

Spotlight

Two-Way Communication in Lucid REM Sleep Dreaming

Benjamin Baird^{1,*}
Stephen LaBerge,² and
Giulio Tononi¹



Dreamers were long thought absolutely isolated from the outside world. Yet psychophysiological studies over the past 40 years have firmly established that lucid dreamers can use eye movements to report on their dream content in real time while in rapid eye movement (REM) sleep. We now also know that sensory input is not completely suppressed during sleep. A recent study by Konkoly *et al.* illustrates how experimenters can question lucid dreamers during ongoing dreams and asks whether more extended two-way communication during lucid REM sleep dreaming is feasible.

For most of human history, dreams have seemed altogether beyond everyday experience. Similarly, psychologists widely presumed the topic nonscientific because dreams seemed unpredictable and uncontrollable and, perhaps uniquely, could only be studied after the fact, through the unverifiable memories and reports of the dreamers. That attitude shifted after the discovery of REM sleep and its strong association with vivid dreaming, and resultant burgeoning of psychophysiological studies of dreaming. Nevertheless, these studies remained restricted to collecting verbal reports following awakening and then attempting the difficult task of aligning these reports with previously recorded physiological signals.

An exceptional state of consciousness, lucid dreaming, provided the key to overcoming these limitations, opening up new pathways for research into perception, cognition, and the sleeping brain. A lucid dream occurs when one becomes aware of the fact that one is dreaming while continuing to dream. The first physiological studies of lucid dreaming were conducted in the late 1970s and early 1980s. Building on the finding that shifts in the direction of gaze within a dream can be accompanied by corresponding movements of the sleeper's eyes, researchers tested whether lucid dreaming could be scientifically verified through volitional eye movements. It was found that lucid dreamers could make distinct patterns of pre-agreed upon eye movements once they became lucid by looking specific directions within the dream. This research provided objective evidence that lucid dreaming occurs during REM sleep [1].

Lucid dreaming provides a way to gain experimental control of dream content from the inside: once lucid, trained dreamers can exert volitional control over their dream actions and carry out preplanned experimental tasks in their dreams. Furthermore, they can not only mark lucidity onset with a standard pre-agreed upon eye movement signal, but they can also make eye movement signals as a delimiter to mark the start and end of experimental tasks. This method can also be used to time-stamp unplanned dream content of particular interest, allowing precise correlations with electrophysiological measures. This technique therefore offers a powerful method for studying the psychophysiology of REM sleep dreaming [1–3]. This method has been used to study a variety of phenomena in REM sleep, including perception of elapsed time in dreams [3], motor cortex activation during hand clenching [4], voluntary control of respiration [5], and pursuit eye movements during tracking of visual imagery [6].

A recent paper by Konkoly *et al.* applied this methodology to test whether experimenters can establish two-way communication with dreamers and control dream content from the outside [7]. The article describes a collection of studies undertaken by several independent research groups in the USA and Europe. Each team of researchers used slightly different methods for communicating into and out of the participants' dreams. In each case, if a dreamer became lucid, they made an eye movement signal to indicate that they were aware they were dreaming. The experimenters then attempted to pose simple questions, such as math problems like '8 minus 6', by softly spoken speech. When and if the lucid dreamer heard the question, they computed the result and answered with the appropriate number ('2') of horizontal eye movements. In total, no response was obtained in 61% of trials, while ambiguous or incorrect responses were obtained in 21%. Across all the different methods tested, two-way communication was established with six individuals in 29/158 trials (18%).

The possibility of two-way communication during lucid REM sleep had been documented previously. For instance, a pioneering study demonstrated that it was possible to perceive shocks delivered to the forearm during lucid REM sleep, to count the shocks, and to respond with the sum using forearm muscle contractions [8]. In another study, it was found that lucid dreamers could voluntarily attend to and perceive a sequence of tones, and respond with eye movement signals specifically to the high-pitched targets in an auditory oddball sequence during REM sleep [9] (J. Strelen, PhD Thesis, University of Mainz, 2006).

The study by Konkoly *et al.* raises many interesting issues about the best ways to further develop lucid dreaming as a methodology. For instance, how practical is it for an experimenter to interrogate lucid dreamers about dream content while it is happening? To what extent is an

extended, ongoing dialogue possible without awakening participants? The number of instances in which the stimuli led to awakenings was not reported by Konkoly and colleagues and without this information it is difficult to fully ascertain the applicability of the technique as implemented. Moreover, as described earlier, lucid dreamers can remember presleep instructions for experimental tasks and can time-stamp such tasks with ocular codes. It therefore seems that for many research questions, real-time communication is not needed, and would likely be counterproductive, since external stimulation carries the risk of awakening.

Despite these caveats, two-way interaction may prove useful in several contexts. Perhaps most promising is that it could offer a way to study the neural mechanisms of disconnection. Specifically, despite the fact that the brain is highly active during REM sleep, we typically remain unconscious of environmental stimuli. As the earlier data indicate, incorporation is the exception, including during lucid dreaming.

The brain mechanisms of this ‘perceptual disconnection’ remain unknown. One hypothesis was suggested by LaBerge [9], who proposed that attention was the crucial factor determining whether or not sensory input from the outside world is consciously perceived or (mostly) not during REM sleep. Lucid dreamers can give responses in real time regarding whether stimuli are incorporated or not, providing a way to directly test theories of disconnection. This approach therefore appears promising to yield new insight into the enduring mystery of how and why consciousness becomes disconnected from the external environment during sleep.

Acknowledgments

This work was supported by the Tiny Blue Dot Foundation and the Bial Foundation.

Declaration of Interests

No interests are declared.

¹Center for Sleep and Consciousness, Department of Psychiatry, University of Wisconsin-Madison, Madison, WI, USA

²Lucidity Institute: <http://lucidity.com>

*Correspondence:

bbaird@wisc.edu (B. Baird).

<https://doi.org/10.1016/j.tics.2021.04.004>

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