

 Open access • Journal Article • DOI:10.1111/JSR.12134

Memory sources of dreams: the incorporation of autobiographical rather than episodic experiences. — [Source link](#)

Josie E. Malinowski, Caroline L. Horton

Institutions: University of Bedfordshire, Leeds Beckett University

Published on: 19 Feb 2014 - Journal of Sleep Research (Wiley)

Topics: Autobiographical memory, Episodic memory, Childhood memory, Childhood amnesia and Autonoetic consciousness

Related papers:

- [Dreaming and Episodic Memory: A Functional Dissociation?](#)
- [Dreaming of a Learning Task is Associated with Enhanced Sleep-Dependent Memory Consolidation](#)
- [Continuity between waking activities and dream activities](#)
- [Memory Sources Associated with REM and NREM Dream Reports Throughout the Night: A New Look at the Data](#)
- [Cognitive replay of visuomotor learning at sleep onset: temporal dynamics and relationship to task performance.](#)

Share this paper:    

View more about this paper here: <https://typeset.io/papers/memory-sources-of-dreams-the-incorporation-of-2wfi53jjn>

Memory sources of dreams: The incorporation of autobiographical rather than episodic experiences

Malinowski, J. E., & Horton, C. L.

Leeds Metropolitan University, Faculty of Health and Social Sciences, Civic Quarter,
Calverley Street, Leeds LS1 3HE, UK.

j.malinowski@leedsmet.ac.uk

c.l.horton@leedsmet.ac.uk

Corresponding author: Caroline L. Horton, 0 (+44) 113 81 24928

Short title: Autobiographical memory sources of dreams

Word count: 5229

Number of references: 34

Author contributorship: JM designed and collected data for the experiment (as part of PhD studies). JM co-ordinated the writing, especially of the introduction, method and results. CH contributed to design issues, analysis and interpretation, and co-wrote the drafts of the manuscript, especially the discussion.

Conflicts of interest: there are no conflicts of interest for either author

Summary

The present study aimed to explore autobiographical memories (long-lasting memories about the self) and episodic memories (memories about discrete episodes or events) within dream content. We adapted earlier episodic memory study paradigms and re-investigated the incorporation of episodic memory sources into dreams, operationalising episodic memory as featuring auto-noetic consciousness, which is the feeling of truly re-experiencing or reliving a past event. Participants (N=32) recorded daily diaries, dream diaries, and reported on wake-dream relations for two weeks. Dreams were rated for their episodic richness, using a new scale, which categorised memory sources of dreams as being truly episodic (featuring auto-noetic consciousness), autobiographical (containing segregated features of experiences that pertained to waking life), or otherwise. Only one dream (0.5%) was found to contain an episodic memory. However, the majority of dreams (>80%) were found to contain low to moderate incorporations of autobiographical memory features. These findings demonstrate the inactivity of intact episodic memories, and emphasise the activity of autobiographical memory and processing within dreams. Taken together this suggests that memories for personal experiences are fragmentarily and selectively experienced during dreaming, perhaps in order to assimilate these memories into the autobiographical memory schema.

Keywords: dreaming; sleep mentation; memory structure; memory incorporation; continuity hypothesis; declarative memory

Introduction

The Continuity Hypothesis of dreaming (e.g. Hall & Nordby, 1972), in its most basic form, recognises the overlap between waking life and dreaming. It has been studied in numerous ways, such as via the investigation of the memory sources of dreams (e.g. Baylor & Cavallero, 2001). The continuity of waking-life memories in dreams has implications for the memory consolidation function of sleep, i.e. the notion that waking-life memories are selectively enhanced during sleep (e.g. Stickgold & Walker, 2005). Studies have shown that sleep facilitates memory consolidation: for example, rapid-eye-movement (REM) sleep benefits emotional memory (Payne, 2010), and non-REM (NREM) sleep benefits episodic memory (memories for discrete experiences and events) (Walker & Stickgold, 2006). Some research indicates that dream content reflects these processes, such as the emotionality of REM dreams (Hobson et al., 2000), and the greater number of episodic memory sources of dreams in NREM sleep (Baylor & Cavallero, 2001). We pursue this line of enquiry in the present paper.

However, in the case of episodic memories (EMs), memories for experiences with specific time and place referents (Tulving, 1983; 2002), being consolidated during sleep, there is heterogeneity in the results, and the tasks designed to measure episodic memory lack ecological validity as they often utilise tasks such as memorising word lists, which are not valid EMs as they are not memories for discrete events but rather memories for information (Rauchs et al., 2005). Dream research is similarly inconclusive, in that there are conflicting accounts of the amount of EM replay in dreams. One study found that EMs were very rare (<2%) in dreams (Fosse et al., 2003), while another has found that 'discrete episode' memory sources accounted for up to 38% of dream content (Cavallero et al., 1990). If EMs are rarely dreamt of, yet sleep improves EM consolidation, then this process must take place via a method that does not involve replaying intact EMs.

The differences between the dream results may have arisen from incompatible uses of the term 'episodic memory'. The present study aimed first to review studies that have measured waking-life EMs, then to apply a suitable definition to the interpretation of the memory sources of dreams, leading to a new study that has been designed to measure EM as conceptualised by current theory.

The study that most explicitly deals with EMs in dreams is Fosse et al.'s (2003), in which participants wrote down their dreams and waking-life activities for a fortnight. Of the 299 dream reports, only 1.7% were deemed to contain EMs. For a dream to be rated as containing an EM, there had to be high confidence that the dream was a representation of the waking-life event, and high similarity between the dream and waking experience. Additionally, the locations had to be strongly similar, and at least two of the other features (e.g. characters) had to be matched, as well as conservation of all actions, characters, and objects. There also had to be a detailed description of the waking event. Although the study found a low rate of *complete* EMs it found that 65% of the dreams contained at least two episodic *features* of waking life, such as characters or locations.

Fosse et al. (2003) noted the difference between their finding and that of an earlier study which also looked at EM in dreams (Dement et al., 1965), which found that 12% of dreams contained 'complete' renditions of the laboratory setting. Dement et al.'s definition of 'complete' was much broader in scope than Fosse et al.'s of an EM: the criteria were: the appearance of the experimental situation; its purpose; and the dreamer themselves in the bed with electrodes attached. Characters were usually retained, but the number was allowed to vary, and there could even be other characters, illustrating the variability in the use and definition of EM.

Further, Cavallero et al. (1990), when investigating memory sources of dreams, defined EMs even more broadly: 'discrete episodes', opposing semantic and abstract memories, were defined as a "discrete episode in the life of the dreamer, with precise spatial and/or temporal coordinates" (p.452). This is clearly broader than both of the other studies' definitions and this broadness is reflected in the results: discrete episodes accounted for 32-38% of early- and late-night non-rapid-eye-movement (NREM) sleep dream sources and approximately 28% of early- and late-night rapid-eye movement (REM) sleep dream sources.

EM is memory for discrete episodes or events (e.g. Tulving, 1983; 1991), and is often conceptualised in opposition to semantic memory, which is a more generalised type of memory for our knowledge of the world (e.g. Baddeley, 2001; Tulving, 1983). Current conceptualisations of EM, which break from earlier theories, suggest that EMs are detailed summary accounts of short time-period experiences which are forgotten within 24 hours unless they are consolidated during sleep and subsequently become linked to autobiographical memories (AMs) (Conway, 2001, 2009; Williams et al., 2008). EMs, therefore, can be intricately tied to AMs, but the two have different features.

AMs, in contrast, are memory constructions, holding information about the self, created from episodic (events or experiences) *and* semantic (knowledge) memories. While EMs may help to achieve short term goals and therefore do not endure for long time periods (such as 'getting to work'), AMs link with longer-term goals (such as 'getting a job'), and are also essential for a sense of self (Conway, 2001; Conway & Pleydell-Pearce, 2000). We need to draw upon both personal experiences and information in order to create a sense of identity. Simultaneously, this cognitive 'self' acts as a reference point for the ways in which personal experiences are made sense of and subsequently recalled. This can lead to misremembering, so that an EM might be altered if it conflicts with an already-established personal memory or goal. Thus, EM

incorporates aspects of autobiographical remembering, including the 'working self-concept' (Conway & Pleydell-Pearce, 2000). AMs, therefore, are long-lasting memories about the self, which may be informed by any of the memory systems, such as episodic or semantic. The activity of these discrete types of memory within sleep has not been investigated formally in previous studies. We wish to clarify the distinction between EMs and AMs, and investigate the incorporation of both within dreams.

A particularly important feature of EM that distinguishes it from AM is 'autonoetic consciousness', which involves the true re-experiencing or reliving of the memory of a past event, particularly a personal experience, as well as the awareness that the event happened in one's personal history, rather than the present (Baddeley, 2001; Gardiner, 2001; Levine et al., 2002; Tulving, 2002). Only EMs are characterised by this feature. The distinction between EM and AM with regard to autonoetic consciousness is well illustrated by the case of the patient known as KC, who retained some parts of his AM (such as knowledge of various aspects of his childhood), but who could not recall any memories that required autonoetic consciousness, i.e. his personal past experiences (Tulving, 2002). EMs, therefore, are fleeting memories of experiences, with autonoetic consciousness, which may endure if they are consolidated into the autobiographical memory schema.

Of the empirical studies, only Fosse et al. (2003) attempted to define EM in detail. However, none of the studies' criteria for EMs, including Fosse et al.'s, conformed to the current conceptualisations of EM: i.e., they did not include a requirement for the dream to elicit a sense of autonoetic consciousness. In addition, Fosse et al.'s criterion for conserving *all* actions, characters, and objects may be unnecessary since episodic memories are thought to be summary accounts, but the broadness of the Cavallero et al.'s (1990) study is also inappropriate, since the definition 'a discreet episode' does not generate a sense of reliving the experience. In addition, Fosse et al.'s criterion of

confidence in the dream memory association may be an invalid stipulation, since one can have confidence in a false memory (e.g. Roediger & McDermott, 1995), and since remembering and knowing (autonoetic and noetic consciousness) do not necessarily correspond with levels of confidence (Gardiner, 2001). It is the autonoetic nature of the dream, rather than the confidence that the dream was caused by an episodic memory, that needs to be emphasised.

The present study utilised the same dream-diary procedure as Fosse et al. (2003) but with a different method of rating the dreams for EMs. The method developed intended to separate out EMs (with autonoetic consciousness) from AMs, using a modified version of the episodic-autobiographical rating scale developed in the Autobiographical Memory Interview (Kopelman et al., 1989; Levine et al., 2002), which measures the episodic richness of AMs. The highest point on the original rating scale (the only point that includes autonoetic consciousness) was the only one that was considered to describe an EM in the present study. Whilst all dream memory sources were autobiographical insofar as they related to the dreamer's own waking life, other points on the scale, which measured lower degrees of episodic richness, may be more related to the AM system. That is, as the scale points decrease, so too do the clarity and specificity – or episodic nature – of the memories being described, whilst the constructive – or autobiographical nature – increase.

The aims of the study were to investigate the frequency of EMs in dreams using the above method, and to ascertain whether AMs that are richly episodic but fall short of autonoetic consciousness would be more ubiquitous in dreams than EMs. It was hypothesised that there would be a disproportionate distribution of the memory sources of dreams, with there being very few dream reports containing pure EMs, but many more containing AM features.

Method

Participants

Participants were recruited via a participation credit scheme at Leeds Metropolitan University, in which undergraduate psychology students participate for course credits, and via opportunity sample. 32 participants (26 female, 6 male; 16 Leeds Metropolitan University undergraduates, 16 colleagues, friends, and acquaintances of the experimenters) were recruited, with an age range of 19 to 55 years of age ($M = 26.44$, $SD = 9.40$). 328 dreams in total were collected with a mean of 9.91 dreams per participant ($SD = 4.87$). Of these, 186 were suitable for analysis, having both a dream and a description of its waking relation. It was decided to exclude dreams with no discussion of wake-dream relation because for some dreams, there were one or two waking-life *elements* reported (such as a character or a location), but no waking-life experience detailed in the report, meaning that it was not possible to compare the dream against an actual event.

Design

The dream-diary paradigm was employed over fourteen consecutive days. Participants were requested to record as many of their dreams as possible, in as much detail as possible but without post-hoc elaboration, upon awakening from sleep at any part of the night or in the morning, or at any time during the following day. Daily reports were recorded prospectively each day rather than retrospectively at the end of the study. This closely followed the method employed by Fosse et al. (2003). Though reliant on spontaneous recall in the morning following sleep, home-based studies have been

shown to differ little, in terms of the content of dreams, to systematic-awakening (laboratory-based) studies (Domhoff & Schneider, 1999).

The waking-life diary involved reporting up to five Major Daily Activities, Personally Significant Events and Major Concerns (each after Fosse et al., 2003), plus Novel Experiences from that day. Analyses on the different waking-life experiences are reported in Malinowski and Horton (*under review*). Participants also provided a report on how the dream related to their waking-life experiences. Instructions were given on how to report waking-life activities and wake-dream relations, including rating dream elements for wake-dream similarity on a scale of 1 (no similarity) to 5 (identical). Fosse et al.'s criterion of the conservation of all actions, locations and characters was not included, as discussed. Finally, participants were interviewed at the end of the fourteen days of the study to allow further investigation of dream-wake relations. The interview schedule contained starter questions such as: "Can you tell me more about [dream and corresponding waking event]?"

An Episodic Richness in Dreams scale (Table 1) was developed to assess the extent to which EMs and AMs were present in participants' dreams, adapted from the episodic richness scale of the Autobiographical Memory Interview (AMI), and also using Fosse et al.'s (2003) similarity criterion. Ratings were based on participants' dream, waking-life activity, and wake-dream relation reports, and interview material (which augmented brief or missing information from the reports), and frequencies were calculated for each of the points on the scale. No further analyses were conducted on the interview data.

Table 1 – Episodic Richness in Dreams scale

-
- 4 points** Dream contains highly similar replaying of the original experience(s), containing at least 2 elements with similarity ratings of 4 or 5, and evokes an impression of true re-experiencing.
- 3 points** Dream contains highly similar replaying of the original experience(s), containing at least 2 elements with similarity ratings of 4 or 5.
- 2 points** Dream contains moderately similar replaying of the original experience(s), containing at least 2 elements with similarity ratings of 2 or 3.
- 1 point** Dream contains mostly low levels of similarity with original experience(s), containing mostly elements with similarity ratings of 1.
- 0 points** Dream contains no information relating to waking-life experiences.
-

0 points denoted a dream that contained no information from an episode from the dreamer's life. 1-3 points denoted a dream containing non-episodically rich (1), moderately episodically rich (2), or highly episodically rich (3) memories. 4 points denoted a true EM with auto-noetic consciousness. Points 3 and 4 were identical other than the added criterion of auto-noetic consciousness for point 4. Points 1-3 referred to AM incorporations: they were episodes from the dreamer's personal history, but not true EMs because they did not contain auto-noetic consciousness.

Materials

Participants were given a booklet in which to record their dreams and daily activities for fourteen consecutive days. The front page contained the instructions on how to record dreams, daily activities, and wake-dream relations. The remainder of the

booklet comprised one Daily Activity Log and three Dream Logs for each day of the study (fourteen days in total, a total of fourteen Daily Activity and 42 Dream Logs).

Each Dream Log contained one A4 page for participants to describe the dream and rate it for emotional and stressfulness intensities on a scale of 0 (not at all intense) to 9 (very intense) (for which analyses are reported in Malinowski and Horton (*under review*)). On the back of this page there was space for participants to identify up to 20 elements (characters, objects, actions, locations, emotions and themes) of the dream that related to a waking event or thought, and record the degree of similarity between the dream and the waking experience on a scale of 1 to 5. Finally, space was provided for participants to describe the waking event(s) or thought(s) that they believed the dream was related to.

A Pulse Smartpen and dot paper (a pen with built-in Dictaphone that records speech and writes at the same time) was used to audio-record interviews with participants.

Procedure

Participants met with one of the experimenters, and were instructed on the requirements of the study. Once any questions they had were sufficiently answered, participants were given an information sheet to read and an informed consent form to sign, which detailed that the voluntariness of their participation, their anonymity, and their right to withdraw from the study at any time without reason or negative consequence. Following this, participants were given the booklet and required to follow the instructions within and return it after they had completed the fourteen consecutive days of the study. Once participants had returned their booklets, they had a 20 minute interview with one of the experimenters focusing on dreams that were accompanied by a related waking-life experience report.

The study abided by British Psychological Society ethical guidelines, and received local approval from the university's ethics review panel.

Analyses focused on rating dreams on the Episodic Richness in Dreams Scale. Initial analyses were conducted by the first author. To test for inter-rater reliability, a subset of the dreams (20%) was scored by a second judge; rate of exact agreement was calculated to be 82.5%, and the remaining disagreements were discussed and resolved.

Results

A total of 328 dreams were submitted, ranging from 8 to 404 words in length ($M = 82.43$, $SD = 58.81$), of which 186 were suitable for analysis (having both a dream and an accompanying waking-life experience report – all dreams meeting this criterion were included, irrespective of report length), again ranging from 8 to 404 words ($M = 86.42$, $SD = 61.39$). They were rated for episodic richness on the scale of 0 to 4 and frequency counts of each scale level (i.e. points 0, 1, 2, 3, and 4 on the scale) were calculated to obtain a percentage for each scale level.

The mean score for Episodic Richness in Dreams was 1.56 ($SD = .78$), indicating that dreams mostly contained low to moderate levels of similarity with a waking-life experience. Table 2 shows the distribution percentages for each point on the Episodic Richness in Dreams scale, and Table 3 gives an example of the scoring for each kind of dream-wake relationship.

Table 2 – Distribution of frequency of points on Episodic Richness in Dreams scale

Point on scale	Frequency
4	1/186 (0.5%)
3	22/186 (11.83%)
2	66/186 (35.48%)
1	88/186 (47.31%)
0	9/186 (4.84%)

As can be seen, EMs with auto-noetic consciousness were very rare (0.5%), and the frequency increased as episodic richness decreased, from high episodic richness (11.83%), to moderate episodic richness (35.48%), to low episodic richness (47.31%). Dreams containing no wake-dream relations were also quite rare (4.84%). Furthermore, 142 of the total 328 dreams did not include any wake-dream relation reports.

Table 3 – Examples of dreams on the 0-4 point scale

4 points	“I dreamt about the argument. It was exactly the same as the real argument. I woke up not knowing if it was real.” (Elements with similarity ratings of 4 or 5 included location and people.)
3 points	“The whole dream involved me having to clean up a leak at the restaurant at work under the drinks island. It was coffee that was leaking from the machine and it was very frustrating and unusually distressing.” The setting, the work colleagues, and the situation of cleaning up a leak were all from the participant’s waking-life experience of working the

previous day. However, the dream did not elicit a sense of mental re-enactment (autonoetic consciousness).

2 points “I was working as a waitress at a massive function with loads of guests. The surroundings were not familiar to me. My best friend L__ was also a waitress. There were two men they were the chefs, who I used to work with in real life.” This was related to a similar waitressing job the participant used to have, with the friend and the male chefs, but the location and action of the dream were not from a memory of this job.

1 point “I was one of a gang of four kidnapers of twins (babies). For some reason we were giving them injections in the head – I think they were inoculations but I didn’t approve of what we had done but didn’t feel I could say so. The setting seemed to be a workplace, and close to a docklands area.” This related to the participant having her baby inoculated.

0 points “I was pregnant but the bump wasn’t very big but I was due and I went into labour in time to get to the hospital, but I could feel the baby’s hands on my pelvis and I told the midwife and she put her hands in me and moved the baby around, then it came out really fast and painlessly and it was Hispanic, massive, and a boy, had loads of hair and looked like an old Mexican man!” The participant’s description of wake-dream relations was: “I really don’t know – totally random dream”.

Discussion

As predicted, EMs, defined as featuring auto-noetic consciousness (Baddeley, 2001; Gardiner, 2001; Levine et al., 2002; Tulving, 2002), were found to be very rare in dreams (0.5%). This 0.5% represents just one out of 186 dreams. The waking experience to which the dream relates occurred on the evening of the fifth day of the experiment, with the dream coming on the sixth, just over twenty-four hours later, in keeping with the idea that episodic memories are of short duration (Conway, 2001, 2009; Williams et al., 2008).

Highly similar AMs from waking life, which are episodically rich but lack auto-noetic consciousness, occurred with much greater frequency, making up over a tenth of all dreams reported (11.83%). This figure is comparable to Dement et al.'s (1965) 12% of dreams containing complete incorporation of the experimental situation. As discussed by Fosse et al. (2003), the difference between their findings and Dement et al.'s probably occurred due to increasingly liberal criteria in the latter, such as permitting character substitution. The criteria used in the present study for highly episodically-rich AMs is similarly liberal, stipulating that dreams must be 'highly similar' to the original experience, but allowing them to include such things as different locations or character substitution. This falls in line with current conceptions of AM (Conway, 2001, 2009; Conway & Pleydell-Pearce, 2000; Williams et al., 2008).

Dreams with moderate similarity to waking-life experiences were common (35.48%). This figure is comparable to that found by Cavallero et al. (1990), who found that between 28% and 38% of dreams across the night contained EMs. Again, the increase in the proportion of EMs in dreams in Cavallero et al.'s study and in dreams scoring 2 points on the Episodic Richness in Dreams scale in the present study can be explained by the continuing increasingly liberal criteria in defining EMs, since 2 points in the present study denoted moderate similarity to an EM from waking life, and Cavallero et

al.'s relatively broad definition of 'episodic' similarly allowed for only moderate relations to waking life to constitute EMs.

Most common were dreams that had low levels of similarity to waking-life experiences (47.31%). This falls in line with the many studies that found high incidences of episodic features from waking life (as reviewed by Fosse et al., 2003). The way EM and AM are operationalised influences the interpretation of the memory sources of dreams. We propose that relationships between AMs from waking life and dreams are a more appropriate conceptualisation of the memory sources of dreams than EMs in dreams.

Although the present study differs in its conceptualisation of EM, using a theory-driven definition, it mirrors the findings of Fosse et al. (2003). In fact, the present study found EMs to be even rarer. These findings indicate that true EM is indeed extremely rare in dreams, utilising the dream-diary paradigm. Since the question concerning the definition of EM has now been addressed, the question of why intact EMs were found to be so rare in dreams must be considered.

It has been suggested that memory sources of dreams, as an operationalisation of the Continuity Hypothesis, reflect the activation of memories during the processes of sleep-dependent consolidation. However, following this line of argument, the present findings may seem at odds with evidence of EMs being consolidated in sleep (Rauchs et al., 2004). We propose that the partial activation during sleep of information from waking life still fulfils a function of consolidation.

Some memory researchers (Conway, 2001, 2009; Williams et al., 2008) have suggested that EMs may be replayed fragmentarily because only that which is novel or salient need be consolidated and incorporated into longer-term memory schema such as the AM system. This view has been endorsed also by sleep and

dream researchers, such as Schwartz (2003), who suggests that the 65% of EM elements found by Fosse et al. (2003) may be present fragmentarily due to their novelty or salience. Similarly, Payne and Nadel (2004) regard dreams as a reflection of the biological process of consolidating new memories and integrating them into older ones, while Stickgold et al. (2001) suggest that the unique activation of the REM brain is geared up “to identify and evaluate novel cortical associations in the light of emotions” (p.1056). The emphasis, then, is on the novelty and/or the salience of the waking-life memories. Further, waking-life experiences may be selectively consolidated depending on their levels of emotionality. Payne et al. (2008) have demonstrated that emotional waking-life memories are selectively consolidated over neutral ones, and two studies have demonstrated that emotional waking-life experiences are preferentially incorporated into dreams (Malinowski & Horton, *under review*; Schredl, 2006). The inference is that whole, intact EMs are not useful information; therefore they are not replayed in dreams this way. Alternatively, it may be that intact EMs are mostly not re-activated during sleep because of the potential confusion they could create with waking reality, as in the only dream that was scored 4 out of 4 on the Episodic Richness scale. These notions accord with the present study’s findings that the majority of dreams were rated with one point on Episodic Richness in Dreams scale (the least amount of episodic richness possible on the scale without being zero); the original memories may have been incorporated fragmentarily, according to usefulness.

The ~80% of dreams in the present study that contained low to moderate levels of episodic richness also contained much additional created detail, forming dreams incongruent with waking reality. Such ‘dream bizarreness’ may reflect the sleeping brain’s tendency to dream of one’s waking life, and especially one’s emotional concerns, metaphorically (e.g. Hartmann, 1996). As the sleeping brain progresses from sleep onset to NREM to REM sleep, the amount of hallucinatory (as well as

emotional) activity increases, and the amount of logical, directed thought decreases (Baylor & Cavallero, 2001). There may be some purpose behind this exchange: perhaps as (episodic) memory consolidation slows down from sleep onset to REM sleep, and some other function, relating to the processing of emotions, speeds up (Stickgold et al., 2001).

A methodological challenge of the present study is that, as in Fosse et al. (2003), it relies on experimenter ratings, and it has been shown that external raters underestimate various aspects of dreams (e.g. Schredl & Doll, 1998). To verify the present findings, future studies could use participant-given ratings for the memory sources of dreams. Further, identifying the prevalence of different 'bound' autobiographical features (such as characters with locations, for instance) might provide insight into the degrees of association between AM elements, throughout the consolidation process. Sampling both dreams and AMs as systematically as possible, using lab-based systematic awakening paradigms, would reduce the error associated with lengthy intervals between experience and recall.

AM has scarcely been touched upon in dream research. Much more research is needed to gauge how AM appears in dreams (Horton & Conway, 2009; Horton et al., 2010). Additionally, as noted above, EMs may play out more in NREM dreams than REM dreams. Future studies exploring EM, conceptualised in accordance with current memory theory, should also investigate NREM dream reports, using a systematic-awakenings paradigm.

In conclusion, we have found that, utilising a definition of episodic memory that falls in line with current theoretical conceptualisations of it including featuring auto-noetic consciousness, dreams very rarely feature intact episodic memories. This is in line with Fosse et al.'s (2003) findings. However, dreams frequently contained memory sources

with low to moderate levels of episodic richness, indicating that memories for personal experiences do appear in dreams, albeit fragmentarily. We suggest that these memories may be conceived of as autobiographical memories. Rather than replaying experiences intact, dreams constitute autobiographical memory constructions.

References

Baddeley, A. The concept of episodic memory. In: A. Baddeley, J. P. Aggleton, and M. A. Conway (eds) *Episodic memory: new directions in research*. Oxford University Press, Oxford, 2001: 1-10.

Baylor, G. W., and Cavallero, C. Memory sources associated with REM and NREM dream reports throughout the night: a new look at the data. *J. Sleep Res.*, 2001, 24: 165-170.

Cavallero, C., Foulkes, D., Hollifield, M., and Terry, R. Memory sources of REM and NREM dreams. *Sleep*, 1990, 13: 449-455.

Conway, M. A. Sensory-perceptual episodic memory and its context: autobiographical memory. In: A. Baddeley, J. P. Aggleton, and M. A. Conway (eds) *Episodic memory: new directions in research*. Oxford University Press, Oxford, 2001: 53-70.

Conway, M. A. Episodic memories. *Neuropsychologia*, 2009, 47: 2305-2313.

Conway, M. A., and Pleydell-Pearce, C. W. The construction of autobiographical memories in the self-memory system. *Psychol. Rev.*, 2000, 107: 261-288.

Dement, W. C., Kahn, E., and Roffwarg, H. P. The influence of the laboratory situation on the dreams of the experimental subject. *J. Nerv. Men. Dis.*, 1965, 140: 119-131.

Domhoff, G. W., and Schneider, A. Much ado about very little: the small effect sizes when home and laboratory collected dreams are compared. *Dreaming*, 1999, 9: 139-151.

Fosse, M. J., Fosse, R., Hobson, J. A., and Stickgold, R. J. Dreaming and episodic memory: a functional dissociation? *J. Cogn. Neurosci.*, 2003, 15: 1-9.

Gardiner, J. M. Episodic memory and autonoetic consciousness: a first-person approach. In: A. Baddeley, J. P. Aggleton, and M. A. Conway (eds) *Episodic memory: new directions in research*. Oxford University Press, Oxford, 2001: 11-30.

Hartmann, E. Outline for a theory on the nature and functions of dreaming. *Dreaming*, 1996, 6: 147-170.

Hall, C. & Nordby, V. (1972). *The individual and his dreams*. New York: New American Library.

Hobson, J., Pace-Schott, E., and Stickgold, R. Dreaming and the brain: towards a cognitive neuroscience of conscious states. *Behav. Brain Sci.*, 2000, 23: 793-1121.

Horton, C. L., and Conway, M. A. The memory experiences and dreams questionnaire (MED-Q): a validated measure of dream remembering. *Imagin. Cogn. Pers.*, 2009, 29: 3-29.

Horton, C. L., Kahan, T., and Svob, C. Dream Remembering, *Int. J. Dream Res.*, 2010, 3: S3-4.

Kopelman, M. D., Wilson, B. A., and Baddeley, A. D. The Autobiographical Memory Interview: a new assessment of autobiographical and personal semantic memory in amnesic patients. *J. Clin. Exp. Neuropsychol.*, 1989, 11: 724-744.

Levine, B., Svoboda, E., Hay, J. F., Winocur, G., and Moscovitch, M. Aging and autobiographical memory: dissociating episodic from semantic retrieval. *Psychol. Aging*, 2002, 17: 677-689.

Malinowski, J., and Horton, C. L. Evidence for the preferential incorporation of emotional waking experiences into dreams. *Under review*.

Payne, J. D. (2010). Memory consolidation, the diurnal rhythm of cortisol, and the nature of dreams: a new hypothesis. In: Clow, A. & McNamara, P., eds. *International review of neurobiology: dreams and dreaming*. London: Elsevier, pp. 103-134

Payne, J. D., and Nadel, L. Sleep, dreams, and memory consolidation: the role of the stress hormone cortisol. *Learn. Mem.*, 2004, 11: 671-678.

Payne, J. D., Stickgold, R., Swanberg, K., and Kesinger, E. A. Sleep preferentially enhances memory for emotional components of scenes. *Psychol. Sci.*, 19, 2008: 781-788.

Rauchs, G., Bertran, F., Guillery-Girard, B., Desgranges, B., Kerrouche, N., Denise, P., Foret, J., & Eustache, F. Consolidation of Strictly Episodic Memories Mainly Requires Rapid Eye Movement Sleep. *Sleep*, 2004, 27: 395-401.

Rauchs, G., Desgranges, B., Foret, J., and Eustache, F. The relationships between memory systems and sleep stages. *J. Sleep Res.*, 2005, 14: 123-140.

Roediger, H. L. III, and McDermott, K. B. Creating false memories: Remembering words not presented in lists. *J. Exp. Psychol. Learn. Mem. Cogn.*, 1995, 21: 803–814.

Schredl, M. Factors affecting the continuity between waking and dreaming: emotional intensity and emotional tone of the waking-life event. *Sleep Hypn.*, 2006: 8, 1-5.

Schredl, M., & Doll, E. Emotions in diary dreams. *Conscious. Cogn.*, 1998, 7: 634-646.

Schwartz, S. Are life episodes replayed during dreaming? *Trends Cogn. Sci.*, 2003: 7, 325-327.

Stickgold, R., Hobson, J. A., Fosse, R., and Fosse, R. Sleep, learning, and dreams: off-line memory processing. *Science*, 2001, 294: 1052-1057.

Stickgold, R. & Walker, M. P. (2005). Memory consolidation and reconsolidation: what is the role of sleep? *Trends in Neurosciences*, 28 (8), Aug, pp. 408-415.

Tulving, E. *Elements of episodic memory*. Clarendon Press, Oxford, 1983.

Tulving, E. Concepts of human memory. In: L. Squire, G. Lynch, N. M. Weinberger, and G. McGaugh (eds) *Memory: Organization and Locus of Change*. MIT Press, Cambridge (MA), 1991: 3-32.

Tulving, E. Episodic memory: from mind to brain. *Annu. Rev. Psychol.*, 53, 2002: 1-25.

Walker, M. P. & Stickgold, R. (2006). Sleep, memory, and plasticity. *Annual Review of Psychology*, 57, pp. 139-166.

Williams, H. L., Conway, M. A., and Baddeley, A. D. The boundaries of episodic memories. In: T. F. Shipley, and J. M. Zacks (eds) *Understanding Events: From Perception to Action*. Oxford University Press, New York, 2008: 589-616.