

Supplementary information S1 (table) | Some formal properties of dream consciousness of relevance to neurobiology

Phase I (1980-1994): laboratory and unmonitored home reports

Perception ¹	Vision and sense of movement predominate; pain and taste are rare.
Bizarre cognition ²	Times, places, and persons change without notice; measured as plot discontinuity and incongruity
Fantasy ³	Chimeric characters are common in dreaming but absent in fantasy
Children ⁴	Adult type dreaming begins ~ age 5
Emotion ⁵	Anxiety (fear), elation, and anger predominate; sadness, guilt, and depressed affect are rare.
Plot requence ^{6,7}	Gradual loss of orientation within scenes; radical loss of orientation across scenes
Splicing ⁸	Judges cannot recognize continuity across scenes

Phase II (1995-2004): home dreams with physiological monitoring

Report length ⁸	REM reports 7x longer than NREM reports
Sensation of movement ⁹	More common in REM than NREM reports
Character recognition ¹⁰	Unreliable in REM but dreamer does not notice errors
Thinking ¹¹	Highest in waking, lowest in REM; reciprocal with hallucinating across states
Memory source ¹²	Identified in only 20% of dream incidents (80% of dream events synthesized de novo)

Phase III (1995-present): home dreams with physiological monitoring - focus on secondary consciousness (metacognition)

Theory of Mind ¹³	Dreamer recognizes mental process of other dream characters
------------------------------	---

Logic ¹⁴	Some dream thinking is rational; most dream thinking is non-rational
Authorship ¹⁵	Dream reports incorrectly grouped by judges
Schizophrenia ¹⁶	Patients and controls have equally bizarre dreams; patients, but not controls, have bizarre TAT responses
TAT, Thematic Apperception Test	

References

1. McCarley, R. W. & Hoffman, E. REM sleep dreams and the activation-synthesis hypothesis. *Am. J. Psychiat.* **138**, 904-912 (1981).
2. Hobson, J. A., Hoffman, S. A., Helfand, R. & Kostner, D. Dream bizarreness and the activation-synthesis hypothesis. *Human Neurobiol.* **6**, 157-164 (1987).
3. Williams, J., Merritt, J., Rittenhouse, C. & Hobson, J. A. Bizarreness in dreams and fantasies: Implications for the activation-synthesis hypothesis. *Conscious Cogn.* **1**, 172-185 (1992).
4. Resnick, J., Stickgold, R., Pace-Schott, E., Williams, J. & Hobson, J. A. Self-representation and bizarreness in children's dreams. *Conscious Cogn.* **3**, 30-45 (1994).
5. Merritt, J. M., Stickgold, R. A., Pace-Schott, E. F., Williams, J. & Hobson, J. A. Emotion profiles in the dreams of young adult men and women. *Consc. Cogn.* **3**, 46-60 (1994).
6. Sutton, J., Rittenhouse, C., Pace-Schott, E., Stickgold, R. & Hobson, J. A. A new approach to dream bizarreness: Graphing continuity and discontinuity of visual attention in narrative reports. *Conscious Cogn.* **3**, 61-88 (1994).
7. Sutton, J., *et al.* Emotion and visual imagery in dream reports: A narrative graphing approach. *Conscious Cogn.* **3**, 89-99 (1994).
8. Stickgold, R., Rittenhouse, C. & Hobson, J. A. Dream splicing: A new technique for assessing thematic coherence in subjective reports of mental activity. *Conscious Cogn.* **3**, 114-128 (1994b).
9. Porte, H. & Hobson, J. A. Physical motion in dreams: One measure of three theories. *J. Abnorm. Psychol.* **105**, 329-335 (1996).
10. Kahn, D., Stickgold, R., Pace-Schott, E. F. & Hobson, J. A. Dreaming and waking consciousness: a character recognition study. *J. Sleep Res.* **9**, 317-325 (2000).
11. Fosse, R., Stickgold, R. & Hobson, J. A. Brain-mind states: reciprocal variation in thoughts and hallucinations. *Psychol. Sci.* **12**, 30-36 (2001).
12. Fosse, M. J., Fosse, R., Hobson, J. A. & Stickgold, R. J. Dreaming and episodic memory: a functional dissociation? *J. Cogn. Neurosci.* **15**, 1-9 (2003).
13. Kahn, D., Pace-Schott, E. & Hobson, J. A. Emotion and cognition: feeling and character identification in dreaming. *Conscious Cogn.* **11**, 34-50 (2002).
14. Kahn, D. & Hobson, J. A. State-dependent thinking: a comparison of waking and dreaming thought. *Conscious Cogn.* **14**, 429-438 (2005).
15. Hobson, J. A. & Kahn, D. Dream content: Individual and generic aspects. *Conscious Cogn.* **16**, 850-858 (2007).
16. Scarone, S., *et al.* The dream as a model for psychosis: an experimental approach using bizarreness as a cognitive marker. *Schizophr. Bull.* **34**, 515-522 (2008).