HANDBOOK OF STATES OF CONSCIOUSNESS

6. Lucid Dreaming

Stephen LaBerge and Jayne Gackenbach

"Lucid dreaming," as the phenomenon of dreaming while knowing that one is dreaming is commonly termed, is arguably one of the most remarkable states of consciousness a normal person is likely to experience. The case for this assertion can be seen by considering that the lucid dreamer can apparently be in full possession of his or her waking faculties (this is the meaning of "lucid") being able to " . . . reason clearly, remember freely, and act volitionally upon reflection, all while continuing to dream vividly" (LaBerge, 1980a). Both lucid dreamers' subjective reports and the physiological evidence to be reviewed below indicate that these experiences take place during sound sleep. Taken together, these facts make lucid dreaming seem something of a paradox: while lucid dreamers are fully asleep to the external reality of the physical world, they are at the same time fully awake to the inner reality of their dream worlds.

We deal here with four general areas: first, with a descriptive phenomenology of the lucid dream itself; second, with individual differences and general characteristics of frequent lucid dreamers; third, with physiological aspects of the phenomenon; and fourth, with some of the applications and implications of lucid dreaming for research on altered states of consciousness.

THE PHENOMENOLOGY OF LUCID DREAMING

Let the experience speak for itself; here are three lucid dream reports:

> I am crossing a bridge over an abyss. When I look into the depths I am afraid to continue. My companion, behind me, says, "You know, you

don't *have* to go this way. You can go back the way you came," and points back down an immense distance. But then it occurs to me that if I became lucid I would not need to fear the height. As I realize that I *am* dreaming, I'm able to master my fear—I cross the bridge and awaken. (LaBerge, 1981)

In the dream, she was informed that she could choose either to have intercourse with a fantastic dream lover and be strangled by him afterward, or never to have sex again. Her growing desire for a life lived to the full rather than a living death led her to choose the former, and as she was being led into the arena she suddenly became lucid. Instead of waking herself up or changing the scene, she decided to trick them all and go along with the game; and as she laughed to herself as how she would get up and walk away at the end, the environment expanded, the colors deepened, and she was high. Then the scene changed and she found herself flying in an extraordinarily high state, going through walls and windows without difficulty, and although she had been looking forward to the sex, now her deprivation did not seem to matter because she was enjoying other even more exhilarating experiences. (Faraday, 1974, p. 339)

[During a lucid dream] eventually we left the carnival and fire behind us and came to a yellow path, leading across a desolate moor. As we stood at the foot of this path it suddenly rose up before us and became a roadway of golden light stretching from earth to zenith.

Now in this amber-tinted shining haze there appeared countless coloured forms of men and beasts, representing man's upward evolution through different stages of civilization. These forms faded away; the pathway lost its golden tint and became a mass of vibrating circles of globules (like frog's eggs), a purplish-blue in colour. These in their turn changed to "peacock's eyes"; and then suddenly there came a culminating vision of a gigantic peacock, whose outspread tail filled the heavens. I exclaimed to my wife, "The Vision of the Universal Peacock!" Moved by the splendor of the sight, I recited in a loud voice a mantra. Then the dream ended. (Fox, 1962, p. 90)

The three very different accounts just quoted above illustrate something of the diversity of form and content shown by lucid dreams. Although lucid dreams can differ in particulars as much as lucid dreamers, they nevertheless possess a variety of common features allowing for a degree of generalization regarding what happens in them. Let us first consider how the lucid dreaming state of consciousness is initiated and terminated.

Initiations

The lucid dreamer can be metaphorically viewed as a compound composed of two constituents, dreaming and lucid consciousness (LaBerge, 1980b). The lucid dreaming state can therefore, in principle, be initiated in two general ways: either when the person is already dreaming and lucidity is added, or when the person is already conscious and dreaming is added. In the two cases, the initial states are respectively ordinary, nonlucid dreaming and vigilant wakefulness.

In what is by all accounts (cf. LaBerge, 1980b) the most common form of lucid dream initiation, the dreamer realizes in some way during an ongoing dream that he or she is dreaming. One of the ways in which this typically happens involves the perception of inconsistencies in dream content *as anomalous,* followed by the critical recognition that the explanation for the bizarre events is that *it is all a dream.*

Anomalous dream content is not in most cases fully recognized as such. Depending upon the degree to which reality is tested, the dreamer will attain corresponding degrees of lucidity. Fox (1962) believed critical thinking to be the key to lucid dreaming and has provided an unexcelled account of the range of reality testing and perception of anomaly that may occur:

> Let us suppose, for example, that in my dream I am in a cafe. At a table near mine is a lady who would be very attractive—only, she has four eyes. Here are some illustrations of those degrees of activity of the critical faculty.
>
> 1. In the dream it is practically dormant, but on waking I have the feeling that there was something peculiar about this lady. Suddenly I get it—"Why, of course, she had four eyes!"
>
> 2. In the dream I exhibit mild surprise and say, "How curious, that girl has four eyes! It spoils her." But only in the same way that I might remark, "What a pity she has broken her nose! I wonder how she did it."
>
> 3. The critical faculty is more awake and the four eyes are regarded as abnormal; but the phenomenon is not fully appreciated. I exclaim "Good Lord!" and then reassure myself by adding, "There must be a freak show or a circus in the town." Thus I hover on the brink of realization, but do not quite get there.
>
> 4. My critical faculty is now fully awake and fully refuses to be satisfied by this explanation. I continue my train of thought, "But there never was such a freak! An adult with four eyes—it's *impossible.* I am dreaming." (p. 35)

As a result of inadequate reality testing, a dreamer for whom the question arises as to whether or not he is dreaming, will sometimes mistakenly decide that he is in fact awake and *not* dreaming as in Fox's third example above. A dream in which the dreamer has at one point raised this question without arriving at the correct conclusion is commonly termed "pre-lucid" (Green, 1968).

Dreamers who suspect that they could be dreaming may test their state in a variety of ways. However, few of these tests are reliably effective in distinguishing dreaming from waking. For example, pre-lucid dreamers too often conclude that they could not possibly be dreaming because everything seems so solid and vividly real. Or they may pinch themselves, following along with the classical test. This most often has the result not of awakening the dreamer, but of merely producing the convincing sensation of a pinch and the mistaken conviction that he or she is awake.

A better test used by many lucid dreamers seems to be trying to fly (Brown, 1936). Attempted reading may be a still more reliable test. LaBerge (1985) reports that some degree of dyslexia is extremely characteristic of lucid dreams (see also Moers-Messmer, 1939, and discussion below). LaBerge (ibid.) has argued that dreams are more readily distinguishable from waking perceptions on the basis of the relative instability of dream content rather than any necessary differences in vividness. But the last word in reality testing has been provided by McCreery (1973), who pointed out that while awake we almost never doubt whether we are awake or not. Therefore, whenever we find ourselves wondering whether or not we are dreaming, we probably are.

Returning to the content accompanying the emergence of lucidity, it was formerly thought that in the general population lucidity was most likely to emerge as a result of a nightmare or anxiety dream (Green, 1968). However, recent research has shown that although this occurs, it is not the most frequently reported reason (LaBerge, 1980b; Hearne, 1983; Gackenbach, 1978, 1982). Hearne (1983) noted that the majority (53%) of his adult sample cited dream inconsistencies, such as seeing people whom the dreamer knows to be dead, as the apparent cause of lucidity. In contrast, only 19 percent of the more than 300 students in Gackenbach's (1982) sample reported their lucid dreams were due to inconsistencies. In an adult sample, Gackenbach (1978) found that dream inconsistency the least likely way in which individuals reported attaining lucidity.

According to Gackenbach (1978, 1982), the reason most often reported by both her samples as the cause of lucidity was a sense of the "dream-likeness" of the dream. The precise meaning of such reports is problematic. One might suspect that subjects describing the cause of their lucidity in such global terms are just being vague. Perhaps they did not notice or forgot

exactly which features of their dreams made them seem "dreamlike." It seems reasonable to suppose that these anomalies were the actual discriminative stimuli. It may be that what causes some lucid dreams to be attributed to perception of the "dreamlikeness" and others to be attributed to recognition of incongruities is cognitive differences in the lucid dreamers. These could perhaps be explained by reference to the familiar division of mental processes into two levels: preattentive process versus focal attention (Neisser, 1967). The study of individual cognitive differences in relation to these two styles of lucidity initiation would seem a productive direction for future research.

Gackenbach (1982) has reported content and situational differences accompanying lucid dreams initiated in the three ways just described. The day before nightmare-initiated lucids, subjects reported more depressed feelings and more hostile feelings, feelings of lack of attention, and insecure feelings than on days before lucid dreams that were initiated by the dreamlike quality of the dream. Likewise, on the day after these two types of lucid dreams, nightmare-initiated lucid dreams were followed by more anxiety, hostility, depression, insecurity, and lack of attention than dreamlike-initiated lucids. Not surprisingly, nightmare-initiated lucids were viewed as having fewer positive and more negative emotions than dreamlike-initiated lucids. Finally, lucid nightmares were reported as having less of a sense of dream control than the dreamlike lucids. Incongruent-element-initiated lucid dreams were similar to both other types. For instance, incongruent lucids were reported as having as much positive emotion as nightmare-initiated lucids, but significantly less negative emotion than lucid nightmares. In sum, dreamlike-initiated lucids represent the most experientially positive lucid dream experience. They are preceded by "good days" and result in the same.

In factor analytic work with her adult sample, Gackenbach (1978) reported that lucid dreams emerging from nightmares were loaded with experiencing lucidity as a child. This supports the notion that children most typically learn lucid dreaming as a means of coping with nightmares (LaBerge, 1985). The other two dream causes of lucidity (i.e., dreamlikeness and incongruence) were loaded with dream lucidity occurring directly upon awakening or upon falling back to sleep after having awakened in the morning.

In summary, the three major ways dreamers recognize they are dreaming are: (1) perception and rational interpretation of inconsistencies; (2) emotional arousal, especially anxiety; and (3) direct recognition of the dreamlike nature of the experience. It should be unnecessary to add that although these are the most frequent triggers of consciousness during the dream state, they are not the only ones (see LaBerge, 1980b; Gackenbach and LaBerge,

in press). Moreover, dream consciousness can also arise from the waking state, which brings us to the other general class of lucid dream initiations—those beginning in wakefulness rather than in sleep.

It is possible to maintain continuous reflective consciousness while falling asleep and hence to enter a lucid dream directly from the waking state. It seems that this mode of entry to the lucid dream state is a skill that improves with motivation (LaBerge, 1980b) and also with practice. Indeed, its cultivation was described hundreds of years ago by Tibetan yogis (Evans-Wentz, 1960) and more recently by a number of others (Ouspensky, 1931; Rapport, 1948; Rajneesh, 1974; Tulku, 1978; LaBerge, 1980a, 1985; Tholey, 1983).

Most mental techniques claiming to enhance the frequency of lucid dreaming are pre-sleep exercises aimed at developing appropriate cognitive sets that it is hoped will persist into the dream state and there favor the emergence of the critical attitude of lucid consciousness. For example, it is frequently recommended (Narayana, 1922; Evans-Wentz, 1960; Rajneesh, 1974; Tulku, 1978; Malamud, 1980; Tholey, 1983; LaBerge, 1985) that would-be lucid dreamers ask themselves during the day, "Is this a dream?" All agree that this should be practiced as often as possible: indeed, Rajneesh (1974) specifies doing this "for three weeks continuously!" The basis of this method is, of course, that following sufficient daily practice, habit will carry the tendency to ask the critical question over into our dreams.

The other major class of mental techniques for inducing lucid dreams focuses on intention. For example, the classical Tibetan instruction manual for the Yoga of the dream-state (Evans-Wentz, 1960) exhorts the would-be lucid dreamer to "firmly resolve to comprehend the dream state," making no fewer than twenty-one efforts each morning. The importance of intention is insisted upon by most writers (e.g., Narayana, 1922; Garfield, 1974a, 1979; LaBerge, 1980a,b, 1985), although not all (e.g., Tholey, 1983). Others sometimes suggest a form of paradoxical intention such as Sparrow's (1976) claim that meditation in the early morning hours frequently resulted in lucid dreams during subsequent sleep as long as he was careful not to meditate for the specific purpose of having lucid dreams. Others have also suggested that meditation favors lucid dreaming (Banquet, 1973; Reed, 1978; McLeod and Hunt, 1983). In a related approach, Ogilvie et al. (1982) reported alpha feedback training prior to sleep onset was without effect on subsequent lucid dreaming frequency.

Garfield tested an autosuggestion method (1974a) over an eight-month period, reporting that she obtained a "classical learning curve, increasing the frequency of prolonged lucid dreams from a baseline of zero to a high of three per week" (1975). During the first nine months of her study, she had only four lucid dreams (1974b), which illustrates the necessity of pa-

tience at the outset. At last report, after five or six years of practicing autosuggestion, Garfield was having an average of four to five lucid dreams per month (1979, p. 120).

LaBerge (1980a,b) undertook a personal study investigating whether it was possible to learn to dream lucidly at will. Starting with an autosuggestion method similar to Garfield's (1974b), over the course of three years LaBerge recorded a total of 389 lucid dreams and developed a mnemonic method for the induction of lucid dreams (MILD), with which he was able to volitionally induce lucid dreams. He reported that MILD yielded eighteen to twenty-six lucid dreams per month, with as many as four in a single night. Although the efficiency of MILD has been clearly demonstrated for a single subject, we have as yet little definitive information on how effective it is for others. LaBerge (1980b) suggested that the two essential requirements for learning the technique were high motivation and excellent dream recall (i.e., two or three dreams per night). Tholey (1983) has described a similar method, as well as a "combined technique" borrowing elements from most of the preceding procedures. Although Tholey reports this combination to be most effective, he provides no supporting evidence in the form of quantitative data allowing statistical evaluation of the performance of any of these approaches. This criticism unfortunately also applies to most other accounts of techniques put forward as facilitating lucid dreaming.

Hypnosis is another promising but little-researched approach to lucid dream induction (LaBerge, 1980a). Tart (1979) has also reported pilot data indicating "that posthypnotic suggestions may have some potential in inducing lucid dreaming." Relatedly, Dane (1984) found high hypnotic susceptibility to facilitate successful induction of lucid dreams while using MILD (LaBerge, 1980b). Another major approach to lucid dream induction is based on the idea of providing an external cue to remind a dreamer that he or she is dreaming. A number of efforts to put this idea into practice have been attempted with various degrees of limited success. Most studies have utilized auditory cues (LaBerge, 1980a; LaBerge et al., 1981c; Ogilvie et al., 1983; Tholey, 1983), while the remainder have focused on tactile stimuli (Hearne, 1983; Tholey, 1983).

How effective are these various methods of external cuing? The most data is available on the study taking the most direct approach: testing whether a direct verbal suggestion (i.e., "this is a dream") applied to a prepared subject during REM could be used to induce lucidity. A pilot study by LaBerge (1980a) yielded promising results, suggesting the feasibility of such a technique. Thus encouraged, LaBerge, Owens, Nagel, and Dement (1981) recorded four subjects (two experienced lucid dreamers and two inexperienced) for one to two nights each. A tape recording repeating the phrase "this is a dream" was played at gradually increasing volume, 5 to

10 minutes after the beginning of each REM period. The subjects were instructed to signal by means of a pair of left and right eye movements whenever they heard the tape or realized they were dreaming. The technician turned off the tape recorder immediately upon observing this eye movement signal on the polygraph. LaBerge et al. reported that the tape stimulus was applied fifteen times, producing lucidity in 33 percent of the cases, although not all of these lucid dreams lasted more than a few seconds.

In a similar study, Ogilvie et al. (1983) used a buzzer to cue lucid dreamers after 15 minutes of REM sleep from epochs with high or low alpha activity. Subjects were to signal immediately after the cue and 30 seconds later if in a lucid dream; 30 to 60 seconds later, they were awakened to allow dream reports to be collected. The thirty-one cue applications apparently resulted in six persistent lucid dreams (20%) with no difference in number between the two alpha conditions.

In a tactile variation on the REM reminder theme, Hearne (1983) tested the effectiveness of electric shocks to the wrist. Of fifteen female subjects who spent one night each in the sleep laboratory, six had lucid dreams stimulated by this method. Hearne does not report the total number of cue applications, making evaluation difficult. Other studies have reported this procedure to be relatively ineffective (Hearne, 1978; Venus, 1982).

Having dealt with techniques aimed at intentionally inducing lucid dreams, let us ask whether or not there are any pre-sleep activities or circumstances that favor the occurrence of spontaneous lucid dreams. Both Garfield (1975) and Hearne (1978) reported that lucid dreams occur most frequently on nights following days of high-level arousal and activity. Although Gackenbach (1978) was unable to demonstrate such a relationship, in a more comprehensive follow-up study, she found that both women and men were more likely to have lucid dreams on nights following unpleasant social interactions (Gackenbach, Curren, and Cutler, 1983). Additionally, pre-sleep negative emotions favored lucid dreaming for women only; while for men only, high activity was favorable. Faraday (1974) believed her own lucid dreams to result from "an actual coming together of head and heart somewhere in waking life during the course of the day" (p. 57). A variety of other waking activities, especially during the night or early morning have been said to promote lucid dreaming. Sparrow (1976), as mentioned above, reported that early morning meditation favors lucid dreaming. Garfield (1975), on the other hand, wrote that "sexual intercourse in the middle of the night was often followed by a lucid dream." LaBerge cites anecdotal evidence implicating early morning reading, writing, or even being sick in the middle of the night, concluding that "the diversity of the proposed activities suggests that it is not the particular activity, but the alert wakefulness that facilitates lucid dreaming during subsequent sleep" (1980b).

A final factor affecting lucid dreaming frequency is the extent to which a person is familiar with what is dreamlike about his or her dreams. The more intimately one knows the typical idiosyncracies of one's dreams, the more easily will they be recognized as dreams. This probably partially accounts for the positive correlations between lucid dreaming and high overall dream recall (Belicki et al., 1978; Gackenbach, 1978). As part of his lucidity training programs, LaBerge (1985) has students classify the anomalies occurring in the content of their own dreams to develop this useful skill. Malamud (1980) has extensively developed a similar approach; see her Chapter 19 (this book) for details. This completes our survey of how lucid dreams are initiated; having dealt with how they begin, let us now turn to how they end.

Terminations

Returning to the concept described above, treating the lucid dream as a compound of lucidity and the dream state, just as there were in principle two ways of initiating it, likewise there are two general possibilities for terminating it. Either lucidity is lost while the dream continues, or the dream ends with an awakening, with a degree of lucidity presumably remaining.

The first mode of termination is probably the more common in less experienced lucid dreamers. Neophytes are more likely to lose their lucidity, once they have it. Accordingly, after having become at least momentarily lucid, the inexperienced dreamer will frequently become reabsorbed by the dream, forgetting that it is a dream and continuing to dream nonlucidly. This forgetfulness can be countered by repeating to oneself "this is a dream" while dreaming, just as we use speech to organize behavior during the early stages of learning. However, later such talk is unnecessary. For more experienced lucid dreamers, the second mode of termination, awakening, becomes more common than the loss of lucidity characteristic of beginners. For example, LaBerge (1980b) reported that in his own case, lucidity was lost in at least 18 percent of the lucid dreams he recorded during the first year of his study; during the next two years, he retained lucidity until awakening in 99 percent of his lucid dreams.

There are two other possible forms of lucid dream termination, involving the loss of lucidity. One possibility is that the lucid dreamer might enter non-REM sleep, thereby losing lucidity and perhaps also dreaming. If awakened at this point, he would likely recall nothing of the lucid dream. In the other case in which lucidity is lost, the dreamer *dreams* that he or she has awakened.

Since the lucid dream state is normally terminated by an awakening, when a lucid dream begins to fade, it is natural to expect an awakening. Often,

however, this expectation is not fulfilled in actuality, but by a dream of awakening. "False awakenings," as these dreams are usually called (Green, 1968), are very commonly reported concomitants of lucid dreams. Although false awakenings are also reported following nonlucid dreams, the phenomenon appears to be much more frequently associated with lucid dreams, probably because only while we are lucid does the question of being awake or asleep normally arise. Moreover, false awakenings seem to occur more frequently in experienced lucid dreamers than in inexperienced ones. LaBerge (1980b) reported them in only 16 percent of his first year's record of lucid dreams, but in 30 to 40 percent of those in the next three years. This trend may be accounted for by the fact that the more lucid dreams a person experiences, the more he or she associates awakening with the lucid dream fading and thus more strongly expects to awaken. If the profound influence of expectations on dream content is not already obvious, it will be after the next section.

Expectation: Its Impact on Dream Content

The assumptions—conscious or unconscious—that dreamers hold about what lucid dreams are like or could be like determine to a remarkable extent the precise form taken by their lucid dreams. As influential as expectations may be in the waking world, it is readily seen that they play an even more significant role in the dream world. After all, in the physical world there are biological limitations built into our bodies, to say nothing of the constraints we know as the laws of physics. In the dream world, however, these laws are followed merely by convention, if at all. There is no gravity in dreams, but thinking makes it so. It is true that there appear to be "laws of physiology" that constrain a lucid dreamer's action, deriving from functional limitations of the human brain. However, these restraints are far fewer than those imposed by physical law, which leaves more room for psychological influences such as assumptions to play a limiting role. The degree to which expectations influence the experience of a particular dreamer is vividly illustrated by the following examples.

The philosopher Ouspensky assumed on theoretical grounds that "man cannot in sleep think about himself *unless the thought is itself a dream*" (1931). From this premise, he reasoned that "a man can never pronounce his own name in sleep." It should therefore come as no surprise that Ouspensky reported "as expected" that when he pronounced his name during a lucid dream, he immediately woke up.

A generation later, Green (1968, p. 85) described the experiences of a lucid dreamer ("Subject C") who, having heard of the philosopher's account, decided to test the effect of repeating her own name during a lucid

dream. "C" reported that when a suitable occasion presented itself during a lucid dream, she "thought of Ouspensky's criterion of repeating one's own name," and explained that she achieved "a sort of gap-in-consciousness"—whatever that may mean. She explained that the effort seemed to make her "giddy"; in any case, she stopped.

In 1974, Garfield recounted a lucid dream of her own bearing precisely on this issue: she had given this dream the title, "Carving My Name," and "proceeded to do just that on the door where [she] was already carving." When she read what she had just written, the entire fabric of the dream "vibrated and thundered," and she awoke. Garfield, who was familiar with both Ouspensky's and Subject C's experiences, concluded from this that while it is "not impossible" to pronounce one's own name in a lucid dream, "... it *is* disruptive" (1974a, p. 143). LaBerge (1980a) wrote that when he read Ouspensky's account, he neither followed the philosopher's reasoning nor accepted his original premise about thinking in dreams. Consequently, he could see no reason why saying his name while dreaming should present any difficulty at all. He reported that trying to pronounce his name in a lucid dream resulted in nothing more than hearing his own voice. The conclusion would seem to be that the dream experiences of Ouspensky, Subject C, and Garfield were all the effects of self-fulfilling prophecy.

One more illustration of the effect of assumptions on the content of lucid dreams should be enough to prove the case. McCreery's "Subject E," in speaking of the emotional quality of her lucid dreams, declared that "realization that one is dreaming brings a wonderful sense of freedom—freedom to try anything in the extended range of experience" (1973, p. 114). The Englishwoman added that "The nature of lucid dream experience may range up to the mystical, whilst *there seems to be an inherent resistance to anything erotic*" (ibid.).

Garfield's (1979) experiences present a striking contrast. She reported that two-thirds of her lucid dreams are accompanied by sexual arousal, of which half culminate "in an orgasmic burst." She writes that "my own experience convinces me that conscious dreaming *is* orgasmic," and adds that "too many of my students have reported similar ecstatic experiences during lucid dreams to attribute the phenomena to my individual peculiarity." For Garfield, "*Orgasm is a natural part of lucid dreaming*" (ibid., p. 44).

However, as to the question of whether lucid dreaming is "naturally" erotic or the opposite, before answering we must ask "for whom?"

The assumptions that the dreamer makes about what can happen during a lucid dream may wholly or in part determine what *does* happen. As a corollary of this, individual differences may be very significant in the phenomenology of lucid dreaming.

Having considered the beginnings and endings of lucid dreams, as well as certain factors contributing to their general form, we are now ready to deal with the lucid dream itself—including sensory, perceptual, emotional, and cognitive characteristics of this class of experiences.

Sensations and Perceptions

A wide range of approaches to the question of whether lucid and nonlucid dreams differ in reported sensory and perceptual content have been undertaken. The preeminent waking sensory modality is vision, and its representativeness in lucid–nonlucid dreams has been examined from four perspectives: general vision, color, brightness, and clarity of imagery. In the morning-after dream reports, subjects rated their lucid dreams as more visual than their nonlucid dreams (Gackenbach and Schillig, 1983). However, in two later studies controlling for dream recall, no dream difference in vision emerged. Long-term recall (i.e., by questionnaires) evidenced the opposite, that is, nonlucid dreams as more visual than lucid dreams (ibid.). Lucid dreams were seen as more colorful than nonlucid dreams by Gackenbach and Schillig (ibid.) and Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) in morning-after reports, but less colorful as ascertained by long-term recall (Gackenbach and Schillig, 1983). No differences were noted by Gackenbach, Curren, and Cutler (1983).

As regards brightness, Hearne (1978) reports no difference from prior to lucidity to after its onset in one adept subject, and elsewhere (1981) argues for a brightness ceiling. Worsley (1982) points out that the difficulty in turning on a light switch in lucid dreams and thereby elevating the brightness levels may be due to problems with functioning in different modalities and not with a brightness ceiling per se. Relatedly, Gackenbach and Schillig (1983) found that subjects report the presence of a bright or salient light more often in vivid nonlucid dreams than in lucid dreams.

The second major sensory modality in dreams is that of audition, and here lucid dream reports have been generally found to mention auditory experiences more frequently than nonlucid dream reports (Hearne, 1983; Gackenbach, Curren, and Cutler, 1983; Gackenbach and Schillig, 1983). Worsley (1983) notes that although he could easily hear a radio while lucid, he could make no sense of it. This apparent contradiction will be covered in the cognitive section.

Minor sensations such as taste, smell, kinesthesia, touch, pain, and temperature have also been investigated. Taste and smell have generally exhibited no dream-type differences in morning-after reports (Gackenbach, Curren, and Cutler, 1983; Gackenbach and Shillig, 1983). Likewise, these

two surveys reported pain as being noted more frequently in nonlucid dreams. No dream differences have been noted as regards temperature (Gackenbach, personal communication, 1980; Gackenbach and Schillig, 1983). Lucid dreams have been found most often to include body sensations such as touch and kinesthesia (Gilmore, 1983; Gackenbach, Curren, and Cutler, 1983; Gackenbach and Schillig, 1983) although a lack of a difference (Gackenbach and Shillig, 1983) has also been reported.

Emotions

Lucid dreams have historically been described as eliciting strong emotions (Green, 1968), which more recent survey data continue to support. Although lucid dreams appear to be generally characterized by positive affect, negative emotion is also intensified (Gackenbach and Schillig, 1983). The initiation of lucidity is frequently accompanied by very positive emotions, as the following sample of quotations should make clear. For Rapport (1948), the emergence of lucidity "instantly" transformed his dream into incommunicably beautiful vision. For Faraday (1974) "immediately the light became almost supernaturally intense . . . space seemed expanded and deeper, just as it does under psychedelic drugs." Similarly, for Yram (1967), ". . . the transformation was instantaneous. As if under a magic spell I suddenly became as clear headed as in the best moments of my physical life." In even more extravagant terms, Fox (1962) described the onset of his first experience of lucidity: "instantly, the vividness of life increased a hundredfold . . . never had I felt so absolutely well, so clear brained, so divinely powerful, so inexpressibly *free*!"

Cognitions

As with sensory and perceptual components of lucid dreams, the cognitive components have been investigated from multiple perspectives and with many techniques. The memory of waking life during the lucid dream, clarity of thought, dream control, and ability to do experiments in the lucid dream state are highly interrelated. To perform lucid dream experiments, the dreamer needs a clear dream mind in order to be able to remember and execute the intended task. Gackenbach (1978) reported that lucid dreamers, of varying frequencies, felt that their memory of waking life was on the average clearer than other dreams but still a dream memory.

Dream control has repeatedly been demonstrated to be higher in the lucid dream than in the nonlucid dream. This has been found by questionnaire (Gackenbach and Schillig, 1983; Hearne, 1983), by self-evaluation of in-

dividual dreams while keeping a dream journal (Gackenbach, Curren, and Cutler, 1983; Hearne, 1978), and through content analysis by independent judges of dream transcripts (Gackenbach, personal communication, 1985.)

The relative bizarreness of lucid versus nonlucid dreams is another cognitive aspect that has been the focus of considerable inquiry. The results have been mixed. Traditionally, lucid dreams have been conceived to be more realistic and less bizarre than nonlucid dreams (Green, 1968); and some of the more recent research has supported this perspective. Specifically, in content analyses of dream transcripts, Gackenbach (personal communication, 1985) found that nonlucid dreams were rated by independent judges as containing more animate bizarreness such as inappropriate objects and disfigured bodies, inanimate combinations of environmental features, transformations such as scene shifts, and metamorphoses. However, other research has pointed to more bizarreness in lucid dreams (Hearne, 1978; Hoffman and McCarley, 1980) or no difference (Gackenbach and Schillig, 1983). However, there are problems with some of these findings.

The anecdotal association of the initiation of dream with bizarreness has recently received experimental attention: Hoffman and McCarley (1980) tested the hypothesis "that the degree of dream lucidity will be correlated with the amount of accompanying bizarreness" by scoring 104 dream reports for "bizarreness" and "lucidity." The authors found, "as predicted," that the presence of lucidity was associated with the occurrence of bizarreness. However, this result is entirely predictable, given the five-point "lucidity" scale used in this study: "in only one dream was the dreamer conscious that he was dreaming (lucidity score = 5) and also in only one dream was action held up while the dreamer puzzled about an oddity (lucidity score = 3); in 15 dreams the dreamer registered the presence of an oddity (lucidity = 2) while in the remaining 84% of dreams no degree of lucidity was present." "Lucidity" as operationally defined by this scale is essentially equivalent to "perception of anomaly." As LaBerge (1980b) wrote, "The fact that the dreamer will more often 'register the presence of an oddity' in the presence of one (i.e., in dreams rated as bizarre) will hardly strike any reader not now dreaming as odd."

Gackenbach, Curren, LaBerge, Davidson & Maxwell, 1983 had adults evaluate lucid and nonlucid dreams as to their bizarreness the morning after experiencing each dream. The higher bizarreness ratings for lucid dreams may be in part due to the finding that the presence of an inconsistency or an oddity is one of the ways dreamers most often realize that they are asleep and dreaming.

The presence of speech and reading in these lucid dreams has also been investigated. Although they are typically found to possess more voices or

speech (Gackenbach, Curren, and Cutler, 1983; Gackenbach and Schillig, in press), the understanding of such material either through audition or by vision (i.e., reading) has been reported as difficult (Moers-Messmer, 1938; Worsley, 1983; Wilmes, 1983; Gilmore, 1983; LaBerge, 1985).

LUCID DREAMERS: CHARACTERISTICS AND INDIVIDUAL DIFFERENCES

Differences between individuals who experience dream lucidity and those who do not have been investigated in four major domains: physiology, perception, imagery, and abilities and personal disposition.

Physiology

Hemispheric laterality (Snyder and Gackenbach, 1981), vestibular sensitivity (Gackenbach, Sachau, Rokes, and Snyder, 1983), autonomic balance (Gackenbach, Walling, and LaBerge, 1984) and migraine headaches (Irwin, 1983) have all been investigated as a function of lucid dreaming ability.

Snyder and Gackenbach (1981) tested left- and right-handed women in a dual-task paradigm that has consistently been used to infer the cerebral organization for speech in right-handers. This paradigm involves persons performing sequential manual tapping (finger tapping or arm tapping) during silence and concurrent with speech. The pattern of interference that results during concurrent activity relative to the performance during silence is said to depend upon the cerebral organization for speech and manual control.

The results of their study suggest that females who frequently experience lucid dreams, regardless of their handedness, have a greater degree of unilateral cerebral speech organization than do females who never or infrequently experience such dreams. For right-handed frequent lucid dreamers this unilateral organization is based within the left hemisphere, while for left-handed frequents, this unilateral organization is right-hemisphere-based.

Gackenbach, Rokes, Sachau, and Snyder, (1983) found that frequent lucid dreamers evidenced a clear leftward eye movement preference as measured by amplitude of movement in response to directions to look left, right, or forward with eyes open and closed. They also report that subjects differing in the frequency with which they reported dreaming lucidly were administered the caloric irrigation test of vestibular sensitivity. Electronystagmographical evaluation determined that nonlucid dreamers evidence borderline vestibular pathology. In support of this, they note that in a broader sample,

without screening for vestibular dysfunction, high lucid dreaming frequency was negatively correlated, controlling for dream recall, with the presence of ear, vision, and motion sickness problems.

Autonomic balance was determined by Gackenbach et al. (1984) using Plutanick and Conte's (1974) Sympathetic–Parasympathetic test. When both social desirability and dream recall frequency were controlled, relative parasympathetic dominance was significantly associated with lucid dreaming frequency for women but not for men.

Finally, Irwin (1983) found in a chi-square analysis for lucid versus nonlucid dreamers that the former were more likely to report experiencing migraine headaches.

Perception

Frequent lucid dreamers have been found to be more susceptible to the stroop effect, to differential performance on the Southern California Motor Accuracy Test and a test of kinesthetic skills (Gackenbach et al., 1981), and to be field-independent (Gackenbach, Heilman, Boyt, and LaBerge, in press).

Sex differences in these associations also emerged. Specifically, Gackenbach et al. (in press) reported field independence as measured by the Embedded Figures Test to be consistent across sex and associated with lucid dreaming ability, but when it was assessed by the Rod-and-Frame Test (RFT), a sex difference emerged. Males who were frequent lucid dreamers were determined to be field-independent, while no difference in RFT performance as a function of lucid dreaming ability occurred for females. Similarly, Gackenbach et al. (1981) report that male nonlucid dreamers evidenced a strong leftward deviation with their left hands on a test of kinesthetic abilities, whereas male lucid dreamers showed a slight rightward preference. For women, there was no difference between types of lucid dreamers and performance on this task with their left hands. Scores on spatial perceptual completion subscales of the Comprehensive Ability Battery (Hakstian and Cattell, 1974) also revealed sex differences in their relationship to lucid dreaming frequency. It was found that women who frequently dream lucidly were better able to do the perceptual completion task than those who do not, when self-reported sex-role identity, dream recall, and education were controlled. With the same controls, men who reported frequently experiencing lucidity were less able to do the spatial task.

No performance differences as a function of lucid dreaming frequency were found with the Southern California Figure-Ground Visual Perceptual Test, a hand steadiness task, two illusions (Necker cube and Mueller-Lyer)

(Gackenbach, et al., 1981), visual or tactile mazes, and a tracking task (Gackenbach et al., 1981).

Imagery

Both waking and sleeping imagery differences between individuals who vary in the frequency with which they report lucid dreams will be considered. Six aspects of the former have been investigated, and include spontaneous waking images such as hypnagogic images, hallucinations, daydreams, and psychic experiences, as well as experimental waking images such as style, control, and vividness reports of imaginal tasks.

Hearne (1978) found that for women only, the frequency of experiencing dream lucidity correlated positively with the frequency of experiencing hypnagogic images. Gackenbach (1978) investigated the degree to which these images are perceived as similar to lucid or nonlucid dreams, and found that they were perceived by adult high dream recallers as more similar to nonlucid than to lucid dreams. She also reported in a factor analysis that the higher the perceived concurrence between lucid dreams and hypnagogic images, the more likely it was that an individual's lucid dreams would be initiated by dreamlike or incongruent elements, and frequent lucid dreamers had significantly higher scores on this factor than infrequent lucid dreamers.

Blackmore (1983) reports that experiencing lucid dreams was positively associated with experiencing, both quantitatively and qualitatively, waking hallucinations. However, Hearne (1978) found no relationship between frequency of dreaming lucidly and frequency of a body-schema hallucination.

Frequency of daydreams was positively correlated to frequency of lucid dreams for men only, but no relationship was found between vividness of daydreams and lucidity (Hearne, 1978). Likewise, Gackenbach (1978) found no relationship between the degree of emotionality and realism of daydreams and the frequency of dreaming lucidly.

The final spontaneous waking imagery category is that of psi phenomena. Experiences with and attitudes toward four paranormal phenomena: extrasensory perception (ESP), psychokinesis (PK), survival of bodily death, and out-of-body experiences (OBEs), and their relationship to lucid dreaming have been investigated. Both Palmer (1979) and Kohr (1980) found self-reported lucid dreams to be one of the two best predictors among demographic and dream variables of psi experience.

Specifically, Kohr (1981) found a positive relationship between lucid dream reports and experiences with waking and dreaming ESP, whereas Hearne (1978) and Gackenbach (1978) found no such relationships. In a laboratory investigation using the lucid dream as an occasion to receive ESP information, Hearne (1981) reported "mildly encouraging results." Black-

more (1983) reported that those who believe in ESP were also more likely to experience dream lucidity.

In two investigations that have examined the correlation between self-reported experiences of PK and lucid dreaming frequency, no relationship emerged (Kohr, 1980; Gackenbach, 1978).

Experiences and beliefs about survival of bodily death or related phenomena such as seeing apparitions or having a near-death experience (NDE), have also been investigated as a function of lucid dreaming frequency. As for experience with apparitions, Gackenbach (1978) and Hearne (1978) found no such relationship, whereas Kohr (1980) reported that dream lucidity ability was correlated positively with these experiences.

Kohr (1980) identified three groups of respondents to a questionnaire who differed in whether or not they had had a NDE. The NDE group indicated that they had come close to death and reported having had moving personal experiences in this context. A second group indicated that they had come close to death and may or may not have had a moving personal experience. The third group was referred to as the Non-Experiencing group, composed of persons who had never come close to death. In terms of dream states, the NDE group reported a greater frequency of dreaming in color, greater frequency of unusual dream states such as lucidity and vibrations, and a greater range of types of sense modalities in dreams.

Relatedly, Greyson (1983) notes:

> I have already asked about the occurrence of lucid dreams in one questionnaire (a shortened version of John Palmer's Survey of Psychic Experiences) administered to self-selected members of the International Association for Near-Death Studies (IANDS). Among the "controls" (i.e., IANDS members who have not had NDEs), 83 out of 155 respondents (54%) reported having had lucid dreams, which is roughly what Palmer found among his sample from the general population. Among near-death experiencers, 13 out of 62 respondents (21%) reported having had lucid dreams *prior* to their NDEs, and 33 (53%) reported had lucid dreams *since* their NDEs. Thus, a fairly low percentage of near-death experiencers had lucid dreams before their NDEs, while after the NDE, this percentage rises to the level among the IANDS controls and the population Palmer sampled. [p. 6]

Beliefs about survival have also been investigated as they relate to the lucid dreaming experience. Palmer (1979) found a positive relationship, while Blackmore (1983) found no relationship.

The two major dimensions according to which mental imagery abilities have been assessed are control and vividness. Regarding control, neither

Hearne (1978), Blackmore (1982), nor Gackenbach's group has found any relationship between imagery control and lucidity ability. Blackmore (1982) and Gackenbach, Prill, and Westrom (1983) administered Gordon's control of imagery questionnaire, while Hearne asked several control-related imagery questions. The data are mixed regarding vividness. On the one hand, Hearne (1978) found no relation to lucidity for three vividness items, and Blackmore (1982) was unable to discover any differences between lucid and nonlucid dreamers in Bett's vividness of imagery scale scores. On the other hand, Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) have found that when dream recall and social desirability were controlled for and understanding the concept of lucidity was ensured, males who frequently report dreaming lucidly also report more vivid tactile images. Likewise on a visualization task, Blackmore (1983) found a significant positive relationship with lucid dreaming frequency.

Returning to the question of imagery control, performance on mental rotation tasks provides a more accurate assessment of control of imagery abilities than do self-reports. Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) found no relationship between performance on the two-dimensional task and lucidity abilities in two samples (student and adult) where dream recall was controlled. However, in another two-dimensional mental rotation task, with adult women when dream recall and handedness were controlled, the frequency of experiencing prelucid dreams was significantly positively correlated with performance. In the same study, Gackenbach et al. (1983) also determined that skill on three-dimensional mental rotation tasks was positively related to lucid dream frequency for women.

Abilities

Research covering intelligence, creativity, and several motor abilities in relation to lucid dreaming ability will be reviewed in this section. As regards intelligence, Gackenbach et al. (1981) and Hearne (1978) found no dreamer-type difference on the problem-solving tasks of the pyramid puzzle and the Raven's Progressive matrices, whereas Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) reported that for males, in both student and an adult samples, intelligence as measured by Factor B of the 16PF inventory was negatively correlated with lucid dreaming frequency. In a more comprehensive evaluation of intelligence, Gackenbach, Curren, LaBerge, Davidson and Maxwell (1983) administered the four primary subscales (i.e., verbal, numerical, spatial, and perceptual completion abilities) of the Comprehensive Abilities Battery (Hakstian and Cattell, 1974) to adult lucid dreamers who varied in the frequency with which they had these dreams. When differences in dream recall, education, and relative masculinity and

femininity were controlled, high lucid dreaming frequency was associated with high verbal, numerical, and perceptual completion abilities for men.

Gackenbach and Hammons (1983) report that for males only, verbal creativity was marginally associated with high dream lucidity frequency, whereas Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) found no relationship for men between verbal or nonverbal creativity when differences in dream recall and relative masculinity and femininity were controlled. Women, however, who frequently experience this kind of dream were found by this group to be verbally and nonverbally creative.

Several motor abilities have also been examined. No lucid–nonlucid dreamer differences were found for motor accuracy or hand steadiness tasks (Gackenbach et al., 1981), but gross motor balance and related activities did evidence such a relationship. Gackenbach, Sachau, Rokes, and Snyder (1983) reported lucid dreaming ability in males to be associated with leftward leaning on a stabilometer task (i.e., a test of gross dynamic motor balance skill) and rightward leaning in nonlucid dreamers. No dreamer effects for females on this task were noted, nor were there any dreamer effects on a test of static motor balance skills.

Prevalence

Seven surveys have attempted to ascertain the prevalence of lucid dreaming in both student samples (Palmer, 1979; LaBerge, 1980a; Gackenbach, Rokes, Sachau, and Snyder, 1983) and adult samples (Palmer, 1979; Kohr, 1980; Blackmore, 1983; Gackenbach, 1978; Gackenbach, Curren, LaBerge, Davidson, and Maxwell, 1983). Among the latter, estimates of having had at least one lucid dream range from 100 percent (Gackenbach et al., 1983) to 47 percent (Blackmore, 1983), whereas the range estimated for students is from 85 percent (LaBerge, 1980a) to 57.5 percent (Gackenbach et al., 1984). A clearer picture emerges after consideration of both the representatives of the sample as well as attempts to verify that subjects understood the concept. Kohr (1980), Gackenbach (1978), and Gackenbach et al. (1983) were all dealing with highly motivated adult samples, that is, people who have an unusually high interest in dreaming and/or lucid dreaming. Thus their estimates tend to run high (Kohr, 70%; Gackenbach, 76%; Gackenbach et al., 100%). In the Palmer (1979) and Blackmore (1983) surveys, adults were randomly chosen from the telephone directory in the case of the former and from the electoral register in the case of the latter. Their estimates are considerably more conservative (Palmer, 55%; Blackmore, 47%). However, there is no indication that they attempted to verify that their respondents had understood the concept; and both LaBerge (1980b) and Gackenbach, Heilman, Boyt, and LaBerge (1983) have pointed out that

when subjects are asked to supply a lucid dream, incidence rates drop because of confusion over simple definitions.

Sex, race, and age differences modify the frequency with which lucid dreams are reported. Hearne (1978) and Gackenbach (in Gackenbach and Snyder, in press) both found sex differences in incidence favoring females, while Blackmore (1982) reported such a difference but in the opposite direction, and Gackenbach (1978), Blackmore (1983), and Palmer (personal communication, 1974) found no sex differences. Only Palmer has examined race differences, reporting that 76 percent of blacks claimed experience with lucid dreaming compared to only 53 percent of whites. Age differences generally favor the younger respondent (Palmer, 1976; Blackmore, 1983; Gackenbach, personal communication, 1981) with one exception. Gackenbach (1978) found that among adult women with a high interest in dreaming, older women reported experiencing lucidity more frequently than their younger counterparts.

Family demographics have also been considered in several inquiries. Palmer (1979) and Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) found differences as a function of marital status. In both cases a larger proportion of singles reported having had a lucid dream than marrieds. However, Gackenbach (1978) found no relationship between marital status and lucidity reports. Finally, Gackenbach, Curren, LaBerge, Davidson, and Maxwell (1983) report a higher incidence of lucid dreamers among first-borns than among later-borns.

As to education and occupation variables, no difference has been found as a function of education in a random sample (Palmer, 1979) or in well-educated samples (Gackenbach 1978; Gackenbach, Curren, LaBerge, Davidson, and Maxwell, 1983). Palmer (1979) also noted no differences as functions of occupational and family income analyses.

Personality

Personality dimensions examined thus far as possible differentiaters of lucidity ability include extraversion and neuroticism (Gackenbach 1978, in press; Hearne, 1978); self-perception (Belicki and Hunt, 1978); anxiety, hostility, depression, life changes (Gackenbach, personal communication, 1981); risk-taking (Dane, 1984; Gackenbach, Curren, LaBerge, Davidson, and Maxwell, 1983); a general personality inventory (Gackenbach, 1978); and sex-role identity (Gackenbach, Curren, LaBerge, Davidson, and Maxwell, 1983). Liberal or experimenting (Gackenbach, 1978), risk-taking proclivities (Dane, 1983; Gackenbach, Curren, LaBerge, Davidson, and Maxwell, 1983) and masculinity (Gackenbach, Curren, LaBerge, Davidson, and Maxwell, 1983) were found to be differentially characteristic of fre-

quent lucid dreamers. The other students found no differences or contradictory differences.

THE PSYCHOPHYSIOLOGY OF LUCID DREAMS

Lucid Dreaming Physiologically Verified

Under what physiological conditions do lucid dreams occur? Before the recent availability of empirical evidence bearing on this question, speculation largely favored two answers: wakefulness or NREM sleep. Most sleep researchers were apparently inclined to accept Hartmann's "impression" that lucid dreams were "not typical parts of dreaming thought, but rather brief arousals" (Hartmann, 1975; Berger, 1977). Schwartz and Lefebvre (1973) noted that frequent transitory arousals were common during REM sleep and proposed these "micro-awakenings" as the physiological basis for lucid dreams. Although no one had put foward any evidence for this mechanism, it seems to have been the accepted opinion (Foulkes, 1974) up until the last few years. A similar view was put forward by Antrobus et al. (1965), who supposed that recognition by the dreamer of the fact that he or she is dreaming would immediately terminate the experience if it occurred in REM sleep; " . . . continuation of the recognized dream . . . might then be expected more commonly in Stages 2, 3, and 4." Similarly, Hall (1977) ventured that "lucid dreams may represent a transition from Stage-1 REM to Stage-4 mentation" (p. 312), and Gackenbach (1978) concluded that there were "considerable data to support the possibility that lucid dreams may be 'thinking' reports arising out of NREM or hypnopompic mentation" (p. 63). Green (1968) seems to have stood alone in her surmise that since lucid dreams usually arise from nonlucid dreams, " . . . we may tentatively expect to find lucid dreams occurring, as do other dreams, during the 'paradoxical' phase of sleep . . . " (p. 128).

Empirical evidence began to appear in the late 1970s supporting Green's speculation that lucid dreams would occur during REM sleep. Ogilvie et al. (1978) offered some preliminary observations on the physiology of lucid dreaming. Based on standard sleep recordings for two subjects who reported a total of three lucid dreams upon awakening from REM sleep, Ogilvie et al. cautiously concluded that " . . . it *may* be that lucid dreams begin in REM. . . . " However, no proof was given that the lucid dreams had in fact occurred during the REM periods immediately preceding the awakenings and reports. Indeed, the subjects themselves were uncertain about when their lucid dreams had taken place.

What was needed to unambiguously establish the physiological status of lucid dreams was some sort of on-the-scene report from the dream, a motion

first suggested by Tart (1965). LaBerge and his colleagues at Stanford University provided this verification by arranging for lucid dreamers to signal whenever they realized they were dreaming by means of specific patterns of dream actions having polygraphically observable correlates (i.e., eye movements and fist clenches). Following this approach, LaBerge, Nagel, Dement, and Zarcone (1981) reported that the occurrence of lucid dreaming *during* unequivocal REM sleep had been demonstrated for five subjects. After being instructed in the method of lucid dream induction (MILD) described by LaBerge (1980a) the subjects were recorded from two to twenty nights each. In the course of the thirty-four nights of the study, thirty-five lucid dreams were reported subsequent to spontaneous awakening from various stages of sleep as follows: REM sleep, thirty-two times; NREM Stage-1, twice; and during the transition from NREM Stage-2 to REM, once. The subjects who reported signaled during thirty of these lucid dreams. After each recording, the reports mentioning signals were submitted along with the respective polysomnograms to a judge uninformed of the times of the reports. In twenty-four cases (80%), the judge was able to select the appropriate 30-second epoch on the basis of correspondence between reported and observed signals. *All signals associated with lucid dream reports occurred during epochs of unambiguous REM sleep* scored according to the conventional criteria (Rechtschaffen and Kales, 1968). The lucid dream signals were followed by an average of 1 minute of uninterrupted REM sleep (range: 5 to 450 sec).

A replication of this study with two additional subjects and twenty more lucid dreams produced identical results (LaBerge, Nagel, Taylor, Dement, and Zarcone, 1981). LaBerge et al. argued that their investigations demonstrated that lucid dreaming usually (though perhaps not exclusively) occurs during REM sleep. This conclusion is supported by research carried out in several other laboratories (Hearne, 1978; Ogilvie et al., 1983; Fenwick et al., 1983). It should be noted with caution that although these studies have used various forms of signals for verification, none has followed the procedure of blind matching of signals to reports described by LaBerge et al. (1981a,b).

Ogilvie et al. (1983) reported the physiological state preceding fourteen spontaneous lucidity signals as unqualified REM in twelve (86%) of the cases; of the remaining two cases, one was "ambiguous" REM, and the other appeared to be wakefulness. Keith Hearne and Alan Worsley collaborated on a pioneering study of lucid dreaming in which the latter spent fifty nonconsecutive nights in the sleep lab while the former monitored the polygraph. Worsley reported signaling in eight lucid dreams, all of which were described by Hearne (1978) as having occurred during unambiguous REM sleep.

Having shown that lucid dreaming signaling occurs "during REM sleep" may leave unanswered what may be a crucial question for some readers: what exactly do we mean by the assertion that lucid dreamers are "asleep"? Perhaps these "dreamers" are not really dreamers, as many argued in the last century; or perhaps this "sleep" is not really sleep, as some have argued in this century. This issue has been cogently addressed by LaBerge in the following terms:

> 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 conscious 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. (LaBerge et al., 1981a).

Physiological Correlates of the Initiation of Lucid Dreams

Though the preceding studies have shown that lucid dreams occur during REM sleep, they leave unanswered the question of how lucid dreams are initiated. Moreover, to say that lucid dreams happen during REM is by no means an exact statement. REM sleep is a rather heterogeneous state exhibiting considerable variations in physiological activity, of which two distinct phases are ordinarily distinguished. In its most active form, REM is dominated by a striking variety of irregular and short-lived events such as muscular twitching, including the rapid eye movements that give the state one of its most common names. This variety of REM is referred to as "phasic," while the relatively quiescent state remaining when rapid eye movements and other phasic events temporarily subside is referred to as "tonic." So, to specify the lucid dream state no more precisely than as "Stage-1 REM" would be equivalent to saying that this chapter was written in the United States, thus leaving a great deal of territory that would be considerably narrowed by specifying the state as California or Iowa rather

than, say, Florida or Alaska. Thus, to more precisely characterize the lucid dream state, we can ask whether lucid dreams take place in tonic or phasic REM. Research by the Stanford group has provided a definite answer: "phasic," as will be seen below.

LaBerge, Nagel, Taylor, Dement, and Zarcone (1981) distinguished three classes of characteristic physiology within REM accompanying the initiation of lucid dreams. Since lucid dreams are sometimes initiated from the waking state but more frequently from the dream state, it would be reasonable to expect that one general class of lucid dreams ought to involve brief arousals within REM periods, while the larger number of lucid dreams should exhibit no such arousals. This is exactly what LaBerge et al. found when they analyzed fifty lucid dream records derived from earlier studies.

As was mentioned above, momentary intrusions of wakefulness occur very commonly during the normal course of REM sleep, and it had been proposed by Schwartz and Lefebvre (1973) that lucid dreaming takes place during these micro-awakenings. However, LaBerge et al.'s data indicated that while lucid dreams do *not* occur during interludes of wakefulness within REM periods, lucidity is sometimes *initiated* from these moments of transitory arousal, with the lucid dreams themselves continuing in subsequent undisturbed REM sleep. Only 22 percent of the lucid dreams were of this type, and only 40 percent of the seven subjects showed this mode of initiation. The subjects were normally conscious of having been awake before entering this class of lucid dream.

In 78 percent of the cases, the subjects reported having realized that they were dreaming during an ongoing dream. The respective polysomnograms fell into classes with the initiation of lucidity occurring either (a) within 2 minutes of the beginning of the REM periods and frequently as little as 20 seconds after REM onset; or (b) elsewhere during REM, at times ranging from 3 to 45 minutes after the start of the REM period. Of the twenty-six lucid dreams belonging to the latter category, REM burst time in the 30 seconds preceding initiation of lucidity was above median levels for the respective REM periods in twenty-two cases. Since this distribution is unlikely to have occurred by chance ($p < 0.001$), the association of lucid dreams with *phasic* REM would seem to be firmly established.

As for the REM period-onset class of lucid dreams, LaBerge cited a model proposed by McGinty (1979) in which the increase in CNS excitation accompanying the transition from NREM Stage-2 to REM sleep results in a transient "overshoot." LaBerge theorized that this phasic activation, like that accompanying REM bursts, raises the brain to the relatively high level of cortical tone apparently necessary to initiate lucidity.

In an extension of the study just described, LaBerge, Levitan, Gordon, and Dement (1983) reported further characteristics of these three modes of

lucid dream initiation, which they referred to as "wake-initiated" or "W-types," "onset" or "O-types," and "phasic" or "P-types." Analysis of sixty-two lucid dreams from seven subjects revealed 29 percent W-types, 21 percent O-types, and 50 percent P-types. Compared to other initiation types, P-types occurred significantly later in REM periods, while O-types occurred significantly earlier in the night.

For all three types of lucid dream, the initiation of lucidity was frequently marked by indications of orientation responses including respiratory pauses, skin potential responses (SPR), and biphasic heart rate responses. For the P-types, REM burst time, SPR rate, and respiration rate showed significant elevations in the 30 seconds immediately before the initiation of lucidity (as marked by the signals) compared to the preceding portions of the REM periods. The same was true for the 30 seconds immediately before the transitory arousals preceding wake-initiated lucid dreams.

There were striking individual differences regarding the types of lucid dream initiation as well as the particular forms taken by the orientation responses. For example, several subjects did not show heart rate responses at any time, while others always did. All four of one subject's lucid dreams were of the O-type, while none of another's twenty were; this is a highly significant difference ($p < .0001$), suggesting both an opportunity and a caveat. The opportunity is for future research to relate physiological differences in mode of lucid dream initiation to individual differences in personality and cognitive abilities. The caveat is to beware of overgeneralization from preliminary observations on a relatively small number of subjects. If the first subject we had studied had been the wrong one of the two just mentioned, after four lucid dreams, we would have been quite compelled by the mistaken notion that lucid dreams characteristically occur at the beginning of the first REM period of the night. Similarly, Ogilvie et al. (1978) fell victim to sampling error, hastily concluding on the basis of only three observations that lucid dreams were characterized by *low* rapid eye movement activity. Likewise, since the onset of lucidity was immediately preceded by a REM burst, in all eight of Worsley's lucid dreams, Hearne (1978) was tempted to suppose that all lucid dreams were P-types. The lesson of all this is, of course, that we must be careful not to interpret the foregoing studies as showing that there are only three types of lucid dream or that lucid dreams are never found in NREM sleep, and so on. With this caution, here is a paraphrase of LaBerge's (1985) summary generalizations on the psychophysiological conditions that are together necessary and sufficient for the occurrence of lucid dreams. On the psychological side of the coin, the requirement is an appropriate mental set. The would-be lucid dreamer must have the unequivocal intention to recognize when the time comes that he or she is dreaming. On the physiological side of the coin, the requirement

is a sufficiently high level of cerebral activation. Were this condition unnecessary, lucid dreams would be found randomly distributed throughout every stage of sleep. However, the preliminary studies of the Stanford group indicate the contrary: that this condition is in fact necessary and normally (and possibly only) attained only in the particular circumstances described above during stage REM, a state that has been justifiably called "paradoxical sleep."

The EEG during Lucid Dreams

The fact that lucid dreaming occurs during Stage-1 REM sleep defines to a certain extent the EEG activity characteristic of lucid dreams. However, the Rechtschaffen and Kales (1968) scoring manual provides EEG criteria for REM sleep no more specific than " . . . relatively low voltage, mixed frequency . . . ," which allows considerable latitude in terms of how much of which frequencies are mixed. For example, the EEG of REM sometimes shows predominant 2–3 Hz "saw-tooth waves," while at other times it may exhibit prominent 8–10 Hz alpha waves. So the question arises as to whether or not the range of EEG activity characteristic of lucid dreams reliably differs in any way from that of nonlucid dreams.

In a series of studies, the Brock University group has pursued the hypothesis that lucid dreams are associated with high levels of alpha activity. In the first of these investigations Ogilvie et al. (1978) initially came to the "impression that alpha is the dominant EEG frequency during lucid dreams" on the less than solid grounds of a comparison of "percent alpha in the EEG" of just two lucid dream REM periods with percent alpha for six nonlucid dream REM periods for a *single* subject. We have already discussed the interpretive problems with this pilot study, which need not be repeated here.

Ogilvie et al. (1982) followed up their preliminary work with a more sophisticated study entitled "Lucid Dreaming and Alpha Activity." The ten subjects were all good dream recallers reporting lucid dreams with a frequency ranging from "one or two ever" to "near nightly," with "several lucid dreams per year" being the average. They were recorded two nights each in the sleep laboratory, during which they were awakened four times per night from REM sleep: half of the time during periods of relatively high alpha and half of the time during relatively low alpha. Dream reports were collected and rated on a lucidity scale by a judge blind to awakening condition. Significantly ($p < .05$) higher lucidity ratings were obtained for high alpha compared to low alpha awakenings.

However, it is doubtful whether this establishes, as Ogilvie and colleagues appear to have concluded, that lucid dreams are associated with high alpha

activity, for a variety of reasons. Translating the average lucidity ratings back to the words on the scale revealed subjects awakened during low alpha to have reported on the average "a brief moment where subject was prelucid." The high alpha awakenings yielded reports scored on the average "prelucid" somewhere between "throughout the dream" and during "a definite episode (noted at beginning, middle, or end of narrative)." So the two awakening conditions produced reports that differed on the average only in extent of *pre*lucidity. Moreover, we have no assurance of whether, in either condition, the episode of prelucidity or lucidity occurred in association with the final 20–30-second period of either high or low alpha activity that determined the awakening condition. Their scale ought to have distinguished between episodes at the end of the narratives, which would have been temporally associated with the awakening condition, and those at the beginning or middle, rather than lumping all three portions of the reports together. Moreover, since none of the dreams classified as lucid were marked by signals, we have no proof that they were in fact lucid dreams, nor in any case do we have any way of determining what the degree of alpha activity was *during* the frequently brief episodes of lucidity. In view of these considerations, perhaps a less misleading title for this provocative paper would be "Prelucid Dreaming and Alpha Activity."

Because of their design we cannot exclude the possibility that what Ogilvie and his colleagues may actually have demonstrated is that subject tendencies to *retrospectively* judge themselves to have been briefly or partially lucid vary with the amount of alpha activity either just before or during the process of awakening. Support for this interpretation comes from an earlier study, which concluded that mentation reports collected from REM periods showing EEGs with a high proportion of alpha waves were associated with "some feeling of control over the content" and were frequently labeled by subjects as "thoughts" rather than "dreams" (Goodenough et al., 1959). It seems plausible that these two studies were barking up the same tree.

There is one more design problem with the Ogilvie et al. (1982) study that seems serious enough to merit mention: the judge's lucidity ratings were based not upon the spontaneous dream reports but on the subjects' answers to rather leading questions subsequently posed by the interviewer, such as "was there any point when you wondered whether or not you might be dreaming?" and "was there any point at which you knew you were dreaming while that dream was going on?" The demand characteristics should be obvious. Additionally, there is the problem that retrospective judgments about earlier states of mind are likely to be confounded by our current mental state. Cognitive capacities we now possess are likely to be unintentionally carried back to our earlier state and mistakenly remembered as hav-

ıg been there in the first place. The conservative approach would seem to avor reliance upon the original reports, and in the present context one ıould like to know how many subjects spontaneously volunteered in their eports that they had been prelucid or lucid.

The most recent study by the Brock group remedied several of these nethodological problems and arrived at a conclusion regarding alpha activity and lucidity unsupportive of their earlier work. Ogilvie, Hunt, Kushiruk, and Newman (1983) studied eight lucid dreamers for one to four ıights in the sleep lab. The subjects were awakened from REM following pontaneous or cued eye movement signals. The cue buzzer sounded after 5 minutes of REM in the presence of either high or low alpha activity, and he subjects were to signal at the cue and again 30 seconds later if in a lucid lream. Reports were elicited 30 to 60 seconds after cued or spontaneous ignals and rated for lucidity. Contrary to their earlier findings, the low ılpha condition yielded slightly more lucid dreams than the high alpha conlition; however, this difference was not statistically significant. Addressing he same issue as the Brock group, LaBerge (1980b) Fourier-analyzed C_3 EEG activity for a single lucid dream REM period. Comparison of the spectral profiles for the nonlucid and lucid portions of the REM period revealed ılpha activity for the nonlucid dream to more closely resemble the waking EEG spectrum than did the lucid dream; however, the two REM samples lid not significantly differ.

In summary, it would seem at this point that no reliable association of ucid dreaming with alpha activity (whether high or low) has yet been esablished. Rather than measuring a single feature (i.e., alpha power) of the EEG derived from a single electrode site, a more fruitful direction for fuure work would probably involve quantifying whole band EEG frequency spectra from several electrode placements and comparing signal-verified ucid dreams with nonlucid controls.

Temporal Distribution of Lucid Dreams

Van Eeden (1913) stated that his lucid dreams invariably occurred between five and eight o'clock in the morning. By way of explanation, he quoted Dante's characterization of these hours as the time "when swallows begin to warble and our mind is least clogged by the material body." Garfield (1975) exactly agreed with van Eeden's timing though perhaps not with his poetic explanation. LaBerge (1979) plotted the times of 212 of his lucid dreams and found their pattern to closely fit the usual cyclic distribution of REM periods. He suggested that the fact that most REM sleep occurs toward the end of the night provided a plausible explanation for van Eeden's and Garfield's observations. Later, LaBerge (1980a) tested this hy-

pothesis by comparing the temporal distribution of his lucid dreams with that expected on the basis of normative data from Williams et al. (1974). A chi-square test indicated that the observed distribution of lucid dreams was not significantly different from what would be expected on the basis of mean REM period lengths at different times of night.

Again it should be noted that this result is for a single subject. Other factors besides REM period lengths may affect the temporal distribution of lucid dreams for other subjects. For example, one of LaBerge's subjects at Stanford had all four of his laboratory lucid dreams in his first REM periods. Also, the fact that REM density as well as overall dream intensity activity and bizarreness increase as the night progresses may contribute some of the late-night advantage for lucidity, perhaps more for some subjects than others. Cohen's (1977) hypothesis of gradually increasing left hemisphere dominance (GILD) during the course of the night is perhaps also of relevance. This seems especially likely because the left hemisphere's verbal abilities would appear to play a crucial role in lucid dreaming: without words, how else could we tell ourselves that we are dreaming? Clearly this is an area rich in research possibilities.

Another factor that will affect the temporal distribution of lucid dreams is initiation type. Onset-lucid dreams, as we have seen, occur earlier in the night than either wake or phasic types. Another comparison from LaBerge's (unpublished) personal record of lucid dreams indicates that for him, W-type lucid dreams are over ten times more frequent during afternoon naps than they are during the first REM period of the night ($p < 0.0002$).

APPLICATIONS AND IMPLICATIONS OF LUCID DREAMING FOR RESEARCH IN ALTERED STATES OF CONSCIOUSNESS

Regarding the applications of lucid dreaming, LaBerge (1980b) recounted an anecdote concerning electricity, a "scientific curiosity" of the eighteenth century, about which a woman is said to have asked Benjamin Franklin, "but what *use* is it?" "What use, madame," replied Franklin, "is a newborn baby?" As for lucid dreaming, a "scientific curiosity" of the twentieth century, if the analogous question were asked, the corresponding answer could be given.

Nevertheless, even at this early stage in the development of our understanding of this phenomenon, a number of promising applications of lucid dreaming can be seen. A number of these are treated in LaBerge (1980b), and in Gackenbach and LaBerge (in press). Here we must limit ourselves to a single application, that provides a paradigm for a powerful approach to research on various states of consciousness.

Mapping Out the Dream World

One of the major obstacles to making human consciousness a topic of rigorous scientific study has been that the most direct account available of the contents of a person's consciousness is that person's own subjective report. Unfortunately, of the "bad witnesses" that Heraclitus called the senses, "introspection" appears to be among the least reliable. What is needed is a means of corroborating the testimony of the "I-witness" as regards consciousness, and this is just what the psychophysiological approach provides.

A key element in this new strategy is the idea of making full use of the subject's cooperativeness and intelligence. A frequent practice in experimental psychology today requires the subject to be deceived about the true nature of the experiment. This has the advantage of minimizing the effect the subject's knowledge might have on the experiment. But this traditional method is inappropriate when the subject matter of the investigation is the subject's own consciousness. In this case, a more suitable approach is one in which the dichotomous subject/experimenter relationship is modified: perhaps subjects should be regarded, to borrow an anthropological term, as "participant/observers." As for the problem of subjective report reliability, it seems helpful to study highly trained (and lucid!) subjects and make use of the fact that the convergent agreement of physiological measures and subjective reports provides a degree of validation (Stoyva and Kamiya, 1968).

The fact that lucid dreamers can remember to perform predetermined actions and signal to the laboratory suggested to LaBerge a new approach to dream research. Lucid dreamers, he proposed, "could carry out diverse dream experiements marking the exact time of particular dream events, allowing derivation of precise psychophysiological correlations and methodical testing of hypotheses" (LaBerge et al., 1981a). This strategy has been put into practice by the Stanford group in a number of studies summarized by LaBerge (1985).

LaBerge pointed out first of all that the data reported in LaBerge et al. (1981a,b) indicate that there is a very direct and reliable relationship between gaze shift reported in lucid dreams and the direction of polygraphically recorded eye movements. It should be noted that the results obtained for lucid dreams (see also Hearne, 1978; Ogilvie et al., 1983) are much stronger than the generally weak correlations demonstrated by earlier investigations testing the notion that the dreamer's eyes move with his or her hallucinated dream gaze (e.g., Roffwarg et al., 1962). This would seem to illustrate the methodological superiority of the lucid dreamer approach. The parallel between subjective and objective eye movements implies that, to a first approximation, spatial relationships in the dream world are similar in

form to those of the physical world. What about temporal relationships? How long do dreams last?

LaBerge (1980b; 1985) reports having straightforwardly raised the question of dream time by subjects to estimate various intervals of time during their lucid dreams. Signals marking the beginning and end of the subjective intervals allowed comparison with objective time. In all cases, LaBerge reported, time estimates during the lucid dreams were very close to actual dream time.

In another study, LaBerge and Dement (1982a) found evidence for voluntary control of respiration during lucid dreaming. They recorded three lucid dreamers who were asked either to breathe rapidly or to hold their breath (in their lucid dreams), marking the interval of altered respiration with eye movement signals. The subjects reported successfully carrying out the agreed-upon tasks a total of nine times, and in every case, a judge was able to correctly predict on the basis of the polygraph recordings which of the two patterns had been executed ($p < 0.002$).

In regard to other muscle groups, while testing a variety of lucidity signals, LaBerge et al. (1981a) observed that a sequence of left and right dream-fist clenches resulted in a corresponding sequence of left and right forearm twitches as measured by EMG. However, the amplitude of the twitches bore an unreliable relationship to the subjective intensity of the dreamed actions. Since all muscle groups except those that govern eye movements and breathing suffer a profound loss of tone during REM sleep, it is to be expected that most muscular responses to dreamed movements will be feeble. Nonetheless, these responses faithfully reflect the motor patterns of the original dream. In LaBerge's (1985) phrase, "the dreamer's body responds to dreamed actions with movements that are but the shadows of the originals."

A further step toward refining our picture of the degree of connection between the dream body and physical body has been taken by Fenwick et al. (1984). They studied a single proficient lucid dreamer (Alan Worsley, who had also been Hearne's [1978] subject), who carried out a variety of dreamed muscular movements while being polygraphically recorded. In one experiment, Worsley executed movements during lucid dreams involving finger, forearm, and shoulder muscle groups (flexors) while EMG was recorded from each area. The results were consistent: the axial muscles showed no measurable EMG activity, while the forearm EMG "consistently showed lower amplitude and shorter bursts" compared to the finger EMG. A similar experiment with the lower limbs yielded "similar results." In addition to the finding that REM atonia shows a central-peripheral gradient with motor inhibition least for the most distal muscles, Fenwick et al. reported

that similar experiments comparing EMG response to dreamed arm and leg flexions and extensions "suggested" that flexors were less inhibited than extensors. In addition to EMG, an accelerometer was utilized in several experiments demonstrating that Worsley was able to produce minor movements of his fingers, toes, and feet during REM, though not of his legs. Fenwick et al. also presented the results of a single experiment suggesting that dream speech may be initiated in the expiratory phase of respiration just as it usually occurs during waking. In still another experiment they demonstrated the voluntary production of smooth pursuit eye movements during a lucid dream.

As if the foregoing were not enough for one paper, Fenwick et al. also showed that Worsley was able to perceive and respond to environmental stimuli (electrical shocks) without awakening from his lucid dream. This result raises a theoretical issue: if we take perception of the external world to be the essential criterion for wakefulness (LaBerge et al., 1981a; see above), then it would seem that Worsley must have been at least partially awake. On the other hand, when environmental stimuli are incorporated into dreams without producing any subjective or physiological indications of arousal, it appears reasonable to speak of the perception as having occurred during sleep. Furthermore, it may be possible, as LaBerge (1980b) has suggested, for one sense to remain functional and "awake" while others fall "asleep." As long as we continue to consider wakefulness and sleep as a simple dichotomy, we will lie in a Procrustean bed ("one size fits all") that is bound to be at times most uncomfortable. There must be degrees of being awake just as there are degrees of being asleep (i.e., the conventional sleep stages). Before finding our way out of this muddle, we probably will need to characterize a wider variety of states of consciousness than those few currently distinguished (e.g., "dreaming," "sleeping," "waking," and so on).

Since many researchers have reported cognitive task dependency of lateralization of EEG alpha activity in the waking state, LaBerge undertook a pilot study to determine whether similar relationships would hold in the lucid dream state. The two tasks selected for comparison were dreamed singing and dreamed counting, activities expected to result in relatively greater engagement of the subjects' left and right cerebral hemispheres, respectively.

Integrated alpha band EEG activity was derived from electrodes placed over the right and left temporal lobes while four subjects sang and counted in their lucid dreams (marking the beginning and end of each task by eye movement signals). The results supported the hypothesized lateralization of alpha activity: the right hemisphere was more activated than the left during

singing; during counting, the reverse was true. These shifts were similar to those observed during actual singing and counting (LaBerge and Dement, 1982a).

Sexual activity is a rather commonly reported theme of lucid dreams (Garfield, 1979; LaBerge, 1985). However, to this point, only a single physiological investigation of lucid dream sex has been published. LaBerge, Greenleaf, and Kedzierski (1983) undertook a pilot study to determine the extent to which subjectively experienced sexual activity during REM lucid dreaming would be reflected in physiological responses. Their subject was a highly proficient lucid dreamer who spent a night sleeping in the laboratory. Sixteen channels of physiological data, including EEG, EOG, EMG, respiration, skin conductance level (SCL), heart rate, vaginal EMG (VEMG), and vaginal pulse amplitude (VPA), were recorded. The experimental protocol called for the subject to make specific eye movement signals at the following points: when she realized she was dreaming (i.e., the onset of the lucid dream); when she began sexual activity (in the dream); and when she experienced orgasm. The subject reported a lucid dream in which she carried out the experimental task exactly as agreed upon. Data analysis revealed a significant correspondance between her subjective report and all but one of the autonomic measures: during the 15-second orgasm epoch, mean levels for VEMG activity, VPA, SCL, and respiration rate reached their highest values and were significantly elevated compared to means for REM epochs. Surprisingly, there was no significant heart rate increase.

LaBerge (1985) has succeeded in replicating this experiment with two male subjects. In both cases, respiration showed striking increases in rate. Again, there were no significant elevations of heart rate. Interestingly, although both subjects reported vividly realistic orgasms in their lucid dreams, neither actually ejaculated, in contrast to the "wet dreams" commonly experienced by adolescent males.

All of these results unanimously support the conclusion that the events we experience while asleep and dreaming produce effects on our brains (and to a lesser extent, bodies) remarkably similar to those that would be produced if we were to actually experience the corresponding events while awake. To the extent to which this conclusion is valid, it could provide an explanation of why dreams seem so real while they last: it is because of our brains, dreaming of doing something is equivalent to actually doing it.

The preceding outline of the psychophysiological approach to exploring the lucid dreaming state of consciousness and mapping the relationships between inner and outer realities has relied more on illustration than on theoretical discussion. Hopefully, the flavor of this research strategy has been adequately conveyed thereby. However, it may be informative before

leaving the topic to compare and contrast the methodology that the LaBerge group has been pursuing to Tart's (1973) proposal for "state specific sciences" (SSS).

Psychophysiology vs. State-Specific Sciences

According to Tart, each SSS consists of two classes of activity to be carried out within the particular state of consciousness being studied: observing and theorizing. On the issue of observation, applying Tart's general concept specifically to the lucid dream state of consciousness, to carry out such a SSS requires "a group of highly skilled, dedicated and trained practitioners" capable of entering the lucid dream state and "able to agree with one another that they have attained a common state." While in the lucid dream, " . . . they can investigate other areas of interest"—whether totally internal phenomena of the lucid dream state, or " . . . the interaction of that state with external physical reality, or people in other dream states of consciousness" (Tart, 1975, p. 217). Of course, Tart's description is virtually identical with the way we have conceptualized the capacities required by our lucid dreamers and the types of investigations we have been carrying out. So, regarding observations, we are in close agreement.

It is on the issue of theories, however, that we part company. Tart proposes that theoretical explanations for the observations made in a given altered state of consciousness ought to be developed in the *same* altered state of consciousness rather than another one (such as the waking state). The premise underlying this contention seems to be the notion that all states of consciousness are equally valid ways of organizing experience and that none has any intrinsic superiority over any other. This is an assumption that we are unable to accept, but rather than argue, let us note LaBerge's (1985) observations on this issue: "I am rarely tempted to theorize on lucid dreaming while in the lucid dream state, and those few times that I have done so resulted in ideas that seemed unmistakably irrational in the clear light of morning. Tart would say that I ought not judge my lucid dream reasoning with the standards of waking rationality. But this is exactly what seems necessary to do in order to increase my rationality in the lucid dream state." Every state of consciousness has its strengths and weaknesses. The strength of the lucid dream state seems to be in our capacity to vividly create model universes that can provide a new perspective on our view of waking life and the physical universe. Likewise, the lucid dream state seems particularly suited to divergent thinking and the creative generation of ideas—brainstorming, as it were—whereas the state seems ill suited for convergent thinking, critical evaluation of ideas, rational theorizing, and the like. Perhaps we should be content to explore the inner reality of the lucid dream

and its relationship to the external reality of the physical world. Relating the structures and phenomena of a newly explored domain to those of a more familiar domain (of which the physical world is the paradigm) provides what would appear to be a salutary grounding and point of reference. Progress is achieved when an unknown phenomenon is seen in relation to familiar, well-understood phenomena. In any case, there is the important question of what impact the events of the lucid dream world have on the physical world, especially that part of it that comprises the lucid dreamer's body.

In light of these facts, we would perhaps be wise to use the lucid dream to explore the dream world and its relation to the physical world. While in the lucid dream state, we might sensibly limit ourselves to observations and experiments (planned in the waking state!), leaving theorizing on the topic to our more rational waking moments.

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