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Postmaster: Send address changes to *Dreaming*, Human Sciences Press, Inc., 233 Spring Street, New York, N.Y. 10013-1578.

Printed in the USA.

Dreaming, Vol. 2, No. 2, 1992

The Day-Residue and Dream-Lag Effects: A Literature Review and Limited Replication of Two Temporal Effects in Dream Formation

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Several studies point to the existence of two types of effects which describe the temporal relationship between daytime experiences and nighttime dreams: the day-residue effect, i.e., the incorporation into dreams of material from the immediately preceding day, and the dream-lag effect, i.e., the incorporation of material into dreams of material from 6-8 days prior. A review of previous research suggests that the proportion of dreams containing day residues is about twice that for events occurring 2 days prior to the dream, approximately 65-70% of reports. Much less research supports the dream-lag effect, however. In an attempt to replicate previous demonstrations of these effects, 84 undergraduates were asked to keep home records of their dreams and important daily events for a 14-day period. Dreams were then judged for the extent to which they incorporated these daily events. Results clearly supported the day-residue effect, but gave inconclusive results for the dream-lag effect. At present, imprecision in report collection and other conservative features of the experimental design, as well as findings from previous studies, do not warrant complete rejection of the notion of a dream-lag effect.

KEY WORDS: dreaming, day residue, dream-lag effect, chronobiology, infradian rhythm, autobiographical memory.

INTRODUCTION

Most dream researchers accept the assumption that dreaming proceeds from prior experience, whether that experience took place in the recent or remote past (e.g., Freud, 1900; Foulkes, 1985; Hobson, 1988). In other words, it is widely accepted that a temporal delay of some duration stands between the occurrence of a waking experience and its subsequent inclusion in a dream. Although the parameters characterizing such temporal delays have not been well-studied, there is

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evidence that temporal delays are described by at least two kinds of effect: 1) a day-residue effect, in which an event occurring on the day immediately preceding the dream is incorporated into the dream, and 2) a dream-lag effect, in which an event occurring about one week prior to the dream is subsequently incorporated into the dream. Below we review research relevant to these two effects.

The Day-Residue Effect

The day-residue effect has been given preferential attention in the literature, perhaps because Freud (1900) from the outset emphasized the role of day residues in the instigation of dreams. He asserted that '... in every dream it is possible to find a point of contact with the experiences of the previous day' (p. 165) and he furnished numerous examples of such points of contact (e.g., 'Dream of the Botanical Monograph'). He furthermore claimed that day residues instigate dreams by virtue of their incomplete, indifferent, unsolved, or suppressed nature, and by this means provide vehicles for the manifest expression of repressed wishes. He described the day residue as the 'entrepreneur' of the dream and the repressed wish as providing the 'capital'; both instigator and motive force were indispensable processes of dream formation (pp. 554-561). The latter conceptualization of the day-residue effect has been discussed subsequently in much psychoanalytic literature but has not been substantially extended (see review in Langs, 1971).

Many studies of the influence of presleep stimulation on dreaming are compatible with the notion of the day-residue effect, although such studies have usually not examined day residues relative to other temporal delays. For example, many studies concur that day residues of the experience of participation in a sleep laboratory experiment are incorporated into the dreams that were dreamed and reported in the laboratory (e.g., Domhoff & Kamiya, 1964; Hall, 1967; Witkin & Lewis, 1967; see detailed review by Arkin & Antrobus, 1978).

A few studies have examined the day-residue effect in relation to temporal delays of longer duration than a single day. Three case studies based on personal dream collections (Epstein, 1985; Hartmann, 1968; Jouvett, 1979) and two empirical studies (Davidson & Kelsey, 1987; Verdone, 1965) have addressed this specific problem of the temporal parameters of daytime residues in dream content. All of these support the day-residue effect, but they offer widely differing estimates of the frequency of incorporations with longer temporal delays.

First, Hartmann (1968) recorded the time of occurrence of 463 daytime events associated with 800 of his own dreams. He found that 94% of these events could be classified as occurring on the prior day. These associations he rated as being less personally important than the other 6%, a finding consistent with Freud's notion of day residues as indifferent events. In a second study (Epstein, 1985), 50 dreams for which a link to a daytime event could be clearly established were categorized into bins of differing temporal delays. In 52% of the dreams the temporal delay between the event and the dream was 0-24 hours, in 28% the delay was 24-48 hours, in 18% it was 48-72 hours and in 2% it was 72-96 hours. Thus, 52% of the dreams in this study were categorized as containing day residues. Third, Jouvett

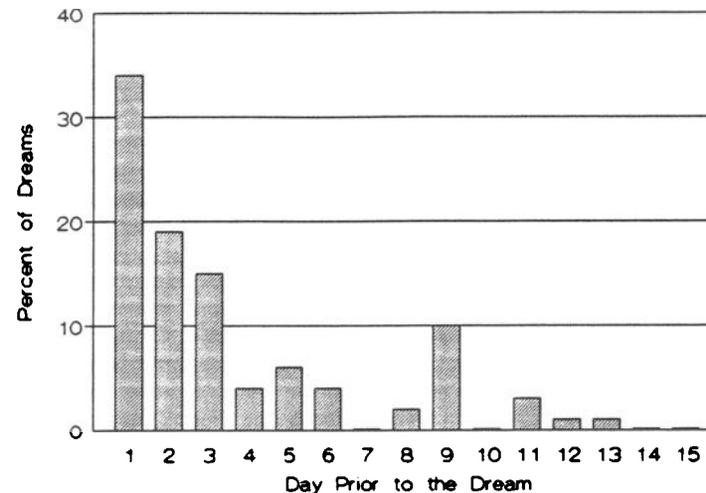


Fig. 1. Percent of dreams with incorporations by temporal delay (adapted from Jouvett, 1979).

(1979) kept records of his dreams and daytime events over a period of several years and selected all dreams for which prior associated events could be accurately dated ($N = 130$). A frequency distribution of the temporal delays between the events and their occurrence in the dream (Figure 1) indicates that he classified 34% of his dreams as containing day residues.

The variable estimates of the occurrence of day residues in these three single-participant studies may be largely due to a methodological difference, specifically, that each investigator searched for potential incorporations over a different length of temporal interval preceding the dream. In at least two of these data sets there is consistency in the relative proportions of incorporation for the two days immediately preceding the dream. Specifically, although Jouvett apparently searched for incorporations over the 14-day period prior to the dream, relative proportions of incorporation for days 1 and 2 prior to the dream alone were 64% and 36% respectively. Similarly, although Epstein apparently assessed incorporations over the 4-day period preceding his dreams, relative proportions of incorporation for days 1 and 2 were 65% and 35%, respectively. In other words, in these two studies the probability of a dream incorporation 2 days after an event was roughly one-half of the probability of a day residue. Hartmann's results can not be reassessed in this manner, but his results may reflect the fact that he restricted his search for incorporations almost exclusively to the 1-day interval preceding his dreams.

Results from experimental studies provide estimates of the day-residue effect that are similar to those from single-participant studies. In one study (Davidson & Kelsey, 1987) pairs of diary sheets and dream reports collected from 40 subjects over 3 days were scored for incorporations. Dreams were paired either with diary sheets from the prior day or with diary sheets selected at random. Incorporation ratings for diary sheets from the prior day were found to be greater than zero

significantly more often (70%) than dreams paired with diary entries selected at random. This estimate of 70% is similar to the prior estimates of 64% and 65% derived from the single-participant studies. Similarly, the estimate of incorporation for diary sheets chosen at random (34%) is similar to the prior estimates of 36% and 35% for events occurring two days prior to the dream. Moreover, because the control comparisons in this study were randomized, the result suggests that the estimates for incorporations for day 2 prior to the dream which was derived from the single-participant studies may be attributable to chance factors in the incorporation rating procedures.

A study of the REM dreams of 4 participants sleeping for 10 nights each in a laboratory (Verdone, 1965) also supports the existence of a day-residue effect. Participants rated dreams on a scale of temporal reference varying from 'earlier this evening' to 'over 5 years ago'. Of 196 dreams, 22% referred to day residues, i.e., to the combined categories of 'earlier this evening' and the 'past day'. This value is about 4 times greater than the value for the 'day before' category. However, the estimates of incorporation are 70% and 30% when the 'earlier this evening' references are dropped on the assumption that these values reflect artificially increased dreaming about the laboratory experiment. These estimates are very similar to those from the Davidson and Kelsey study (70% v. 34%), the Jouvét study (64% v. 36%), and the Epstein study (65% v. 35%).

In summary, the results of both single- and multiple-participant studies converge in supporting the existence of the day-residue effect. These results suggest that dreams are about twice as likely to incorporate events that occurred the day before the dream (65-70%) as they are to incorporate events that occurred two days before the dream (30-35%).

The Dream-Lag Effect

It is often reported anecdotally that dreaming incorporates a daytime event after a delay of more than a single day has elapsed since that event. However, the exact durations of such delays are typically not specified. Freud (1900), too, asserted that abstract, affective structures in dreams ('wishes') could be traced as far back as to early childhood experience, although he rarely demonstrated specific examples of these in his analyses of dreams (Jones, 1980). The little research that is available on the question of temporal delays, however, is consistent in suggesting that dreaming may sometimes draw upon daytime events that took place about 1 week prior to the dream, an effect we refer to as the 'dream-lag' effect (Nielsen & Powell, 1988; 1989).

In the study by Verdone (1965) described above, categories which did not define the day-residue effect accounted for 78% of the temporal ratings. By far the most frequently selected of these was the 'past week', which accounted for 23% of reports. This predominance of material from the prior week is generally consistent with the dream-lag effect. Results from the study by Jouvét (1979) are also consistent with a dream-lag effect. He reported a peak in dream incorporations of waking experience on day 9 following daytime events (see Figure 1). In a second

analysis of his own dreams, he reported incorporations which were recorded after he had abruptly changed surroundings for a specified period of time—either leaving home for trips of from 5 to 20 days or returning home after such trips. On average, his dreams only began to incorporate features of the changed surroundings 7.8 days after leaving home for a trip and 6.5 days after returning home from the trip. These values are very similar to that proposed for the basic dream-lag effect.

Jouvét (1979) suggested that his analyses demonstrated the existence of two qualitatively different types of memory process. The first is a relatively short-term process which is responsible for the day-residue effect and which seems to preserve no information about physical features of the daytime environment. The second is a relatively long-term process which is responsible for the observed incorporation delay of 7-8 days and which reproduces features of spatial layout of the daytime environment. This intriguing hypothesis remains to be tested on a larger sample of participants.

Recent Experimental Tests of the Day-Residue and Dream-Lag Effects

We addressed the question of the day-residue and dream-lag effects in a series of experiments that made use of a longitudinal home dream diary method (Nielsen & Powell, 1988; 1989). In the first study, 69 undergraduates recorded dreams for a period of one week then retrospectively listed all important events that had occurred during that week. Judges subsequently selected one event from each list and rated the extent to which each participant's dreams incorporated it. Incorporations were found to be described by a quadratic sinusoid, with significantly higher degrees of incorporation being rated for dreams recorded on days 1 and 6 after the event than for dreams recorded on days 2 and 5 after the event. Both a day-residue and a dream-lag effect were thus suggested by this pilot study.

In an attempted replication, we selected 7-day home diaries from a study that had been completed a year before the dream-lag hypotheses were conceptualized, thus assuring that the dream reports were free from some sources of experimenter bias overlooked in the prior study. The dreams were recorded by 34 self-reported high dream recallers who had previously slept one night each in the sleep laboratory. Judges rated the extent to which each participants' dreams incorporated aspects of their laboratory experience. Analyses revealed only a weak day-residue effect, but the 6-day dream-lag effect was replicated. The pattern of incorporation scores over the 7-day period were also found to be described significantly by a cubic curve.

These results suggested, among other possibilities, that the dream-lag effect may be a function of some infradian process with a recurrent period (e.g., Lerman, 1985). It prompted us to predict (Nielsen & Powell, 1989) that with home diaries maintained over a 2-week period, incorporation peaks would be found in dreams recorded 1, 6, and 12 days following a significant daytime event. The latter prediction was tested—and partially confirmed—in the replication study reported below.

To summarize, the few available studies examining dream incorporations of daytime events after intervals of more than one day after the event are consistent

with the notion of a dream-lag effect with a delay of about 6-8 days. However, a number of methodological problems are unresolved in these studies. Thus, we attempted another replication of the day-residue and the dream-lag effects using dream collection and rating procedures that improved upon some of the problems inherent in prior studies.

METHOD

For 14 days, undergraduate psychology students ($N = 84$) wrote out their dreams in the morning and their emotionally meaningful daytime events in the evening. One judge then selected a negative daytime event from each participant's diary without any reference to the dream reports and according to the following criteria: (1) the event seemed relatively important; (2) the description of the event was relatively specific; (3) the event occurred relatively early in the 14-day recording period. The selected event and all of the dream reports for that participant were subsequently combined into a single folder and presented to 2 independent judges for ratings of incorporations. Dreams in each folder were presented in a scrambled order with all information about the date obscured. Incorporation ratings were made using a 0-9 scale reflecting the extent to which the chosen event was incorporated into the dream. Judge 1 was a researcher with several years experience in rating dreams; Judge 2 was an undergraduate student with no previous rating experience.

Incorporation scores for each dream were entered into an ANOVA with one repeated measures factor (Day Prior to Dream). Least-squares estimates of the mean were entered for each day on which a dream was not recalled by a participant; the Geisser-Greenhouse correction factor for degrees of freedom in a repeated measures design was applied in all tests. Multiple comparisons were used to test differences between individual means. Also, the probabilities of observing peak incorporation ratings as predicted (Days 1, 6, and 12) were assessed by calculating the probability of choosing the observed combination of peaks out of all possible combinations.

To permit comparisons with prior studies of the day-residue effect, proportions of incorporation for dreams on days 1 and 2 prior to the dream were calculated as the number of dreams on a given day rated as greater than 0 on the 0-9 incorporation scale.

RESULTS

The number of recalled dreams decreased from a high of 59 on Day 1 to a low of 11 on Day 14 ($M = 42.4/\text{Day}$). As in our previous experiments, the number of dream reports rated as greater than 0 out of 9 by at least one judge was relatively low for all Days (16.6% of reports) as was the overall mean extent of incorporation (Judge 1 $M = .291$; Judge 2 $M = .218$). The two judges agreed on 90.3% of reports: on 83.4% that no incorporation was present (score = 0) and on 6.9% that an in-

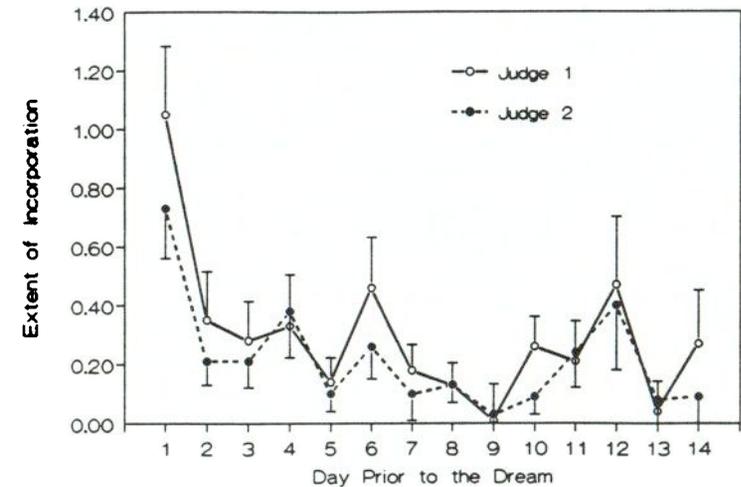


Fig. 2. Extent of incorporation into dreams by temporal delay.

corporation was present (score > 0). They disagreed on the remaining 9.7% of reports. Thus, although the proportion of overall agreement was high, the proportion of specific agreement on the presence of an incorporation relative to base rates was low ($K = .12$). These data suggested that judges were identifying different incorporation features in over half of the reports; their results are thus assessed and reported separately.

Judge 1

Considering only data for Days 1 and 2 prior to the dream, Judge 1 scored 17 (65%) and 9 (35%) of the dream reports as containing an incorporation (score > 0). Further, multiple comparisons on the ratings for Judge 1 revealed that the mean incorporation rating for Day 1 was significantly greater (all $p < .05$) than the mean ratings for all other Days, but that the mean ratings for Days 6 and 12 were not (Figure 2). This result statistically confirms the day-residue effect relative to other days preceding the dream but does not replicate the dream-lag effect. The result also fails to statistically demonstrate the predicted 12-day effect. However, both the 6-day and the 12-day effects are suggested by the profile of mean incorporation ratings for Judge 1 plotted in Figure 2. As predicted, the three Days showing peaks of incorporation for this judge were Days 1, 6, and 12. The probability of this combination of 3 Days out of 14 attaining the peak values is .003. Results from the experienced rating judge, then, provide clear support for the day-residue effect and only limited support for the dream-lag effect.

Judge 2

Considering only results for Days 1 and 2, Judge 2 also scored 17 (65%) and 9 (35%) dreams as containing incorporations. Further, multiple comparisons showed that the mean incorporation rating for dreams on Day 1 was significantly greater (all $p < .05$) than the mean ratings for all other Days except Day 12 (see Figure 2). Also, incorporation peaks were identified for Days 1, 4, and 12; the probability of predicting only 2 Days out of the 14 correctly is .013. These results from the inexperienced judge replicate the day-residue effect and confirm the 12-day effect, but fail to replicate the 6-day dream-lag effect.

DISCUSSION

The Day-Residue Effect

The present results further validate the day-residue effect postulated by Freud (1900) and demonstrated in previous single-participant (Hartmann, 1968; Epstein, 1985; Jouvett, 1979) and multiple-participant (Nielsen & Powell, 1989; Davidson & Kelsey, 1987) studies. In the present study, the proportions of dreams with incorporations on Days 1 (65%) and 2 (35%) after an event corresponded very closely with estimates based upon previous studies, suggesting that the probability of the day-residue effect is approximately twice that of incorporation of an event from 2 days prior to a dream. The results therefore do not exactly confirm Freud's (1900) speculation that *all* dreams reveal a point of contact with the prior days' events. However, the results are striking in that they reflect such a statistically reliable relationship between two relatively disparate samples of psychological life: a single dream—a sample probably reflecting only the last few minutes of the last REM period of the night, and a single daytime event—a sample likely accounting for only a small proportion of the total daytime experience. If we were able to conduct similar comparisons between several dreams of a single night and all of a previous days' events, the present results suggest that the amount of incorporation would be much higher and that Freud's postulation of a 100% day-residue effect might indeed be borne out.

However, it should also be considered that the day-residue effect observed in these relatively brief samples of nocturnal and diurnal mentation may be apparent because the emotionally important daytime events used in the present study were better incorporation targets for dreams than indifferent or suppressed events have been. The preponderance of authors who subscribe to the view that dreaming is a period during which emotional concerns are processed (e.g., Cartwright, 1986; Hobson, 1988; Greenberg, Pearlman, Schwartz, & Grossman, 1983; Palombo, 1980) as well as evidence indicating that current concerns are incorporated into dreams (Bisson & Baylor, 1990; Hoelscher, Klinger, & Barta, 1981; Kramer, Roth, Arand, & Bonnet, 1981) suggest that emotional concerns are more likely to appear as day-residues in dreams than are indifferent daytime events.

The Dream-Lag Effect

The present results provide only limited evidence for the existence of the 6-day dream-lag effect or for its recurrence on Day 12. Specifically, we were able to show a predicted pattern of peaks and troughs on Days 1, and 6 and 12 which is consistent with the idea that an infradian rhythm with a 6-day period is implicated in the dream incorporation process. However, with the exception of means for Day 1 and to a lesser extent Day 12, we were not able to show discrete differences between incorporation scores on given days. If the dream-lag effect is, indeed, present in these data it is a weak effect.

However, some methodological factors which may be responsible for the conservative results should be considered further. First, the low interjudge agreement and low mean incorporation scores suggest that the incorporation judgments lacked precision. The home reporting method used in this study likely failed to elicit sufficient descriptive details to allow for much precision. The dreams and events collected were for the most part sketchy reports by students untrained in self-observation. Frequently, their descriptions consisted of single sentences such as 'I had a bad fight with my mother' or 'Things went really well with my girlfriend last night'. Free associations to the dreams and the events were also not encouraged, which may have rendered the dream and daytime event protocols even less comparable.

Further, judges were given no explicit criteria for assessing the incorporations. A previous study (Kuiken, Rindlisbacher, & Nielsen, 1990-91) found that when judges were provided specific categories with which to classify both dream content and a pre-sleep film, a significant degree of incorporation was observed; unpublished results indicated that when only unspecific categories were provided, no incorporation effect was seen. This question of rating criteria is especially important in light of Jouvett's suggestion that immediate and delayed incorporations may differ qualitatively. If the day-residue and dream-lag effects are responses to qualitatively different types of daytime events, or to different features of the same daytime events, then different types of rating scales for assessing incorporations may be appropriate. For example, Jouvett's work suggests that spatial layout of an environment might be an appropriate measure for rating delayed incorporations; other research suggests that emotion might be an appropriate measure for rating immediate incorporations.

A third possible reason for the weak dream-lag effect in the present study may be that the strategy of asking participants to record their significant events every day prior to sleep inadvertently biased them to incorporate these events into their dreams as day residues, and thus to suppress their incorporation in dreams occurring several days hence. Prior studies demonstrating the dream-lag effect (Nielsen & Powell, 1988; 1989) either requested that participants retrospectively report significant daytime events at the end of the dream recording period or used an obvious target event such as participation in a sleep laboratory experiment that participants were not required to write down.

Finally, it should be noted that the statistical procedure employed in the present study to assess between-groups differences was a conservative one. The Geisser-

Greenhouse correction factor is the most conservative procedure for correction of degrees of freedom in designs with repeated measures (Winer, 1971). With a less conservative procedure, or an experimental design with less missing data due to dream forgetting, more of the differences evident in the profile of the present results may have proven statistically different.

In summary, the present results provide relatively strong support for the day-residue effect but only weak support for the dream-lag effect. However, several methodological considerations suggest that the hypothesized dream-lag effect may have been masked by unforeseen variables in the present study. The two effects should be explored further in light of these considerations.

ACKNOWLEDGMENTS

This article is based on a presentation at the 5th Annual International Conference of the Association for the Study of Dreams, Santa Cruz, California, June 28-July 2, 1988; the research was supported by the Alberta Heritage Foundation for Medical Research and the 'Fonds de la Recherche en Santé du Québec'.

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