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# Recall and Recognition of Dreams and Waking Events: A Diary Paradigm

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**Summary.** Dream recall is often considered to be poor, although it is rarely systematically compared to the retrieval of waking event memories. A diary paradigm was implemented to explore the memory profile of recalled dreams over time, in comparison to recalled waking experiences. Twenty-five participants completed a dream and waking-event diary over two weeks. Titles of reports were re-presented in a surprise recall task. Subsequently, extracts of the reports were re-presented for recognition. No significant differences were found between dream and waking event memories in terms of either recall or recognition although some differences were found in terms of recollective experience, with waking-events being “remembered” as episodic memories more than dreams. Diary dream memories that are recalled, reported and to some extent rehearsed are therefore accessible and detailed in a similar manner to waking experiences, providing that they are adequately encoded close to their time of occurrence. The continuity of retrieval processes over sleep and wake is outlined.

**Keywords:** Recognition; Dream recall; Recollective experience; Dreaming; Memory retrieval

## 1. Introduction

The study of dreams relies upon memory for dream experiences, as there is (as yet) no method of measuring dreams objectively. Hence, in order to investigate dreams, it is necessary to comprehend the processes involved in remembering them. If much detail of a dream memory is lost, it is difficult to ascertain the validity of the original dream experience. Unfortunately the distinction between characteristics of a dream memory as defined distinctly from a dream experience is rarely acknowledged in the dream literature. Applying knowledge of waking memory to dream memories enables an understanding of the extent to which we can trust reports of dream experiences.

Memories for dreams can be compared to memories for waking experiences. We may assume that dreams are episodic memories (Conway, 2001; Tulving, 1983) – specific memories for an experience or an event – however dreams are likely not encoded in the same way as waking experiences due to the relative attenuation of the brain, in particular the frontal lobes whilst asleep (Braun et al., 1997; Hobson, Stickgold & Pace-Schott, 1998; Hobson et al., 2000; Maquet, 2000; see also Horton, 2008). There is therefore reason to believe that the characteristics of dream and waking memories could differ. Dreams are experientially different to waking memories, experienced when in a somewhat different physiological environment, and likely not immedi-

ately encoded as memories. It follows that dreams that are reported in a diary paradigm are transferred into a verbal account whilst in the waking state. This relies upon memory construction processes (Cicogna, 1983; Cipolli, Calasso, Maccolini, Pani & Salzarulo, 1984), rendering dreams more comparable to autobiographical memories than episodic memories (Conway, 1990; 2005; 2009; Horton, 2008; Horton & Conway, 2009; Horton, Kahan & Svob, 2010; Horton, Moulin & Conway, 2009). The present paper explores the memory profile of dreams in comparison to waking events, in terms of their characteristics at the time of reporting as well as those at the time of retrieval.

Autobiographical memories are considered to be constructed in accordance with the self, whilst episodic memories may replay an experience, to some extent, especially if retrieved with auto-noetic consciousness, or recollective experience (Tulving, 1983). A small body of research has demonstrated the overlap between autobiographical memory functioning and dreaming (Botman & Crovitz, 1989-90; Cappeliez, 2008; Grenier et al., 2005; Horton, 2008; Horton & Conway, 2009). In addition Fosse, Fosse, Hobson and Stickgold (2003) argue that episodic memories are not replayed during dreaming but, rather, that fragments of autobiographical information may be activated in the sleeping brain (see also Horton et al., 2009). This indicates that episodic memory may not function whilst asleep in the same way as whilst awake. Indeed, the autobiographical memory system may also likely operate differently in the sleeping brain. This leads to the idea that the development of dreams as memories may differ from the development of memories for waking experiences. Relatively little has been investigated in a systematic and rigorous manner in terms of autobiographical memory functioning and dream recall. The present paper explores the nature of dreams as episodic memories, by employing a recollective experience paradigm at retrieval (Dewhurst & Conway, 1994; Gardiner, 1988; Tulving, 1983). This aimed to determine whether dreams are

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less likely to be retrieved as episodic memories, compared to memories for waking events.

Various models of dream generation acknowledge that, for dream memories, the sleeping brain renders it difficult for an experience such as a dream to be encoded during or shortly after its occurrence. However when retrieved, the waking brain is substantially more active. In contrast, waking memories can be consciously (as well as non-consciously) encoded and retrieved. This may give rise to a recall advantage for waking memories over dream memories, especially if they have been rehearsed whilst awake (Horton, 2008; Horton et al., 2010). Although investigating dreams as memories cannot allow processes of dream generation to be inferred, exploring the retrieval of dreams as memories can provide insight into how dreams differ from waking memories, thus allowing memory theory to inform dream science. On the basis of our current understanding of dreams, one could predict that dream memories are likely to be less recallable than waking event memories.

Support for these ideas come from findings that dreams are rarely easily recalled (e.g. Reed, 1974) and that waking memories seem to be far richer in characteristic detail than dream memories (Johnson, Kahan & Raye, 1984; Kemp & Burt, 2006; Kemp et al., 2003). That is, studies have generally found that dreams contain less perceptual and contextual detail than memories for actual experiences. These differences imply that dreams are difficult to encode and are thus less recallable and less detailed than comparable waking experiences. Of course some dream memories must be encoded, whether whilst asleep or upon awakening, as it is possible to recall some dreams. Characteristic measures of memories allow the strength of the memory trace to be investigated, as do measures of memory detail, such as report length. We could assume that the characteristics of dream memories will be less strong and intense than those for waking event memories.

An alternative view then is that dreams are encoded but become more difficult to retrieve over time. Kemp, Burt and Sheen (2003) indeed noted that dreams may become increasingly difficult to access over time. Thus one might predict that immediate dream recall upon awakening is easy, but that long-term dream memories decay (Parke & Horton, 2009). Presenting more cues at retrieval would allow a deeper investigation of the strength of the possibly decaying memory trace, over time. Recognition tasks, as opposed to recall tasks (the latter requiring memories to be brought to mind spontaneously with minimal cues) provide a potential method of investigation. Thus it would follow that the ability to recognize elements of dream memories may be comparable to that for waking memories, even if recall is more difficult for dream memories.

It is unclear as to whether dreams and waking experiences display the same recall and recognition trends over time. That is, are dreams similarly recognizable and recallable than events, or more so? Work from our laboratory has demonstrated that retrospectively experienced dreams are more difficult to recall freely than waking events (Horton, 2008), however it is not clear as to whether the dream memory trace has vanished entirely. If the latter, recognition of dreams would be problematic also. If the memory trace exists and is simply difficult to access, recognition rather than recall may facilitate retrieving details of that dream.

One notable investigation employed recall as well as recognition measures of dream memories. Montangero, Ivani

and de Saint-Hilaire (2003) directly compared the recallability, as well as the characteristics, of dreams and waking memories. Waking memories were manipulated to be comparable to dreams in that dream-like films were created and presented to individuals when awoken at specific times in a sleep lab, so to be as similar to dreams as possible. Thus, dreams and the "events" (films) were compared appropriately, as the films were presented to participants in the night, after they had been awakened 10 minutes after the second onset of REM sleep, when arousal levels and brain activity would be as comparable to the dreaming brain as possible. In addition, the films were viewed and recalled by the participants, being similar to experiencing a dream and then recalling it. More information was recalled in the morning, than when the original experience was recalled in the night, indicating that the experience could be communicated coherently whilst awake. In the case of the films, the validity of the memories of the extra information could be verified, and was found to be accurate in most instances (86%).

The findings of Montangero et al. (2003) implied that dream memories are accessible. This is largely contrary to many other studies on dream recall. However, Montangero et al. (2003) provided suitable memory cues in the form of event specific knowledge about the dreams and films, and their recent occurrence may have contributed to the dreams being more recallable than older dreams. The films also differ substantially from waking autobiographical experiences and typical waking event memories, upon which most academic understanding of memory is based. The investigation presented in the present paper measured recognition of waking event memories over a longer time scale, to see whether dream memories may be accessible in a similar manner and whether recall task performance would also be comparable.

The present experiment explored recently recalled dreams and events (waking experience memories) in a diary paradigm. Dreams and waking experiences were reported, and three weeks later a recall task explored whether memories had changed, i.e. whether information was lost over time. A subsequent recognition task one week later then investigated whether dreams might still be accessible episodically, as compared to waking events. Predictions were made about the memories' characteristics, and recall and recognition trends. That is, dreams would be less detailed, episodically rich, positively emotional, salient and comprehensible than events, in line with previous findings (Johnson et al., 1989; Kemp & Burt, 2006; Kemp et al., 2003). The episodic nature of these memories was assessed using a recollective experience paradigm. It was also hypothesized that dreams would be less recallable than waking events over time. Recognition scores were predicted not to differ between dreams and events, however, assuming that dream memories remain accessible (Montangero et al., 2003) if cued sufficiently. Furthermore, as the memory qualities of dreams and events were compared, the characteristics of those experiences that had been remembered in the recall phase, as distinct from those that were forgotten, were of interest to determine the characteristics that may be particularly important in determining the likelihood of subsequent recallability. No specific predictions were made concerning the comparisons of the characteristics of the remembered versus the forgotten reports, as these analyses were novel and exploratory.

## 2. Methods

### 2.1. Participants

Email advertisements for the experiment were distributed to all undergraduate and postgraduate students at the Institute of Psychological Sciences, University of Leeds. Respondents were asked to participate in a dream diary study and were informed that they would be required to recall and report their dreams. They were asked if they usually recalled their dreams. Some participants reported that they struggled with recall, but would engage with the study nonetheless. Initially 63 participants were recruited. 37 people managed to record their dreams and events (26 were unable to recall the recommended minimum of five dreams). However only 25 completed the full tasks.

Sample attrition was likely due to the length of the study and unexpected difficulties encountered when completing diaries at home. Specifically, some participants found it difficult to report their dreams, and some admitted that diary completion was troublesome to incorporate into a morning routine. This resulted in a sample consisting of 4 males and 21 females, likely of relatively high or motivated dream recallers. The mean age was 19 years. Participants were awarded with course credits and were paid £10 upon successful full completion. The analyses reported here are for the 25 individuals who completed the entire study.

### 2.2. Design and materials

The paradigm involved reporting dreams and waking events in a diary. A surprise recall task was administered approximately three weeks later and a surprise recognition task followed one week after that. The design was experimental insofar as controlling for mode of memory retrieval (recall vs recognition), however analyses were to some extent exploratory also. A full outline of measures employed and associated scoring techniques, are outlined below.

In the first phase of the study participants were required to recall dream and waking memories. A standard template was used for each report (see Horton, 2008). Participants were given a pack of 30 templates (for up to 15 dream and 15 event reports to be recorded). These templates included space for the memory to be handwritten, rating scales and information about when and where the memory occurred. All reports were given a unique title by participants. Characters involved in the memory were listed.

In the second phase ten reports were selected randomly consisting of five dreams and five events, for a surprise recall task. The titles of these reports were presented to the participant as a recall cue. (Debriefs indicated that no participants had expected this task to occur, thus we can eliminate the confound of deliberate or strategic rehearsal of memories.) A control sample rated the titles and deemed them to be of comparable salience across individuals, even though some were longer than others. Thus these cues arguably relied upon autobiographical memory rather than logic in the recall task. Participants were then instructed to write as much as they could recall about that event.

For the third phase (recognition task), the same ten reports were selected and formed the basis of the recognition items, which were re-presented for memory ratings to be undertaken. All tasks were completed in pen and paper form.

### 2.3. Measures

A number of dependent variables were measured. In the diary phase, word counts of reports were taken along with four rating scales (as completed by the participant): emotionality, comprehensibility, personal importance/salience (from hereon referred to as, "importance"), and surprise, as used and described by Horton, Moulin and Conway (2009). Dream characters were listed and identified as familiar (had been encountered in waking life, or were recognisable, such as a character from a television programme) or unfamiliar. The number of familiar and unfamiliar characters were counted by the research team. Detail and episodic richness scores were assigned to the reports as based upon the ratings of the Autobiographical Memory Interview (AMI; Kopelman, Wilson & Baddeley, 1989) on a scale of 0-3. A detail score of 3 concerned a detailed personal memory that is specific in place and time. A score of 2 involved either "a specific personal memory with few or no details" or "a less specific event in which time and place are recalled". A score of 1 depicted "a vague personal memory" or "an incident that occurred on multiple occasions but no single instance is recalled". Memories corresponding to the latter definition omitted any references to the unique episodic nature of the memory. Similarly a score of 0 denoted either no recollection or a response based on general knowledge. The episodic richness score is a basic extension of the detail score, although refers to the specificity of the occurrence. Elaborations almost always contained sensory-perceptual information. A score of 3 denoted a memory response "...rich in detail, containing at least 2 elaborations, and [that] evokes an impression of true re-experiencing". A score of 2 denoted a response with "moderate detail" also containing at least 2 elaborations. 1 point referred to "limited detail and/or limited elaboration of events" and reports scored 0 contained no episodic information. All quotes were taken from the AMI scoring guidelines (Kopelman, Wilson and Baddeley, 1989).

At the recall phase (Phase 2) the same characteristic ratings of detail and episodic richness, as well as word counts, were scored by the research team. In addition a detail rating ("How much detail can you recall? All the details; most of the details; some of the details; a few of the details; none of the details") determined a comparable measure of strength of memory across participants. This was followed by a large box in which the participant was instructed to record their memory of the experience in as much detail as they could.

Phase 3 took the form of a recognition task. This 40-item task was structured such that there were an equal number (20) of targets and lures. Target sentences came from dreams (10 sentences) and waking events (10 sentences). Two sentences from each selected report were used as targets. No report was so brief that it did not include at least two sentences. Lures were devised as being related to the selected report cues (report titles – 5 dreams and 5 events) or non-related (10 sentences). Typically one aspect of the cue featured in the non-related lure sentence, whilst at least one other was changed, so to create an experience that was believable and typical of a dream or event. An example of such a sentence, related to the title, "violin at Albert Hall", was, "It was amazing to be playing my violin at such a place - the audience was huge". The non-related lure sentences in each task were administered to all participants (see Appendix A). These sentences were matched along the dimensions of emotionality, comprehensibility, personal importance/salience, and surprise as they typically appeared

for each memory type (as based upon findings from unpublished pilot studies from the author's lab). That is, the dreams were more negatively emotional and surprising, although less comprehensible and salient than the events. 30 of the 40 items in the recognition task were unique to each participant. An example of a target dream sentence was, "The garden was very strange and things seemed to be out of proportion". A comparable event target item was, "Gave first oral presentation at conference, in Coventry".

If a presented sentence was judged to have been recognized, by answering "yes" to: "This sentence appeared in one of your dream/event reports" Y/N, participants were required to indicate the episodic nature of their recognition memory through the recollective experience paradigm (Dehurs & Conway, 1994; Gardiner, 1988; Rajaram, 1993; Tulving, 1983, 2002). Participants indicated the extent to which they remembered the actual experience happening as well as the extent to which they remembered reporting it. Both ratings featured the recollective experience responses, "remember" (indicating an episodic recollection), "know" (indicating a semantic memory), "familiar" (indicating a relatively hazy recollection) and "guess", although only findings concerning remembering the actual experience will be reported here, for brevity.

#### 2.4. Procedure

Initially, the diary phase (Phase 1) required participants to record their dreams and waking event experiences. Participants were required to record a dream whenever they could remember one occurring. Thus, if a dream could be recalled from the previous night, they were to record it as soon as possible after waking. Whenever a dream template was completed, an event template was to be completed for an episodic event from the previous day. This meant that if two or more dreams were recorded from one night, a corresponding number of event templates were also completed, each for an event that had occurred during the preceding day. This procedure was continued until as many dreams had been recorded as possible within a two-week period. Materials were returned to the experimenter at the end of this time. This method presented a number of confounds which need to be addressed: the recalled dream could have influenced the selection of the waking event experience that was reported. Participants were instructed not to necessarily select an event that was related to the dream content, however one cannot be sure that this did not occur. Further, as dreams (and events) were reported in the morning, time of day effects may have influenced recall. However the design was deemed to be non-intrusive to participants and preferentially favoured dream recall, which tends to be substantially more difficult than waking event recall. This point is returned to in the discussion.

The frequency distribution of the reported dream and event data for the 25 participants is shown in Table 1. The differences between distributions of reported dreams and waking events indicated a slight memory advantage for dreams, which may reflect the design in that waking events only needed to be reported if a dream was reported. Also the experiment recruited participants for an investigation of dreams, so participants may have prioritized these instructions.

Once these materials had been returned by post, there was an intervening period of around ten days before Phase 2 could begin (the maximum of 21 days was employed for

Table 1. Frequency of dreams and events reported in phase 1 (diary).

Frequency	dream		event	
	n	reports	n	reports
5	5	25	6	30
6	3	18	2	12
7	2	14	3	21
8	2	16	1	8
9	0	0	1	9
10	2	20	3	30
11	1	11	1	11
12	0	0	0	0
13	1	13	3	39
14	4	56	2	28
15	5	75	3	45
total	25	248	25	233

a couple of participants who were unavailable for the next phase until that time). The recall task included the ten titles of the dream and event reports. The report's title acted as a cue in the recall task. A reality monitoring task was included, requiring participants to identify the source of the memory as a dream or an event (results are not presented here, for brevity). Participants were encouraged to continue overleaf/elsewhere if required. The order of the titles (dream/event) was randomized.

After another latency period of one week, the recognition task (Phase 3) was distributed to participants. Order of presentation of all items was randomized. In the recognition task participants were instructed to identify whether each presented sentence had appeared in one of their reports or not. If a sentence was recognized, participants indicated the extent to which they recollected the experience in question, as well as the extent to which they recollected reporting it. Full instructions on how to use the ratings were administered to participants.

#### 2.5. Statistical analyses

A series of descriptive and inferential analyses were conducted, comparing characteristics, recallability and recognition values across dreams and events. In order to ascertain how much information of the original reports had been recalled, length (word count), detail and episodic richness ratings were collected and compared over the original reports and at recall. A series of 2 x 2 repeated measures ANOVAs were conducted on these data measuring the main effects of time (original/recalled), memory type (dream/event), and the time x type interactions.

For each individual, the dreams and events that were correctly remembered and those that were forgotten in the recall task were compared upon 9 dimensions: report length (word count), detail and episodic richness (on a scale of 0-3, as detailed in Kopelman, Wilson & Baddeley, 1989), number of familiar and unfamiliar characters featuring in the original report, and salience, emotionality, comprehensibility,

and surprise of the original reports. A series of comparative analyses were then conducted in order to identify whether any characteristic differences existed between the experiences that were recalled in Phase 2 as opposed to forgotten.

2.6. Control task.

In order to ascertain that differences between recognition of targets as opposed to lures in the task at phase 3 were not due to chance or logic (on the basis of dreams being typically less detailed, for example, than episodic memories, Johnson et al., 1984), an opportunity sample of 26 participants who had not completed the other phases completed a recognition task. This control task was composed of 40 items, taking the same structure and format as a typical recognition task. However “target” sentences were taken randomly from the reports of 20 participants, as were the “lures” (although strictly speaking in this case they were all lures). As these sentences described dreams and events that should have been unfamiliar to the control group, the task was to guess whether the sentence came from a dream or event report, and also to indicate whether the sentence described something that had happened to the participant before. Thus there were directly comparable recognition task data. Performance was compared across experimental and control groups, so to identify whether experimental participants were performing differently, employing the use of memory strategies as opposed to logic. Data have been omitted from this paper for brevity, however analyses demonstrated that in the experimental group actual memories were being retrieved, as based on significantly different trends being demonstrated within the control group, who had to rely upon logic when completing the recognition task.

3. Results

3.1. Phase 1

Each participant reported a mean of 9.74 dreams and 9.15 events. Waking events were significantly more important, emotional (positively), comprehensible and containing more familiar characters than the dreams, which themselves contained significantly more unfamiliar characters than the events (all  $p < 0.01$ ).

3.2. Phase 2

No differences were found between the percentage of recalled events (70%) and the number of recalled dreams (67.5%),  $t(23) = -.340$ , n.s.. Table 2 details the descriptive statistics for these variables.

Original reports were longer than those in the recall task,  $F(1, 24) = 54.96$ ,  $p < .001$ ,  $\eta^2 = .70$ , 95% CI of difference = 22.88–40.54. Experiences reported in the original diary phase (62.18) were significantly longer—about twice as long—as those reported in the recall task (30.47) for recalled reports. There was also a significant main effect of memory type,  $F(1, 24) = 14.79$ ,  $p < .001$ ,  $\eta^2 = .38$ , 95% CI of difference = 6.25–20.72, with dreams (53.07) being significantly longer than events (39.58). The interaction was also significant,  $F(1, 24) = 23.68$ ,  $p < .001$ ,  $\eta^2 = .50$ , illustrating that dreams decreased in length between the time of reporting the experience and recalling it, more than the events decreased.

Table 2. Means and standard deviations for report characteristics.

		Dream		Event	
		M	SD	M	SD
word count	Original	74.79	31.93	49.58	23.77
	Recall	31.35	22.58	29.59	20.55
Detail	Original	2.81	0.19	2.74	0.26
	Recall	2.18	0.6	2.26	0.62
Episodic richness	Original	2.20	0.23	2.01	0.23
	Recall	1.82	0.62	1.91	0.57

The same analyses were conducted for the detail scores. Original reports were much more detailed than the recalled reports,  $F(1, 21) = 41.10$ ,  $p < .001$ ,  $\eta^2 = .65$ . There was no significant effect of memory type,  $F(1, 21) = 0.02$ , n.s., as means were very similar. The interaction also did not reach significance,  $F(1, 21) = 0.33$ , n.s. As shown in Table 2, dreams were slightly more detailed than events, and the initial reports were more detailed than those of the recall task.

The original experiences ( $M = 2.11$ ) were also more episodically rich than those in the recall task ( $M = 1.86$ ),  $F(1, 21) = 5.10$ ,  $p < .05$ ,  $\eta^2 = .20$ , 95% CI of difference = .20–.47. The main effect of memory type was not significant,  $F(1, 21) = 0.54$ , n.s., but the interaction was,  $F(1, 21) = 5.213$ ,  $p < .05$ ,  $\eta^2 = .20$ , 95% CI of difference = -1.44–19.36. As for the length of the reports, dreams lost their episodic richness over time more than the events. The source of events were monitored significantly more accurately (83.2%) than dreams (72.8%),  $t(24) = -2.40$ ,  $p < .05$ .

Recall performance was similarly high for both dreams and events, with 75.87% accuracy for dreams and 77.61% for events,  $t(24) = -.76$ , n.s..

3.3. Phase 3

If a presented target sentence (from an actual report) was judged to be “true”, or a lure sentence, “false”, that sentence had been correctly recognized. Table 3 details the percentage of hits (correct recognition) and false positives (FPs; incorrect recognition of lure sentences) for dreams and events. Recognition performance was similar for both dreams and events. The means of 77.6 and 71.7 (%) for dreams and waking events, respectively, did not differ significantly,  $t(24) = -.96$ ,  $p > .05$ .

Table 3. Percentage recognition performance and standard deviations for dreams and events.

	Hits		False positives		Overall performance	
	M	SD	M	SD	M	SD
Dreams	88.2	18.6	29.4	26.1	77.6	21.4
Events	80.7	17.4	33.8	28.0	71.7	23.5
Means	84.4	15.2	31.6	25.9	74.6	21.4

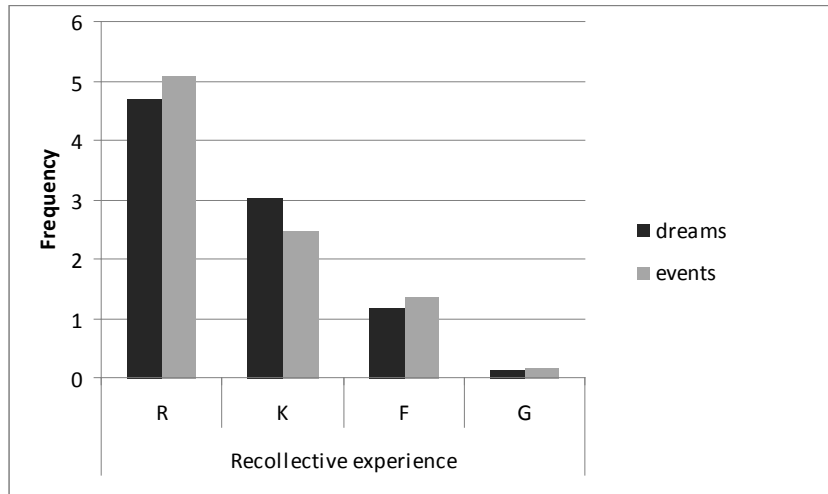


Figure 1. Frequency of recollective experience for retrieving the original experience for dreams and events (target sentences).

### 3.4. Recollective Experience

In addition to making a recognition judgement, sentences recognised (either correctly or incorrectly) were judged to be either remembered (R), known (K), found familiar (F) or guessed (G). Figure 1 illustrates these trends for target sentences, that is sentences that were correctly recognized. Patterns of recollective experience differed for the dreams and events with events ( $M = 2.23$ ,  $SD = 0.09$ ) having higher values than dreams ( $M = 2.05$ ,  $SD = 0.14$ ),  $F(1, 20) = 5.07$ ,  $p < .05$ ,  $\eta^2 = .20$ , 95% CI of difference =  $-.34$ – $.01$ . This indicates that each participant made slightly more recollective experience judgements overall for the events, irrespective of what those judgements were. This reflects the slightly higher recognition accuracy for events than dreams, although this did not reach significance. In terms of recollective experience, a significant main effect was found with more R judgements being made and very few guesses,  $F(1.96, 39.21) = 19.75$ ,  $p < .001$ ,  $\eta^2 = .50$ . The repeated measures ANOVA assumption of sphericity was violated for the recollective experience analysis, so the Greenhouse-Geisser corrected degrees of freedom values were adopted. A significant memory  $\times$  recollective experience interaction was found,  $F(3, 60) = 3.59$ ,  $p < .05$ ,  $\eta^2 = .15$  (see detailed in Figure 1). Very few guess responses were used overall and these did not differ for dreams and events,  $t(20) = -1.21$ ,  $p = .24$ . The waking event memories were more likely to be “remembered” (R) than dreams,  $t(20) = -2.48$ ,  $p < .05$ , 95% CI of difference =  $-2.90$ – $-2.48$ , with relatively few K and F responses being used. For dreams, slightly fewer R responses were adopted but K and F responses were selected more. No significant differences were found between dreams and events for the use of K and F judgements,  $t(20) = 1.79$ ,  $p = .09$  and  $t(20) = .60$ ,  $p = .55$ , respectively.

### 3.5. Remembered and Forgotten Reports

The characteristics of all the reports that were recalled in Phase 2 were compared with those that were not recalled for each individual. This aimed to pinpoint specifically which, if any, of the characteristics seemed to be most important in ensuring that a memory was recalled a month after being reported.

A series of comparative analyses were conducted in order to identify whether any characteristic differences existed between the experiences that were recalled in the phase 2 as opposed to forgotten. Table 4 conveys the descriptive statistics for the remembered and forgotten reports for the characteristics measured. There were few forgotten reports to be characterized and compared to the recalled reports. This resulted in low degrees of freedom coupled with relatively high standard deviations so few analyses were significant. Main effects of memory were found for report lengths,  $F(1, 10) = 8.46$ ,  $p < .02$ ,  $\eta^2 = .46$ , number of unfamiliar characters described in the experience,  $F(1, 9) = 6.82$ ,  $p < .05$ ,  $\eta^2 = .43$ , for comprehensibility,  $F(1, 8) = 51.78$ ,  $p < .001$ ,  $\eta^2 = .87$ , and for surprise,  $F(1, 8) = 7.66$ ,  $p < .05$ ,  $\eta^2 = .44$ . These mirror the overall trends for the reports as described above. Furthermore, a significant memory  $\times$  remembered interaction was found for the surprise ratings of the reports,  $F(1, 8) = 5.46$ ,  $p < .05$ ,  $\eta^2 = .41$ . Forgotten reports were less surprising overall. Remembered dreams were surprising, whilst remembered events were not (as indicated by their negative score). Remembered reports were also more salient than forgotten reports,  $F(1, 8) = 5.42$ ,  $p < .05$ ,  $\eta^2 = .40$ .

## 4. Discussion

The retrieval of memories for dreams and waking events was manipulated and the memory characteristics, recall and recognition performances were compared. Memories for dreams and waking events were similarly recallable, and recognizable, thus upholding predictions about the comparability of autobiographical remembering for these distinct types of experiences. That is, there were no significant differences between the recall and recognition performances of dreams compared to waking events. This was found despite dreams being less characteristically detailed than the waking events, in line with previous findings (Johnson et al., 1984; Kemp & Burt, 2006; Kemp et al., 2003). Thus the reported dreams had been encoded sufficiently for diary reporting, but their memory traces were not as strong as those for waking experiences. Retrieval processes seemingly operate similarly for dream and waking event memories.

Table 4. Mean characteristics and standard deviations of remembered and forgotten reports.

Characteristic		Dream		Event		Total	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Word count	Remembered	75.79	31.82	53.81	29.31	59.04	42.12
	Forgotten	79.64	53.63	52.45	22.05	65.73	29.32
Detail	Remembered	2.87	0.23	2.86	0.26	2.85	0.17
	Forgotten	2.78	0.34	2.67	0.41	2.75	0.32
Episodic Richness	Remembered	2.18	0.27	2.08	0.27	2.75	0.32
	Forgotten	2.09	0.52	2.03	0.34	2.06	0.33
Number familiar	Remembered	1.67	1.18	1.7	0.84	1.58	0.54
	Forgotten	1.60	1.14	1.75	0.66	1.75	0.76
Number unfamiliar	Remembered	0.78	0.80	0.17	0.33	0.45	0.42
	Forgotten	0.52	0.62	0.18	0.53	0.3	0.43
Salience	Remembered	-0.15	0.98	0.78	0.86	0.38	0.7
	Forgotten	-0.21	1.19	0.15	1.12	0.16	0.86
Emotionality	Remembered	-0.39	0.52	0.41	0.83	0.05	0.47
	Forgotten	-0.27	0.69	0.24	0.84	-0.07	0.37
Comprehensibility	Remembered	-0.27	0.96	1.23	0.86	0.42	0.75
	Forgotten	-0.34	0.95	1.26	0.57	0.35	0.51
Surprise	Remembered	0.80	0.57	-0.35	1.04	0.18	0.64
	Forgotten	0.74	0.80	0.18	1.00	0.66	0.65

The present data therefore imply there to be some differences between dream and waking memories, in experiential terms. Specifically waking memories are more likely to be retrieved with recollective experience, indicating their episodic nature. Dreams, on the other hand, may be seen to be more autobiographical (Conway, 1990; 2001; Horton et al., 2009). It should be noted that any analysis or interpretation of sleep mentation may involve constructive processes of the (waking) memory system, thus dream reports may not always be pure accounts of sleeping experiences. Such construction typifies the autobiographical memory system (Conway, 2009). The true nature of the continuity of autobiographical memory processes over the sleep-wake cycle therefore need to be further explored, with particular emphasis upon encoding as well as retrieval of dreams compared to those processes of waking events. Manipulating and measuring dream encoding presents many methodological challenges, not least because the validity of any dream memory cannot be objectively ascertained. Future studies could nevertheless attempt to investigate the relationships between encoding and retrieval. Whilst it is assumed that dreams are somewhat difficult to encode at their time of occurrence, sampling dreams via systematic awakenings may yield more lengthy and valid reports. Daily events could be comparably sampled via an alarm system. Differences between dream and event reports may often be found, but exploring, and subsequently controlling for, contextual overlap between encoding and retrieval, would provide further

insight into the ways in which memory processes can be discerned from dream generation.

Distinguishing between the processes of dream encoding and dream generation may be rather difficult. However sampling dream and waking event reports carefully can render inferences about encoding versus retrieval, more valid. This leads to an important methodological point: Whilst every care was taken to ensure that recall and recognition cues were taken from reports with a unique title, it is highly likely that some dreams contained elements of waking memories, and that some events were reported as they related to, or were even cued by, the dream that had just been reported in Phase 1. We cannot be sure of the extent to which this occurred in the present investigation, but it is the nature of dreams that they comprise autobiographical memory references and fragments from waking life, thus this cannot, indeed should not, be entirely controlled for. A more poignant methodological issue that also concerns possible associations between dream and event reports, results from the instruction to report a waking event memory only when a dream memory had been recalled and reported. Although dreams always chronologically followed events and were reported first, dreams were more difficult to gather than events in Phase 1, thus the method ensured that a comparable number of dreams and events would be reported and used in the study. Secondly, dreams likely came from early morning experiences whilst there was no time of day limit to the waking event experiences. This reflects the true



nature of a dream's occurrence. Ideally future investigations would overcome such order and time of day effects, perhaps by employing systematic awakening procedures, such as alarms.

A further method of understanding the nature, and potential predictability, of the future retrievability of a memory, comes from comparing the experiences that were retained for subsequent access (those "remembered") to those that were not retained ("forgotten"). In the present study, when comparing the characteristics of the experiences that had been remembered as opposed to forgotten, many of the analyses did not reach significance. The statistical insignificance of other analyses may have been due to a number of factors. Firstly, dream and event reports may not have any characteristic in particular that determines whether an experience is remembered or forgotten. Rather, other factors could determine this, such as conscious encoding upon waking, or subsequent rehearsal. Secondly, the sample size was too small, considering the low numbers of reports than had been forgotten and the great variability in the values, for any significant effects to emerge. As events were better recalled than dreams, and they were significantly more salient, positively emotional and comprehensible, it seems that these characteristics may be particularly important in determining the successful retrieval of an autobiographical memory. However remembered (recalled) experiences were significantly more salient than forgotten ones, and remembered dreams were (mildly) more surprising than forgotten dreams (and indeed remembered events). This highlights the influence of salience upon subsequent retrieval of a memory (Cohen & MacNeilage, 1974). The concept of salience is worthy of further study (Parke & Horton, 2009) as it could either refer to personal importance, as in the present study, or it could refer to the strength of a memory trace.

The present experiment provided insights into the general nature of dream recall. Participants were able to recall dreams when required to do so, in great detail in the case of many dreams. Thus dream recall is not as poor as some authors would have us believe (Hobson et al., 2000; Meier, Ruef, Ziegler & Hall, 1968; Reed, 1974). Theoretically, this implies that dream memories can be accessible and detailed, in line with waking experiences, providing that dream memories are recalled and reported soon after waking, which implies that dream encoding needs to occur rather quickly upon awakening. Investigating the time course of dream memory decay might also provide further insight into the mechanisms and possibilities of dream encoding, when the wake-state is disrupted.

It has been well documented that some individuals are much more likely than others to recall their dreams. In the present study, sample attrition was high, resulting in a sample biased towards dream recall. Measures of dream recall will often be muddied by such sampling bias. Nevertheless the trends from the present experiment regarding dreams' comparability to waking memories are clear and the diary paradigm provides a valid and systematic design for the study of real world autobiographical remembering, especially as participants were not informed that their memory would be tested for the dreams and events that they reported. Another design possibility would be to collect data concerning the personality characteristics of the sample, known to correlate highly with dream recall, and to control for such individual differences trends.

Overall, these data demonstrate that memories for dreams are autobiographical experiences that are recallable and recognizable, providing the dream memory trace is sufficiently encoded in the form of being recalled and reported in a diary. While dreams are characteristically less detailed than waking experiences, they are comparable to them. The relative difficulties in recalling dreams as compared to events may reflect how dreams are less rehearsed and less salient than memories for waking events. As to whether this is the result of problems at the level of encoding, likely due to physiology of the sleeping brain, or the result of attending to waking memories more than dreams, remains to be disentangled. Data from recognition tasks described here have demonstrated that, if recalled and recorded, dream memories are as accessible as memories for waking events. However, their lack of characteristic detail, coupled with the effort taken to report the dream upon waking, indicates that reconstructive processes of the autobiographical memory system may typify dream recall. As the difference in recallability of dreams and events disappeared when measuring current experiences compared to retrospective experiences (see Horton, 2008), it is implied that given the appropriate means to do so (a dream diary and intent), dreams can be recalled and are comparable to waking autobiographical in terms of retrieval trends in the medium term, at least. As dream recall had to rely here upon waking encoding processes to some degree during initial (diary) reporting, any differences between dream and waking event memory characteristics, recallability and/or recognizeability refer to how those memories had been stored, consolidated and retrieved over time. That is, this paradigm did not allow for distinguishing between encoding processes to be inferred. Nevertheless these processes may well be comparable to everyday methods of dream remembering.

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## Appendix A

Unrelated lure sentences for recognition tasks:

### Dreams

- Later we were at a party with the people I live with.
- My friend told us she was pregnant and we didn't know what to say, so we nervously congratulated her.
- At a Spanish themed bar, having some drinks with friends.
- I was rushing to get ready in time and suddenly I was changed and ready to go.
- I saw what was on the exam paper before I had sat the exam!

### Events

- I had just nipped out to the shop to buy some milk and I bumped into an old friend.
- I watched TV with some friends and ate pizza.
- I went for a walk as I was feeling so stressed about it.
- We went out for something to eat, ended up staying out until 1am.
- I went to the lecture, fell asleep through most of it and then left with my friends.