ORIGINAL ARTICLES

REM and NREM Sleep Mentation Differences: A Question of Story Structure?

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Although it is widely accepted that mentation can occur during NREM sleep, there is disagreement over whether such mentation is qualitatively equivalent to that occurring during REM sleep. This study approaches the problem from the perspective of narrative structural analysis, assessing sleep mentation reports for evidence of the basic attributes of story narratives. Twenty-four college students, of whom 12 were high and 12 were low frequency habitual recallers of their dreams, contributed mentation reports after experimental awakenings from stage REM and stage 2 sleep. A story grammar tool was used to parse these reports into their constituent components (actions, scenes, characters) and to identify the causal precursors and consequences of the constituent actions. Three measures of story coherence were derived: story constituent recall, story constituent co-occurrence, and episodic progression. For these measures, it was found that (a) more stage REM than stage 2 reports contained at least one story constituent, but only for the late night reports of high frequency recallers; (b) stage REM and stage 2 reports contained at least one instance of story constituent co-occurrence in about equal proportions; and (c) a greater proportion of stage REM than stage 2 reports contained at least one minimal story unit—episodic progression—but again only for high frequency recallers. Results support the notion that stage REM dreams are stories in the specific sense suggested by our microstructural criteria for episodic progression. They also speak to discrepancies among prior attempts to discriminate stage REM from stage 2 mentation reports, specifically, they underline the need for considering time-of-night and habitual dream recall frequency in such analyses. (Sleep and Hypnosis 2001;3(1):9-17)

Key words: *sleep mentation, dreaming, REM sleep, NREM sleep, narrative analysis, story structure*

INTRODUCTION

Dreaming is an expression of vivid imagery with a seemingly storylike structure (1-3). Early observations (4,5) temporally linked vivid dreaming with REM sleep, an association which many took to be an exclusive one (e.g., 6-8). However, when the definition of dreaming was expanded to include more general forms of cognition (9), more serious consideration was given to the notion that dreaming is also a feature of NREM sleep. Indeed, dozens of studies reported evidence that awakenings from any NREM stage can produce recall of cognitive activity and in many instances recall of mentation that appears wholly dreamlike (for review see 10).

Opinions are still mixed, however, as to whether the quality of mentation occurring in REM and NREM sleep stages is, in fact, identical. Whereas many have reported qualitative differences between the two types of mentation (for reviews see 10-12), many such differences are diminished when steps are taken to statistically control the length of reports

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(e.g., 13-15). Nevertheless, even with such controls in place, residual qualitative differences between REM and NREM reports remain (13,15-24). In addition, the conceptual justification for controlling a quantitative variable such as visual imagery by partialing out a quantitative variable such as total word count has been challenged (12,20).

From the perspective of dreams-as-stories, most of the variables investigated in the preceding studies constitute low-level story constituents but do not quantify what is the essence of a story's structure. A coherent story requires that its constituents be organized in some causal or enabling fashion. We earlier reported preliminary findings pertinent to this question, i.e., evidence both that home dreams resemble mythic stories in several respects (25) and that stage REM dreams possess a storylike complexity relative to NREM dreams (26). There is also more recent evidence that story-like organization of stage REM dreams increases later in the night and is not simply due to reconstructive effects in recall (27,28). Further, the story organization of sleep mentation reported by Parkinsonism patients varies as a function of their daytime cognitive functioning (29). The heuristic value of a structure-analytic approach to quantifying sleep mentation is also demonstrated by at least 3 other related approaches to the problem: (a) a script-based analysis of dreams and associations (30), (b) an analytic method drawn from the work of Levi-Strauss (31), and (c) quantification of 'central relationship patterns' in the dreams and waking narratives of individual subjects (32). Such studies do signal the value of approaching the question with standardized tools for narrative analysis. However, research is still scarce on the fundamental question of how mentation is organized in a narrative manner across different stages of the sleep/waking cycle. The present study employs a modified 'story grammar' instrument (cf. 33,34) to compare stage REM and stage 2 mentation reports. Three levels of story complexity in mentation reports is examined; the factors of gender, habitual frequency of dream recall, and time of night are also explored. It is hypothesized that, although reports from the two sleep stages might not differ with respect to simple presence or absence of the constituents of a story (characters, scenes, etc.), stage REM mentation would more likely be characterized by the complex story measure of episodic progression.

METHODS

Subjects

Twenty-four healthy college students (18-25 years old) with no reported sleep problems slept in the laboratory and contributed mentation reports. Twelve subjects were self-reported high frequency habitual recallers of their dreams (at least 5 dreams/week) while 12 were self-reported low frequency recallers (at most 1 dream/week). Six men and six women comprised each of the two groups.

Sleep Recording

Each subject spent four nights sleeping in the laboratory. They were fitted with Beckman silver electrodes for recording sleep stages: EEG (C3 and C4, A1+A2 reference), EOG, and submental EMG. Their records were scored for sleep stages following the standard procedures (35).

Awakening Conditions

When possible, awakenings were made 4 times each night, 2 in the first 4 hours (early half) and 2 in the second 4 hours (late half) of the night (see Figure 1). In the early half, there occurred a stage 4 awakening followed by either a stage REM or a stage 2 awakening. In the late half, there occurred either a stage 2 or a stage REM awakening (depending upon which had occurred in the early half) followed by the morning awakening. The order of stage REM/stage 2 awakening pairs was counterbalanced over the 4 nights. One hour of uninterrupted sleep was always required between awakenings. The morning awakening was independent of the ongoing stage of sleep although, as for all other awakenings, at least 10 minutes of the stage had to elapse before the awakening was initiated. Mentation reports were also collected following unscheduled, spontaneous awakenings and classified according to the sleep stage that preceded them. Thus, over the 4 successive nights, each subject underwent a total of 16 experimental awakenings and possibly 1 or more spontaneous awakenings. Spontaneous awakenings and awakenings from stage 4 sleep were not further considered in the present analyses.

Subjects were aroused from sleep by the experimenter requesting that they keep their eyes closed and not move before the light was turned on (see Table 1). They were then asked to lie still and

Figure 1. Awakening schedule for mentation reports from Stages 2, 4 and REM sleep for a single night. The same schedule was followed for 4 laboratory nights, with awakenings from Stages REM and 2, awakenings (b) and (c), counterbalanced over nights. Morning (d) and spontaneous awakenings could occur from any sleep stage. At least 10 minutes of stage REM or stage 2 sleep stage was required to qualify a mentation report for analysis. Stage 4 reports (a) were not assessed in the present study.

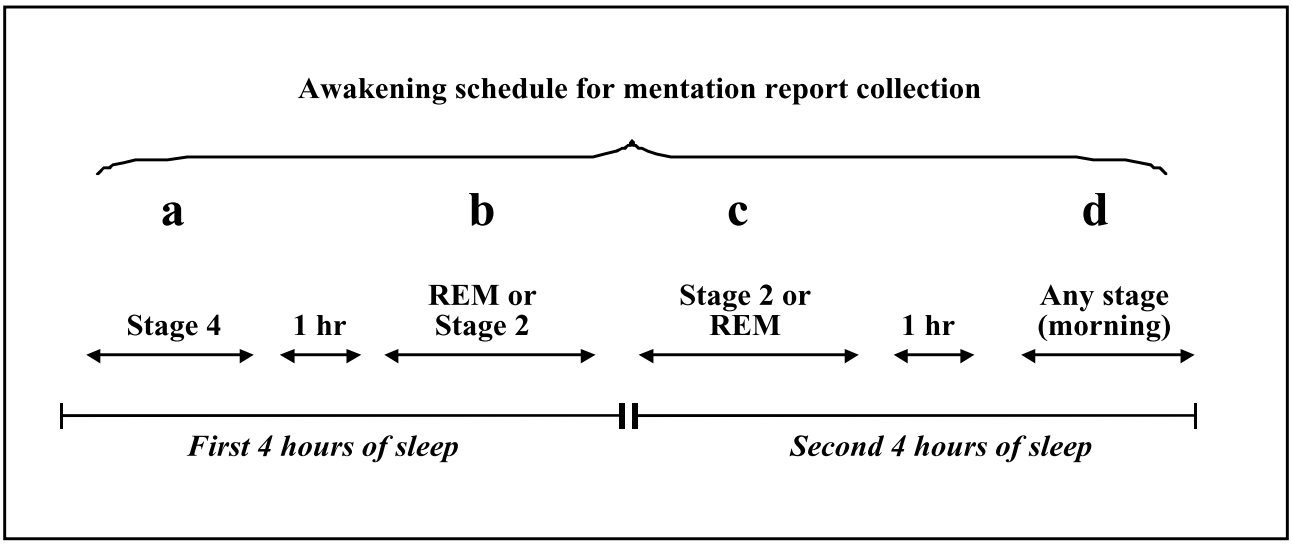


Table 1. Instructions for eliciting sleep mentation from stage 2 and REM sleep awakenings

Instructions
1. _____ (subject's name), please keep your eyes closed and don't move; I'm going to turn on the lights.
2. During the next four minutes, please try to lie still and recall any experiences you were having before I called your name. After the 4 minutes I'll ask you to describe them, if there were any. (WAIT FOUR MINUTES)
3. Describe any experience that you had before you heard me call your name.

attempt to recall any mental experiences that had occurred before the call. Subjects were given 4 minutes alone to recall their mentation before the experimental interview continued. If subjects showed signs of returning to sleep during this time, they were called again. Following this free recall period, a structured set of questions was administered. The content of these questions varied upon whether any experience could be recalled. If none was recalled, subjects were probed for a subjective estimate of depth of sleep, 'distance' from the previous experience, present motivation to recall, and body position. If minimal experience could be recalled, subjects were also queried about specific experiential content such as presence of speech, emotion, color, control, judgment, ease of recall, bizarreness, continuity, participation, activity, and temporal setting. None of these prompted responses are further assessed here. Only free reports from the stage 2 and stage REM sleep awakenings were assessed for their structural features.

Scoring of Mentation Reports

All mentation reports were tape-recorded and transcribed. Transcriptions containing any verbal content were randomly ordered and coded to obscure information about subjects and awakening conditions. Eight reports were lost due to equipment malfunctions; 4 reports were added because both subjects and judges felt that 4 mentation reports each described two separate dream experiences.

Mentation reports were scored for narrative structure using the Structural analysis of stories (SAS; Kuiken and Nielsen, in 36). This scoring system was derived from 'story grammar' instruments which have been used to assess the ability of children and adults to recall and generate narrative text (33,34); they were adapted by us to deal specifically with the idiosyncrasies of sleep mentation. The complete application of the SAS is a lengthy process that will not be described in detail here. However, for purposes of understanding the three dependent measures that were assessed in the present study, the following steps by the scoring judges are pertinent; a sample mentation report scored for scenes, characters and actions appears in Table 2.

a) Actions. Placing brackets around the phrases or clauses containing basic agent-action or agent-action-object constituents identified individual actions in the reports. Actions vary in their complexity, sometimes being quite simple (e.g., The man squeezed my arm) or complex (e.g., I was preparing breakfast).

Table 2. Sample mentation report scored for scenes, characters and actions with the story grammar

Mentation Report	1/I[A] had been at a performance with my wife.[B]/ 2/Now I was not with her but standing around a pool table watching some despicable men[C] shooting pool. I remembered suddenly that I had agreed to meet my wife in the adjoining restaurant and was late./ 3/(I ran) anxiously for the door and (went into the restaurant.)/ 4/(I walked up to a table) where two friends[D] were sitting. (They told me) that my wife had left only minutes earlier./ 5/Next (I am running) down the street toward my parent's home, knowing that my wife was on her way there and if I hurried I could arrive at the same time. Suddenly (I am running) over a huge pile of fat green wine bottles. They slow my progress. I remember also (stepping on) flattened beer cans and (picking up one of these) and (examining it). It was beige-colored./ 6/Then I am in an apartment (going down) some stairs. (My wife and I embrace) on the stairs. (She starts to talk) about finances./
Scenes	Scene boundaries are designated with slashes: / and numbered with lower-case numbers: 1,2,3,..., N. In this example: 1/ = a performance (historical scene) 2/ = pool room 3/ = restaurant (transitional scene) 4/ = restaurant 5/ = street 6/ = apartment
Characters	Characters are designated with upper-case letters: A, B, C, ..., X. In this example: A = narrator B = narrator's wife C = men (undifferentiated) D = two friends (undifferentiated)
Actions	Action clauses and phrases are designated with round brackets:)(

b) Scenes and objects. Simple scenes are concrete depictions of locations, e.g., 'We were in the kitchen'. These were designated with slashes '/' in the transcripts. Objects are considered a subcategory of scenes and were scored simply for presence or absence.

c) Characters. Every reference to a character in the report was identified and numbered. Undifferentiated groups of characters (e.g., 'we') and animated or personified entities (e.g., cartoon characters) were also scored as individual characters.

d) Initiating events and consequences of actions. Every action in the report was assessed independently for whether it was caused or enabled by an initiating event, i.e., an immediately preceding event or group of events. Actions may have been, at times, scored as having been caused by an event even though the event was not the immediately preceding event, but rather a group of preceding events which together caused the action. Each simple action was also assessed for whether it caused or enabled a consequence, i.e., an immediately following event.

From the previous scores, three different dependent variables were derived, assessing three different levels of narrative organization in the mentation reports:

Variable 1: Story constituent recall. Recall of story constituents was defined as recall of hallucinatory characters (including actions), scenes, and/or objects. Failures to recall story constituents included reports of no recall of any preawakening mentation, claims that there was content but no recall of that content, and reports without hallucinatory characters, scenes, or objects.

Variable 2: Co-occurrence of story constituents. Recall of co-occurring story constituents was defined as the co-occurrence within a report of at least one character, at least one action, and at least one scene. Such reports were sometimes quite simple, e.g., "A man was walking in the hallway". At other times, there occurred very complex combinations of these constituents, with numerous characters, scenes and actions in a single report.

Variable 3: Episodic progression. Episodic progression within a report was defined as the occurrence of at least one character action for which both an initiating event and a consequence were also identified. Episodic progression could be quite simple, for example, "A fellow sat down at our dinner table. I asked him about his trip. He said he had discovered a religion of some kind." In other instances very complex sequences of interlocking action sequences and episodes were described.

RESULTS

Scoring Reliability

A total of 380 awakening reports formed the data set. Reliability estimates were calculated as proportions of constituents positively identified by both judges working independently. These estimates were performed on randomly chosen sub-samples of the reports as indicated in Table 3.

Table 3. Reliability estimates for scoring of individual constituents in the story grammar

Story Constituent	N reports	Reliability
Individual actions	50	75%
Scenes: number	50	68%
Scenes: presence of at least one	40	95%
Objects: presence	40	90%
Characters: exact identification	172	97%

Variable 1. Recall of story constituents. The proportion of awakening reports accompanied by recall of story constituents, calculated for each subject, was submitted to a 2 X 2 X 2 X 2 ANOVA with self-reported frequency of recall (high, low) and subject gender (male, female) as between subjects factors and sleep stage (stage REM, stage 2) and order of awakening (stage REM first, stage 2 first) as repeated measures factors. For the missing observations due to equipment malfunctions, the overall mean for the affected subject was inserted as the data point (5 subjects, 6 observations). Excluding these subjects from the analyses produced essentially the same results, thus, results for the completely balanced design are reported.

Main Effects

A marginal main effect for frequency of recall ($F_{1,20}=3.17$, $p=.09$) indicated that high dream recallers tended to recall story constituents slightly more frequently ($M = .44 \pm .42$) than did low recallers ($M = .28 \pm .42$). Also, a marginal main effect for sleep stage ($F_{1,20}=4.09$, $p=.06$) indicated that stage REM awakenings provided more reports with recalled constituents ($M = .44 \pm .45$) than did stage 2 awakenings ($M = .29 \pm .40$). A highly significant difference for order of awakening ($F_{1,20}=9.83$, $p=.005$) indicated that story constituent recall was more likely when stage 2 awakenings occurred first and stage REM awakenings second ($M = .45 \pm .40$) than when stage REM awakenings occurred first and stage 2 awakenings second ($M = .27 \pm .45$). These main effects are clarified by two- and three-way interactions described below.

Interactions

A significant two-way interaction between sleep stage and order of awakening ($F_{1,20}=4.62$, $p=.04$) demonstrated that when stage REM awakenings occurred second (late in the night) and stage 2 awakenings first (early in the night) recall of constituents was much more abundant from stage REM ($M = .58 \pm .42$) than stage 2 ($M = .31 \pm .38$) than when the order of awakenings was reversed (stage REM $M = .29 \pm .48$ vs. stage 2 $M = .25 \pm .42$). A significant three-way interaction ($F_{1,20}=.6.95$, $p=.02$) indicated that the preceding two-way interaction was characteristic of high- but not low-frequency dream recallers (see Figure 2). Thus, high recallers more frequently provided recall of story constituents from late night stage REM awakenings, whereas low recallers provided uniformly low levels of recall under all awakening conditions.

Variable 2. Co-occurrence of story constituents. An ANOVA was conducted using reports for which any story constituents were recalled. To control for presence or absence of story constituent recall between stage REM and stage 2, only those 20 subjects who reported at least one instance of both a stage REM and a stage 2 recall were considered. The 2 X 2 X 2 ANOVA included gender (male, female) and self-reported frequency of recall (low, high) as between subjects factors, and sleep stage (stage REM, stage 2) as a repeated measures factor. The dependent variable was the proportion of reports, calculated for each subject, in which at least one character was represented as acting at least once in at least one scene.

None of the effects were significant in this analysis.

Variable 3. Episodic progression. The same reports described for the previous analysis were further examined to assess the hypothesized relationship between sleep stage and episodic progression in reports containing story constituents. The 2 X 2 X 2 ANOVA again included gender, frequency of recall and sleep stage as factors. The dependent variable was the proportion of reports for each subject in which at least one instance of episodic progression was scored.

As predicted, a sleep stage main effect ($F_{1,16}=4.77$, $p=.04$) indicated that stage REM reports more frequently included episodic progression ($M = .66 \pm .30$) than did stage 2 reports ($M =$

Figure 2. Mean proportion of recall of simple story constituents for stage REM and stage 2 awakenings by time of night and habitual frequency of dream recall.

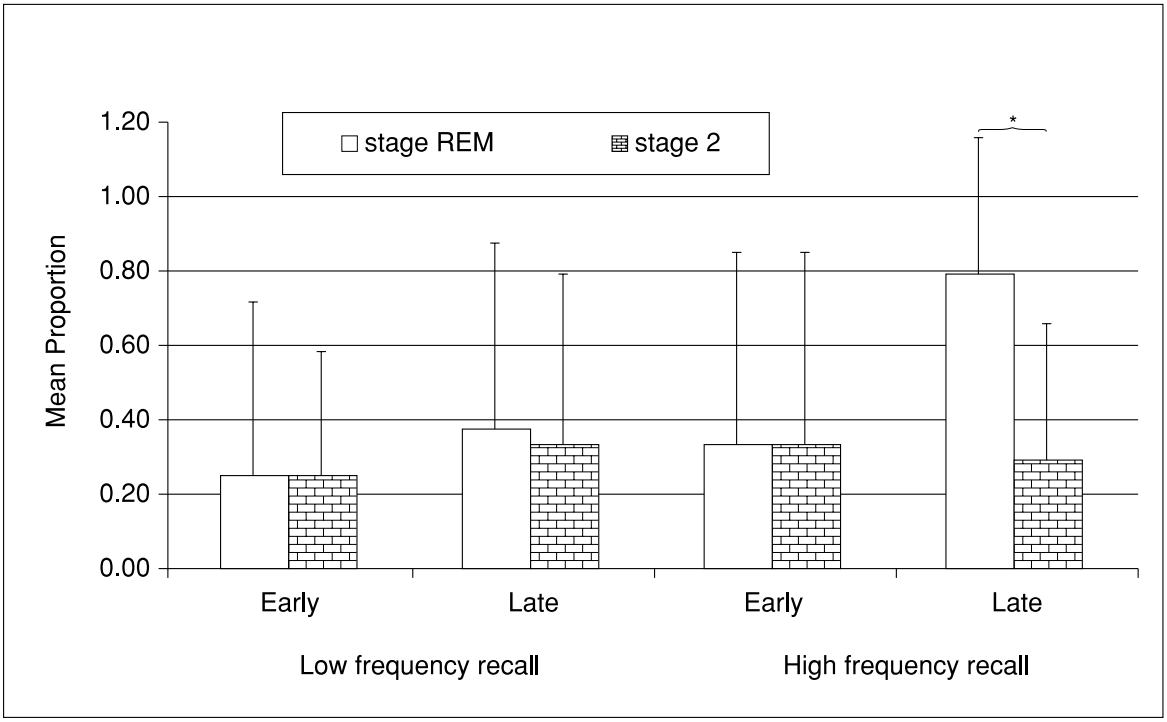
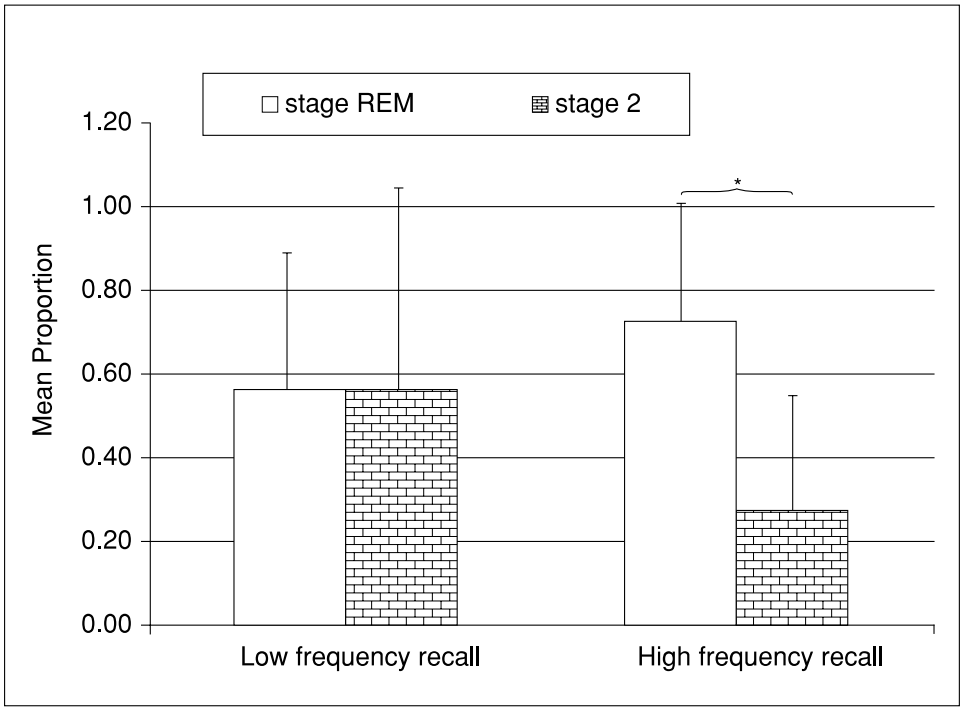


Figure 3. Mean proportion of recall of episodic progression measure for stage REM and stage 2 awakenings by habitual frequency of dream recall.



.43 ± .38). A significant sleep stage by frequency of recall interaction (F1,16=4.23, p=.05) (see Figure 3) indicated that this difference was negligible for low frequency recallers (M = .58 ± .33 vs. M = .58 ± .49), but substantial for high frequency recallers (M = .74 ± .26 vs. M = .28 ± .28). No differences were obtained as a function of gender.

DISCUSSION

The sense in which dreams are stories is clarified by the present findings: (a) They provide limited confirmation of the traditional assertion that the occurrence of visual hallucinatory mentation (i.e., the recall of particular characters, actions, scenes) is

more frequently associated with stage REM than with stage 2 awakenings. (b) Stage REM and stage 2 mentation reports were not differentiable when an index specifying only the co-occurrence of characters, actions and scenes was used; thus, mentation from the two types of sleep are not different with respect to the mere presence of story components. (c) However, stage REM mentation reports more frequently than stage 2 reports possessed an organization of components particular to stories, i.e., certain events cause a character's action which in turn causes certain consequences. Stage REM reports more frequently manifest a type of episodic progression that characterizes 'well-formed' simple stories.

Previous research has shown that stage REM mentation is more likely to involve visual hallucinatory content than stage 2 mentation (37; see 11 for review). By the same token, the present results reveal more frequent recall of story constituents following stage REM awakenings, but this relationship was limited to awakenings performed late in the night and to subjects who report that they have a high habitual frequency of recalling their dreams.

Even though stage REM reports were like stories more frequently than were stage 2 reports—even with recall of story constituents held constant—it might nevertheless be argued that the observed difference in episodic progression is not a qualitative difference. Rather, it might only reflect differences in the processes responsible for accurate recall of the mentation (cf. 38). However, the lack of a difference for the constituent co-occurrence variable in this study indicates that such memory differences would have to be subtle enough to account for both the absence of a co-occurrence effect and the presence of an episodic progression effect. It is not clear why memory should be selectively faulty for stage 2 propositional structures and not for stage 2 constituent co-occurrence. A more parsimonious explanation is that the propositional structure was less present in the case of the stage 2 mentation itself.

It should be noted that the mean recall rates in the present study were low compared with those previously reported in other studies. The present overall proportion of stage REM recall for experimental awakenings of 44% is below the range of 60-93% (M = 81.9 ± 9.0%) reported in a recent review of the literature (10). This is likely due to several interacting factors. The most predominant is almost certainly the fact that half of our sample was comprised of self-reported infrequent recallers of dreams. Goodenough (39) found that the recall of dreams from REM sleep among such subjects is a highly comparable 46%. Second, recall may have been inhibited by the 4-minute interval during which subjects were required to recall their verbal reports. This interval may have produced a protracted, incomplete, or distracting awakening and led to some forgetting of the pre-awakening mentation. Gradual awakenings have been shown to lead to poorer recall than abrupt awakenings (40) and distractions introduced after awakenings to lead to dream forgetting (41). Finally, low recall may be a function of the fact that stage REM reports were collected from both early and late in the night in a counterbalanced fashion. Low levels of recall from early night awakenings depressed the overall recall rate. In the present results, if only values for late night stage REM awakenings are considered (high recallers = 79%; low recallers = 42%), recall performance is comparable to published norms. It is likely that many previously documented rates of recall are based upon dream samples that were collected disproportionately from late in the night: 'Most studies have not described how their awakenings were distributed throughout the night, and of those that have, very few matched the REM and NREM reports by time of night (11, p. 77)'.

The present findings for both recall of constituents and occurrence of episodic progression are limited to self-reported high frequency dream recallers. That is, only high recallers showed greater recall of hallucinatory stage REM contents late in the night and more frequent occurrence of episodic progression in stage REM reports. Further research is thus needed to clarify the nature of content and memory differences among different subject groups. This finding does question to what extent discrepancies among previous studies is due to a lack of attention to the 'habitual dream recall' variable as an inclusion/exclusion criterion. It is possible that studies demonstrating large differences between stage REM and stage 2 mentation have tended (inadvertently) to recruit high-recalling subjects whereas those demonstrating few or no differences to recruit subjects with lower recall frequencies. From these results we might also question whether high and low frequency recallers—who presumably also differ in their degree of experience with reflecting upon and verbally reporting their dreams—also differ in their ability to accurately communicate the kinds of microstructural and perceptual details assessed in the narrative measures of the present study.

Dreams as Stories

That stage REM reports more frequently than

stage 2 reports contain at least one simple story episode confirms the informal observation that dreams are like stories (42,43). The finding is also consistent with research in which mentation from stage REM and stage 2 have been assessed for attributes similar to, but not as precise as, episodic progression as measured in the present study.

For example, Hobson (44) considered dreams sufficiently storylike to define the occurrence of a dream (i.e., dream recall) as whether the subject had experienced 'complex visual imagery which had undergone dramatic development' (p. 82). This definition was more frequently descriptive of stage REM reports than stage NREM reports. Similarly, Kamiya (45) used a definition of dreaming which echoes the quality of causal connectedness in the episodic progression index: 'short but coherent…the parts of which seem related to one another' (p. 169). He, too, reported an association between this index of dreaming and stage REM reports. Snyder's (46) assessment of dream 'coherence' in a large sample of exclusively stage REM reports explicitly included consideration of story quality—how well the report 'hung together' as a story. He defined dreaming according to two minimal criteria: 1) the experience reflects complex and organized perceptual imagery, and 2) the imagery must have undergone some temporal progression or change, i.e., dramas were accepted as dreams, tableaus were not. Seventy-five percent of REM reports conformed to this minimal definition of dreaming. He eschewed the common idea that stage REM dreams are incoherent, 'extremely few were really disjointed or mixed up, and by far the largest number were about as coherent as we might expect from descriptions of real life events' (p. 142).

In sum, the significant difference between stage REM and stage 2 storylike quality observed in the present study is consistent with previous research which has demonstrated a difference in dramatic development and coherence between stage REM dreams and other types of sleep mentation. The episodic progression index defined here differs from these other indices of story progression in that the microstructural criteria comprising it are clearly specified.

REFERENCES

1. *Jacobi J. Complex, Archetype, Symbol, Princeton University Press: Bollingen Series 57, 1959.*
2. *Jung CG, von Franz M-L. Man and His Symbols, London: Aldus Books, 1964.*
3. *Jones R. The Dream Poet, Boston, Mass: Schenkman Publishing, 1980.*
4. *Aserinsky E, Kleitman N. Regularly occurring periods of eye motility, and concomitant phenomena during sleep. Science 1953;118:273-274.*
5. *Dement W, Kleitman N. Cyclic variations in EEG during sleep and their relation to eye movements, body motility, and dreaming. EEG Clin Neurophysiol 1957;9:673-690.*
6. *Jouvet M. Le problème des résidus diurnes dans les souvenirs de rêves. Paper presented to the 'Réseau de recherche en santé mentale axe troubles du sommeil et de la vigilance', Montreal Neurological Institute, 1997.*
7. *Hobson JA. A new model of brain-mind state: activation level, input source, and mode of processing (AIM). In: Antrobus JS, Bertini M, eds. The Neuropsychology of Sleep and Dreaming. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1992;227-247.*
8. *McCarley RW. Dreams and the biology of sleep. In: Kryger MH, Roth T, Dement WC, eds. Principles and Practice of Sleep Medicine, 2nd Edition. Philadelphia: WB Saunders Company, 1994;373-383.*
9. *Foulkes WD. Dream reports from different stages of sleep. J Abn Psychol 1962;65:14-25.*
10. *Nielsen TA. A review of mentation in REM and NREM sleep: 'covert' REM sleep as a possible reconciliation of two opposing models. Behavioral and Brain Sciences 2001;23 (in press).*
11. *Herman JH, Ellman SJ, Roffwarg HP. The problem of NREM recall re-examined. In: Arkin AM, Antrobus JS, Ellman SJ, eds. The Mind in Sleep. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1978;59-92.*
12. *Hobson JA, Pace-Schott E, Stickgold R. Dreaming and the brain: toward a cognitive neuroscience of conscious states. Behavioral and Brain Sciences 2000;23(in press).*
13. *Antrobus J. REM and NREM sleep reports: Comparison of word frequencies by cognitive classes. Psychophysiol 1983;20:562-568.*
14. *Fein G, Feinberg I, Insel TR, Antrobus JS, Price LJ, Floyd RC, Nelson MA. Sleep mentation in the elderly. Psychophysiol 1985;22:218-225.*
15. *Foulkes D, Schmidt M. Temporal sequence and unit composition in dream reports from different stages of sleep. Sleep 1983;6:265-280.*
16. *Antrobus J, Kondo T, Reinsel R, Fein G. Dreaming in the late morning: Summation of REM and diurnal cortical activation. Cons Cog 1995;4:275-299.*

17. *Casagrande M, Violani C, Lucidi F, Buttinelli E, Bertini M. Variations in sleep mentation as a function of time of night. International Journal of Neuroscience 1996;85:19-30.*

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

19. *Cicogna P, Cavallero C, Bosinelli M. Cognitive aspects of mental activity during sleep. Am J Psychol 1991;104:413-425.*

20. *Hunt H, Ruzycki-Hunt K, Pariak D, Belicki K. The relationship between dream bizarreness and imagination: Artifact or essence? Dreaming 1993;3:179-199.*

21. *Porte HS, Hobson JA. Physical motion in dreams - one measure of three theories. J Abn Psychol 1996;105:329-335.*

22. *Purcell S, Mullington J, Moffitt A, Hoffmann R, Pigeau R. Dream self-reflectiveness as a learned cognitive skill. Sleep 1986;9:423-437.*

23. *Strauch I, Meier B. In Search of Dreams. Results of Experimental Dream Research, New York: State University of New York Press, 1996.*

24. *Waterman D, Elton M, Kenemans JL. Methodological issues affecting the collection of dreams. J Sleep Res 1993;2:8-12.*

25. *Kuiken DL, Nielsen TA, Thomas S, McTaggart D. Comparisons of the story structure of archetypal dreams, mundane dreams, and myths. Sleep Res 1983;12:196.*

26. *Nielsen TA, Kuiken DL, Moffitt A, Hoffman R, Newell R. Comparisons of the story structure of stage REM and stage 2 mentation reports. Sleep Res 1983;12:181.*

27. *Cipolli C, Poli D. Story structure in verbal reports of mental sleep experience after awakening in REM sleep. Sleep 1992;15:133-142.*

28. *Cipolli C, Bolzani R, Tuozzi G. Story-like organization of dream experience in different periods of REM sleep. J Sleep Res 1998;7:13-19.*

29. *Cipolli C, Bolzani R, Massetani R, Murri L, Muratorio A. Dream structure in Parkinson's patients. J Nerv Ment Dis 1992;180:516-523.*

30. *Baylor GW, Deslauriers D. Dreams: Nature, Function, and a Method of Study, Montréal: Université de Montréal, 1985.*

31. *Kuper A. The structure of dream sequences. Cult Med Psychiat 1983;7:153-175.*

32. *Popp CA, Diguer L, Luborsky L, et al. Repetitive relationship themes in waking narratives and dreams. J Consult Clin Psychol 1996;64:1073-1078.*

33. *Mandler JM, Johnson NS. Remembrance of things parsed: story structure and recall. Cognitive Psychology 1977;9:111-151.*

34. *Stein NL, Glenn CG. An analysis of story comprehension in elementary school children. In: Freedle RO, ed. New Directions in Discourse Processes. Norwood, New Jersey: Abiax, Inc., 1979.*

35. *Rechtschaffen A, Kales A. A Manual of Standardized Terminology, Technique and Scoring System for Sleep Stages of Human Subjects, Bethesda: HEW Neurological Information Network, 1968.*

36. *Nielsen TA. Dreams as stories: Structural analysis of sleep mentation. Unpublished Masters Thesis, Department of Psychology, University of Alberta, 1983.*

37. *Foulkes D. The Psychology of Sleep, New York: Charles Scribners Sons, 1966.*

38. *Pivik T, Foulkes D. NREM mentation: Relation to personality, orientation time, and time of night. J Consult Clin Psychol 1968;32:144-151.*

39. *Goodenough DR, Shapiro A, Holden M, Steinschriber L. A comparison of "dreamers" and "nondreamers": Eye movements, electroencephalograms, and the recall of dreams. J Abnorm Psychol 1959;59:295-302.*

40. *Goodenough DR, Lewis HB, Shapiro A, Jaret L, Sleser I. Dream reporting following abrupt and gradual awakenings from different types of sleep. J Pers Soc Psychol 1965;2:170-179.*

41. *Goodenough DR. Qualitative aspects of dream recall. In: Arkin AM, Antrobus JS, Ellman SJ, eds. The Mind in Sleep. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1978.*

42. *Jones RM. Freudian and post-Freudian theories of dreams. In: Wolman BJ, ed. Handbook of Dreams: Research, Theories and Applications. New York: Van Nostrand Reinhold Co., 1979.*

43. *Rechtschaffen A. The single-mindedness and isolation of dreams. Sleep 1978;1:97-109.*

44. *Hobson JA, Goldfrank F, Snyder F. Respiration and mental activity in sleep. J Psych Res 1965;3:79-90.*

45. *Kamiya J. Behavioral, subjective and physiological aspects of drowsiness and sleep. In: Fiske DW, Maddi SR, eds. Functions of Varied Experience. Homewood, Illinois: Dorsey Press, 1961.*

46. *Snyder F. The phenomenology of dreaming. In: Madow L, Snow LH, eds. The Psychoanalytic Implications of the Psychophysiological Studies on Dreams. Springfield, Illinois: Charles Thomas, 1970;124-151.*