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LUCID DREAMING VERIFIED BY VOLITIONAL COMMUNICATION DURING REM SLEEP[1]

STEPHEN P. LA BERGE, LYNN E. NAGEL, WILLIAM C. DEMENT, AND VINCENT P. ZARCONE, JR.

Stanford University

Summary.—The occurrence of lucid dreaming (dreaming while being conscious that one is dreaming) has been verified for 5 selected subjects who signaled that they knew they were dreaming while continuing to dream during unequivocal REM sleep. The signals consisted of particular dream actions having observable concomitants and were performed in accordance with presleep agreement. The ability of proficient lucid dreamers to signal in this manner makes possible a new approach to dream research—such subjects, while lucid, could carry out diverse dream experiments marking the exact time of particular dream events, allowing derivation of precise psychophysiological correlations and methodical testing of hypotheses.

That we sometimes dream while knowing that we are dreaming was first noted by Aristotle. According to accounts of conscious or "lucid" dreaming, as this phenomenon is commonly termed, the dreamer can possess a consciousness fully comparable in coherence, clarity, and cognitive complexity to that of the waking state, while continuing to dream vividly (Van Eeden, 1913; Brown, 1936; Green, 1968; Tart, 1979; LaBerge, 1980b). As a result of theoretical assumptions about the nature of dreaming, contemporary dream researchers have questioned whether these experiences take place during sleep or during brief periods of hallucinatory wakefulness. The purpose of the present study was to give an empirical answer to this question by determining the physiological conditions in which lucid dreaming occurs.

Our experimental approach was suggested by previous investigations (Antrobus, *et al.*, 1965; Salamy, 1970; Brown & Cartwright, 1978), showing that sleeping subjects are sometimes able to produce behavioral responses highly correlated with dreaming. Since these subjects have not, according to Cartwright (1978), been conscious of making the responses, these earlier studies do not provide evidence for voluntary action (and thus, reflective consciousness) during sleep. However, we reasoned that what could be done unconsciously could also be done consciously.

The experience of one of us (S.P.L.) indicated that, if subjects became aware they were dreaming, they could also remember to perform previously

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intended dream actions. Because dreamed gaze and limb actions have sometimes shown very good correlations with polygraphically recorded eye movements and muscle activation (Rechtschaffen, 1973), it seemed plausible that lucid dreamers could signal that they knew they were dreaming by means of intentional dream actions having observable physiological correlates.

Method and Results

Five subjects, trained in the method of lucid dream induction (MILD) described by LaBerge (1980c), were selected on the basis of their claimed ability to have lucid dreams on demand, and studied for 2 to 20 nonconsecutive nights (see Table 1). Standard polysomnograms (Rechtschaffen & Kales, 1968), i.e., electroencephalogram (EEG), electro-oculogram (EOG), and chin electromyogram (EMG), were recorded, as well as left and right wrist EMG (for signaling). The subjects attempted to follow a predetermined procedure of signaling whenever they became aware that they were dreaming. A variety of signals were specified, generally consisting of a combination of dreamed eye movements and a pattern of left and right dream-fist clenches. The subjects demonstrated the signals during pre-recording calibrations but were asked not to practice further while awake.

In the course of the study, 35 lucid dreams were reported subsequent to spontaneous awakening from various stages of sleep as follows: rapid-eye-movement (REM) sleep in 32 cases, non-REM (NREM) Stage 1 twice, and during the transition from NREM Stage 2 to REM once.

The subjects reported signaling during 30 of these lucid dreams. After each recording, the reports mentioning signals were submitted along with the respective polysomnogram to a judge uninformed of the times of the reports.

TABLE 1

Summary of Lucid Dream Signaling Experiments

Subject (age, sex)	Nights recorded	Lucid dreams reported (sleep stage)	Lucid dream signals verified*/reported
S.L. (32 yr., M)	20	17 (REM)	14/15
R.K. (28 yr., M)	4	5 (REM)	3/5
L.L. (34 yr., F)	2	1 (REM)	0/0
		2 (NREM—1)	0+/1
B.K. (27 yr., F)	6	6 (REM)	5/6
		1 (NREM—2/REM)++	0/0
S.P. (26 yr., M)	2	2 (REM)	2/2

*Blindly matched for correspondence between reported and observed signals.
+On awakening from NREM Stage 1 sleep (2 min. after having awakened from REM), the subject reported performing the agreed-upon signal during a vivid and lengthy lucid dream. However, neither her EOG nor wrist EMG showed any sign of the reported signals, as might be expected from the normal lack of correspondence between dream gaze and eye movements during descending Stage 1 sleep (Rechtschaffen, 1973).
++The subject awoke, in this case, during the transition from NREM Stage 2 to REM.

The judge was asked to determine whether one (or none) of the polysomnographic epochs corresponded with the reported lucid dream signal. In 24 cases, the judge was able to select the appropriate 30-sec. epochs (out of about 1000 per polysomnogram) on the basis of correspondence between reported and observed signals (Table 1). The probability that the selections were correct by chance alone is astronomically small. All signals associated with lucid dream reports occurred during epochs of unambiguous REM sleep scored according to the standard criteria (Rechtschaffen & Kales, 1968). The lucid dream signals were followed by an average of 1 min. (range: 5 to 450 sec.) of uninterrupted REM sleep.

Inspection of the polysomnographic epochs preceding the lucid dream signal reports suggested the failures with blind matching (the "false negatives") were due to high baseline EOG and wrist EMG activity, resulting in an unfavorable signal-to-noise ratio. However, no clear instances of signals were observed except where reported, i.e., there were no "false positives." On the other hand, in many cases, the reported signals were unequivocal (see Figs. 1 and 2). The most reliable signal was a series of extreme horizontal eye movements (left, right, left, right.)

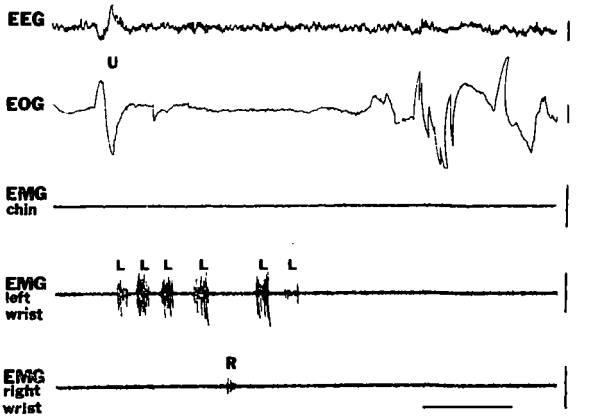

FIG. 1. Polygraph record of a subject signaling that he knows he is dreaming. The subject awoke approximately 20 sec. after this excerpt and reported recognizing that he was dreaming and performing the agreed upon signal in the dream, i.e., he directed his dream gaze upwards momentarily (U) and then executed a sequence of dreamed left (L) and right (R) fist clenches, Morse code for S.L., the subject's initials. Note that unlike the predominantly horizontal eye movements (above right), the extreme upward eye movement (U) produces characteristic artifact in the EEG channel. All three of the scoring criteria for REM sleep are met: low amplitude chin EMG, episodic REMs, and low-voltage, mixed-frequency EEG (Rechtschaffen & Kales, 1968). The EEG shows occasional 10-Hz (alpha) activity as is normal during REM sleep (Rechtschaffen, 1973); integration of the alpha band-pass filtered EEG showed the amount of alpha activity during the lucid dream did not significantly differ from that during the preceding non-lucid portion of the REM period. (Calibrations: 50μV; 5 sec.)

The most complicated signal (shown in Fig. 1) consisted of a single upward dream-eye movement followed by a series of left (L) and right (R) dream-fist clenches in the order "LLL LRLL." This sequence is equivalent to the subject's initials in Morse code (LLL = . . . = S; LRLL = . -- . . = L). The complexity of this signal argues against the possibility that the EMG discharges might be spontaneous.

That all cases of lucid dream signaling occurred during epochs scored as REM sleep specifies, to a certain extent, the physiology of lucid dreaming as "a relatively low voltage, mixed frequency EEG in conjunction with episodic REMs and low amplitude electromyogram (EMG)" (Rechtschaffen & Kales, 1968). This definition allows variation in the three parameters, the details of which will be reported elsewhere. In brief, the variations in the EEG patterns of the lucid dream polysomnograms were typical of REM sleep, i.e., sporadic "saw-tooth" waves as well as alpha and theta rhythm, and not wakefulness. The occasional, but normal, appearance of alpha rhythm (a brain wave usually associated with wakefulness), in the EEG during REM periods raises the possibility that lucid dreaming could occur during momentary partial arousals or "micro-awakenings" (Schwartz & Lefebvre, 1973). However, alpha rhythm need not be present during lucid dream signaling, as is shown by Fig. 2. Furthermore, some of the lucid dreams were several minutes long, ruling out any explanation based on the notion of brief intrusions of wakefulness.

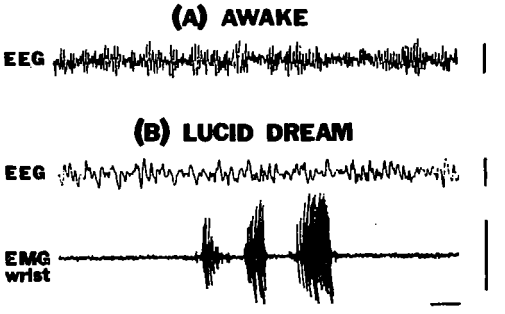

FIG. 2. Comparison of EEG (C3/A2) during lucid dream signaling (B) and immediately after awakening (A). The continuous waking alpha (10 Hz) activity for this subject is clearly distinct from the mixed frequency patterns during REM sleep. Although other EEG patterns are compatible with wakefulness, the tracing illustrated is the pattern normally exhibited when subjects awaken from sleep. The 2- to 4-Hz EEG activity prominent in the lucid dream sample (B) is highly characteristic of REM sleep. (Calibrations: 50 μV; 1 sec.)

DISCUSSION

How do we know that the subjects were "really asleep" when they communicated the signals? If we allow perception of the external world as a

criterion of being awake, we can conclude the subjects were indeed asleep: Although they knew they were in the laboratory, this knowledge was a matter of memory, not perception; upon awakening, they reported having been totally in the dream world and not in sensory contact with the external world. Neither were the subjects merely not attending to the environment, e.g., as when absorbed in reading or daydreaming; according to their reports, they were specifically aware of the *absence* of sensory input from the external world. If subjects were to claim to have been awake while showing physiological signs of sleep, or vice versa, we might doubt their subjective reports. However, in the present case, the subjective accounts and physiological measures are in clear agreement, and it would be extremely unparsimonious to suppose that subjects who believed themselves to be asleep while showing physiological indications of sleep were actually awake.

The two principal conclusions of this study are that lucid dreaming can occur during REM sleep and that it is possible for lucid dreamers to signal intentionally to the environment while continuing to dream. These findings have both theoretical and practical consequences. The first result shows that under certain circumstances, dream cognition during REM sleep can be much more reflective and rational than has been commonly assumed. Evidence indicating that lucid dreaming is a learnable skill (LaBerge, 1979, 1980a, 1980b, 1980c), taken with the second result, suggests the feasibility of a new approach to dream research: lucidly dreaming subjects could carry out diverse experiments marking the exact time of occurrence of particular dream events, which would allow the derivation of precise psychophysiological correlations and methodical testing of hypotheses.

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