's $\rho = 0.533$, $p = 0.140$, two-tailed), therefore Hypothesis 3 was not supported.

Discussion

This study examined precognitive dreaming from both psychological and parapsychological perspectives. To test whether participants' dreams contained information about the future target, an independent judge rated the dream and associated transcripts against the target pool. The judge did not give significantly elevated rankings to the target videos, thus no support was found for the precognitive dreaming hypothesis. How do we account for this failure to obtain evidence of precognitive dreaming using sleep laboratory methodology? We will discuss various different arguments to assess their plausibility.

1. Dream precognition cannot be demonstrated under controlled conditions because it does not exist. Aside from one pilot Maimonides study, we are aware of just two formal sleep laboratory studies of dream precognition, both of which were conducted at Maimonides and obtained strong effect sizes (Krippner, Ullman and Honorton, 1971; Krippner, Honorton and Ullman, 1972; Sherwood and Roe, 2013). Child (1985) has questioned the methodological and statistical rigour of the Maimonides studies, but a conclusive evaluation cannot now be

made because the original study data is unavailable. Aside from the present study, we are aware of only six published post-Maimonides studies that have formally⁴ assessed dream precognition, none of which took place in a sleep laboratory. One study (Watt, 2014) found a significant hitrate (however, see Watt and Valášek, in press, for a postscript to this study). One non-significant study (Markwick and Beloff, 1988) had only 2 precognition trials out of 100 trials. One study (de Pablos, López Sabater and Martínez Liarte, 2011) involved several psi hypotheses, and obtained a mixture of significant and non-significant results. Three further studies found no evidence of precognitive dreaming (McLaren and Sargent, 1982; Sherwood *et al.*, 2002; Luke *et al.*, 2012). At present the database of dream precognition studies is rather impoverished, variable in methodology, and therefore inconclusive.

2a. The present study was not optimally designed to allow precognition to be detected, due to insufficient dream mentation. Most of our participants reported four or more dreams, so it cannot plausibly be argued that there was a loss of potentially target-relevant material in the present study. Also, as with the earlier sleep laboratory studies, the present study interviewed participants in the morning to obtain further associations on their dreams.

2b. The present study was not optimally designed to allow precognition to be detected, because it did not involve ‘star’ participants. The only previous controlled studies whose findings could be interpreted as strongly supporting the precognitive dreaming hypothesis used a special subject who reported a history of spontaneous precognitive dream experiences. The present study did not have such a single ‘star’ subject. However, our participants were selected on the basis of their prior precognitive dream experience, defined according to Bender’s (1966) criteria for evidentiality. While our participants cannot be regarded as ‘gifted’, they are representative of the population of people who report spontaneous precognitive dream experiences.

2c. The present study was not optimally designed to allow precognition to be detected, owing to insufficient statistical power. The paucity of previous research into precognitive dreaming does not allow us to confidently estimate an expected effect size. However, the

⁴ Sargent and Harley (1982), and Schredl, Götz and Ehrhardt-Knutsen (2010) each reported a pilot study.

two prior precognitive dreaming studies with a special subject had only 8 trials each and large effect sizes. It is therefore plausible to argue that the present study had a fair chance of detecting any precognitive effect with a selected sample of precognitive dream experiencers and with 20 trials. Any large sleep laboratory study will be prohibitively costly, and we suggest solutions to this problem later.

The present study was designed to test the hypothesis of dream precognition. However, with only a small number of formal studies testing dream precognition using a variety of different designs, the database remains inconclusive. Future researchers are advised to be more systematic in study design, and to pre-register their study to assure against selective reporting. While the readers of this journal may wish (as our referees did) to see a discussion of the phenomenological aspects of dream precognition, this is outwith the scope of the present investigation. When formally testing the psi hypothesis, qualitative comparisons, for instance of correspondences between dream reports and target film clips, are of limited evidential value due to the possibility of chance similarities between dreams and targets. For this reason, parapsychologists resort to statistical evaluations that admittedly do not address phenomenological aspects of participants' experiences. Spontaneous case collections do, however, explore such aspects, indeed it is observations from these naturalistic reports that first encouraged parapsychologists to explore the use of altered states of consciousness when testing the psi hypothesis in more controlled settings (Ullman, Krippner and Vaughan, 1973). We do offer one anecdote, however, to illustrate the limits of qualitative reports when considering the psi hypothesis. During the study, one of our participants, Paul, reported the following dream (quoted with Paul's permission):

My dream was that I was having to meet someone and go somewhere. I was having to decide whether or not to walk along Princes St, because I had the electrodes and wires still attached to my head. I knew I did not have time to sort the problem with the electrodes, as this would make me late. I decided that there were plenty of 'strange' or 'different' people in this world, so I should not be bothered having to walk down Princes St with my odd headgear!

When Paul woke up the following morning, the technicians discovered that they had run out of the solvent that is normally used to remove the scalp electrodes. Eventually they had to improvise and purchase some nail varnish remover from a nearby pharmacy. Could this have been a precognitive dream? We can't know for sure. It is

common to dream about anxieties or preoccupations in one's daily life and, when participants are sleeping with electrodes glued to their head, it would not be surprising if this unusual circumstance influenced their dreams. Other participants also had dreams about the experimental set-up and procedure that seemed to be elicited by the situation and that did *not* relate to their specific future experiences. So it is possible that Paul's dream corresponded to subsequent events just by chance.

Regarding individual differences on the psychological variables, no relationship was found between performance on the controlled test of dream precognition and participants' prior precognitive dream belief or experience. Additionally, no relationship was found between precognitive dream belief and experience and the rating that participants gave to the target. However, most participants expressed high levels of prior precognitive dream belief and experience, so the lack of variability of responses to these questionnaire items might be a contributory factor to these results.

The study also explored whether precognitive dream experiences might arise from a participant unconsciously incorporating environmental information into their dreams. However, our formal test of this hypothesis failed on the planned two-tailed test. The study obtained a non-significant correlation of 0.630 between prior precognitive dream experience and sensory incorporation. Unfortunately this analysis was hampered by low statistical power, since it was based on the data from only nine trials. It is worth reflecting that this analysis, which had been conservatively pre-registered as a two-tailed test, would have been significant one-tailed. This is exactly the kind of situation where researchers may be tempted to report a significant outcome, illustrating the importance of study pre-registration. This is an issue in which parapsychologists have played a leading role: the Koestler Parapsychology Unit Registry for Parapsychological Experiments opened in 2012, and psychologists and neuroscientists are now also realizing the value of pre-registration (Chambers, 2013). We urge colleagues routinely to pre-register their studies to increase methodological quality in their field.

The loss of sensory incorporation data highlights the practical difficulty of finding a stimulus intensity that will not awaken participants despite them being towards the end of a night's sleep and therefore near to waking spontaneously. There are at least two possible solutions to this problem. First, one could use less complex or cognitively arousing sensory stimuli that might be less likely to awaken

the participant, such as a mild vibration, odour, or a simple tone (e.g. Arzi *et al.*, 2012). However, we feel that very simple sensory stimuli would not provide an ecologically valid operationalization of the idea that sleeping individuals may be sensitive to sensory stimuli that may, in turn, influence the content of their dreams leading to an erroneous attribution of precognition. Another solution might be to expose the participants to the sensory stimulus earlier in the night, when the participant is less likely to awaken. This was not done in the present study because we wished to minimize the disruption to our participants' sleep on the familiarization night of the study.

The present study was costly to conduct due to the use of specialized facilities and technical staff. Prohibitive costs are likely to be one reason why the post-Maimonides dream-ESP studies were not conducted in sleep labs. Instead, participants slept in their own homes, but this comes at the cost of gathering only a small proportion of dreams because typically the participant does not awaken after every dream period during the night. Recent technological developments may help to increase the efficient recording of dreams when participants sleep at home. Simple and inexpensive equipment is now available that claims to be able to detect when a person is in REM sleep and then wake them (<http://www.thinkmelon.com>). So, we would encourage researchers to take advantage of new technology to allow more efficient use of limited resources to help answer the question of what lies behind people's precognitive dream experiences. The sensory incorporation hypothesis merits further investigation, given the suggestive results that we obtained, however there remain technical challenges to testing this hypothesis outside of a laboratory setting.

Acknowledgments

Dr Caroline Watt conducted this study while she held the position of Perrott-Warrick Senior Researcher. We are grateful to the Perrott-Warrick Fund for financial support for this study, to Marios Kittenis, Stevie Williams, and Susan Fifer of the Edinburgh Sleep Centre for technical support, and to Milan Valášek, Catherine Gladstone, and Ruth Howard for their assistance with the study.

References

- Alcock, J.E. (1981) *Parapsychology: Science or Magic?*, Oxford: Pergamon.
- Arzi, A., Shedlesky, L., Ben-Shaul, M., Nasser, K., Oskenberg, A., Hairston, I.S. & Sobel, N. (2012) Humans can learn new information during sleep, *Nature Neuroscience*, **15**, pp. 1460–1467.
- Bender, H. (1966) The Gotenhafen case of correspondence between dreams and future events: A study of motivation, *International Journal of Neuropsychiatry*, **2**, pp. 398–407.
- Berger, R.J. (1963) Experimental modification of dream content by meaningful verbal stimuli, *The British Journal of Psychiatry*, **109**, pp. 722–740.
- Chambers, C.D. (2013) Registered reports: A new publishing initiative at *Cortex*, *Cortex*, **49**, pp. 609–610.
- Child, I. (1985) Psychology and anomalous observations: The question of ESP in dreams, *American Psychologist*, **40**, pp. 1219–1230.
- Corning, J.L. (1899) The use of musical vibrations before and during sleep — supplementary employment of chromatoscopic figures — a contribution to the therapeutics of the emotions, *The Medical Record: A Weekly Journal of Medicine and Surgery*, **14**, pp. 79–86.
- de Pablos, F., López Sabater, R. & Martínez Liarte, L. (2011) Incorporation of future events into dream content: An experimental study, *Australian Journal of Parapsychology*, **11**, pp. 138–153.
- Delaney, D.L., Morris, R.L. & Watt, C.A. (2004) A study of free-response ESP performance and mental training techniques, *Journal of the American Society for Psychological Research*, **98**, pp. 28–67.
- Gurney, E., Myers, F.W.H. & Podmore, F. (1886) *Phantasms of the Living*, 2 vols., London: Trubner.
- Hameroff, S. (2012) How quantum brain biology can rescue conscious free will, *Frontiers in Integrative Neuroscience*, **6**, 93, doi: 10.3389/fnint.2012.00093.
- Hameroff, S. (2014) Consciousness, microtubules, & ‘Orch OR’: A ‘Space-time Odyssey’, *Journal of Consciousness Studies*, **21** (3–4), pp. 126–153.
- Haraldsson, E. (1985) Representative national surveys of psychic phenomena, *Journal of the Society for Psychological Research*, **53**, pp. 145–158.
- Koulack, D. (1969) Effects of somatosensory stimulation on dream content, *Archives of General Psychiatry*, **20**, pp. 718–725.
- Krippner, S., Ullman, M. & Honorton, C. (1971) A precognitive dream study with a single subject, *Journal of the American Society for Psychological Research*, **65**, pp. 192–203.
- Krippner, S., Honorton, C. & Ullman, M. (1972) A second precognitive dream study with Malcolm Bessent, *Journal of the American Society for Psychological Research*, **66**, pp. 269–279.
- Luke, D., Zychowicz, K., Richterova, O., Tjurina, I. & Polonnikova, J. (2012) A sideways look at the neurobiology of psi: Precognition and circadian rhythms, *NeuroQuantology*, **10**, pp. 580–590.
- Markwick, B. & Beloff, J. (1988) Dream states and ESP: A distance experiment featuring a pure clairvoyance, free-response design, in Weiner, D.H. & Morris, R.L. (eds.) *Research in Parapsychology 1987*, pp. 77–81, London: Scarecrow Press.
- McLaren, I. Sargent, C.L. (1982) Awareness of success in free-response dream ESP testing with a single subject, in Roll, W.G., Morris, R.L. & White, R.A.

- (eds.) *Research in Parapsychology 1981*, pp. 195–196, Metuchen, NJ: Scarecrow Press.
- Parnia, S., et al. (2014) AWARE — AWAREness during Resuscitation — A prospective study, *Resuscitation*, **85** (12), pp. 1799–1805.
- Sargent, C.L. & Harley, T.A. (1982) Precognition testing with free-response techniques in the ganzfeld and the dream state, *European Journal of Parapsychology*, **4**, pp. 243–256.
- Schredl, M., Atanasova, D., Hörmann, K., Maurer, J.T., Hummel, T. & Stuck, B.A. (2009) Information processing during sleep: The effect of olfactory stimuli on dream content and dream emotions, *Journal of Sleep Research*, **18**, pp. 285–290.
- Schredl, M., Götz, S. & Ehrhardt-Knutsen, S. (2010) Precognitive dreams: A pilot diary study, *Journal of the Society for Psychological Research*, **74**, pp. 168–175.
- Sherwood, S.J., Roe, C.A., Simmonds, C.A. & Biles, C. (2002) An exploratory investigation of dream precognition using consensus judging and static targets, *Journal of the Society for Psychological Research*, **66**, pp. 22–28.
- Sherwood, S.J. & Roe, C.A. (2013) An updated review of dream ESP studies conducted since the Maimonides dream ESP programme, in Krippner, S., Rock, A.J., Beischel, J. & Friedman, H. (eds.) *Advances in Parapsychological Research* 9, pp. 38–81, Jefferson, NC: McFarland.
- Ullman, M., Krippner, S. with Vaughan, A. (1973) *Dream Telepathy: Experiments in Nocturnal ESP*, Jefferson, NC: McFarland.
- Van de Castle, R.L. (1977) Sleep and dreams, in Wolman, B. (ed.) *Handbook of Parapsychology*, pp. 473–499, Jefferson, NC: McFarland.
- Van Lommel, P., van Wees, R., Meyers, V. & Elfferich, I. (2001) Near-death experience in survivors of cardiac arrest: A prospective study in the Netherlands, *The Lancet*, **358** (9298), pp. 2039–2045.
- Watt, C. (2014) Precognitive dreaming: Investigating anomalous cognition and psychological factors, *Journal of Parapsychology*, **78**, pp. 115–125.
- Watt, C. & Valášek, M. (in press) Postscript to Watt (2014), on precognitive dreaming: Investigating anomalous cognition and psychological factors, *Journal of Parapsychology*.

Paper received September 2014; revised November 2014.

Appendix: Participant Questionnaire

1. What is your age? _____
2. Are you male or female? _____
3. How often have you recalled your dreams recently (in the past several months?) (please tick one)
 - 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

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

- 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'?)
- The dream must contain enough details to render chance coincidence unlikely
- The possibility of inference from actual knowledge must be excluded (i.e. the dream must refer to an unexpected or unpredictable event)
- Self-fulfilling prophecies must be excluded (i.e. you could not make the dream 'come true' through your own actions after the dream)
- 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).

Based on these criteria, please indicate how much the following statements apply to you, by circling the relevant point on the 1–5 scale:

4. Some individuals have dreams that can only be described as precognitive.

1	2	3	4	5
(strongly disagree)				(strongly agree)

5. Sometimes, my dreams have provided information about the future that I could not have received from any waking life source.

1	2	3	4	5
(strongly disagree)				(strongly agree)

6. I do not think that I can predict the future by means of precognitive dreaming

1	2	3	4	5
(strongly disagree)				(strongly agree)

7. I have had at least one dream that came true and which (I believe) was precognitive

1	2	3	4	5
(strongly disagree)				(strongly agree)

8. It is not possible to predict the future via precognitive dreams.

1	2	3	4	5
(strongly disagree)				(strongly agree)

9. Dreams can provide information about the future that cannot be acquired by other means.

1	2	3	4	5
(strongly disagree)				(strongly agree)

Again, with reference to the above 5 criteria, if you **have** had a precognitive dream, please answer questions 10 to 14 below. (If you have not had a precognitive dream, please go to question 14.)

10. Approximately how often have you had a precognitive dream over the last few years? (please tick one)

- Never
- Less than once a year
- About once a year
- About once in six months
- About once a month
- About once a week

11. What age were you when you had your first precognitive dream?

12. How vivid is your recollection of this first dream? (please tick one)

- As vivid as real life
- Very vivid
- Fairly vivid
- Not very vivid
- Not at all vivid

13. To which area of life did the dream pertain?

- Personal pertaining to myself
- Personal pertaining to a significant other
- Local event/person
- National event/person
- International event/person
- Other (please specify): _____

14. 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? (please tick one)

- Direct personal experience
- Knowledge of another person's experience
- Popular print or broadcast media
- Scientific evidence
- Social/cultural traditions
- Other (please specify): _____

*If you have had a dream about the future that does not meet these criteria, this does not necessarily mean that it was not a genuinely precognitive dream. However, parapsychologists like to use the above criteria in order to help establish the evidentiality of the precognitive dream experience.