11 The Neurocognitive Theory Compared to Other Dream Theories

As this book demonstrates, the neurocognitive theory of dreaming does not face any of the problems confronting the Freudian, activation-synthesis, and adaptive theories. It has a neurocognitive basis rooted in the findings on the default network. Future detailed neuroimaging findings will continue to refine this picture. Future lesion studies may make it possible to be more specific concerning the exact locations leading to the loss of dreaming or to alterations in dreaming. Nevertheless, the work to date has outlined the general picture.

It is therefore the activated portions of the default network that provide the neural basis subserving the cognitive processes that generate dreaming. However, for dreaming to occur, the default network must be mature and intact, and it must be cut off from the external world and incoming stimuli by gates in the thalamus. There also has to be continuing relative deactivation of the frontoparietal control, dorsal attention, and salience/ventral networks. These conclusions could be incorporated by adaptation theories, and perhaps by Freudian theorists, but they are inconsistent with the major emphasis activation-synthesis theory puts on the importance of random stimuli from the brainstem in generating dreaming and dream content.

The neurocognitive theory of dreaming also has a sound developmental dimension because it incorporates the evidence concerning the gradual maturation of the default network, as well as the longitudinal and cross-sectional studies of the changes in the frequency, complexity, and content of dream reports collected in sleep-dream laboratories from more than 100 children ages 3–15 (Foulkes, 1982; Foulkes et al., 1990; Strauch, 2004, 2005; Strauch & Lederbogen, 1999). The theory also makes use of the parallel findings on the development of waking cognition in young children,

preadolescents, and adolescents, which provide convincing supporting evidence for the dream-lab results. However, none of the other theories of dreaming has incorporated these replicated findings as yet.

Much still needs to be learned about the development of dreaming, and refinements very likely will be made. However, there is little doubt about the default network maturing only gradually and not beginning to be adultlike until ages 9–13. The work on the development of cognition in children is also firmly established. There are plausible parallels between the developmental pattern of dream content and the emergence of various cognitive capacities, such as the production of mental imagery and the use of narrative. To the degree that the longitudinal and cross-sectional lab findings on the frequency, complexity, content, and emotionality of dreaming and dream content are judged to be credible, then the absence of a developmental dimension in the Freudian, activation-synthesis, and adaptation theories can be seen as a major shortcoming in them.

Few, if any, of the other theories can accommodate the systematic findings on dream content. The findings on continuity, the rarity of symbolism, and the relative lack of emotions are very difficult for Freudian theory. The everyday nature of most dream content, the minor role of unusual elements, and the relative infrequency of emotions are contrary to what activation-synthesis theorists expect. The fact that dream content can be studied in a systematic fashion also goes against their claims. As for adaptation theories, the minor role of incorporations from daily waking life, the slowness with which dream content changes over time, and the frequent enactments of several basic concerns over years and decades, are not what most adaptation theories would expect.

Dream series provide dream researchers with an unexpected source of ideal unobtrusive and nonreactive archival data. The numerous studies of dream series have led to replicated results that are similar to those from representative samples of dream reports analyzed with the same quantitative content methods. The similarity of the findings, using both representative samples of dream reports and dream series, is a form of convergent validity that increases the likelihood that the results from both types of studies are valid. Studies of dream series also have extended the scientific findings on dream content to include impressive consistency over months and years, as well as further evidence for the continuity between the frequency with

which characters and avocations appear in dream reports and the intensity of conscious personal concerns about those characters and avocations in waking life. No other theory of dreams has incorporated the consistency dimension, and only a few of them could accommodate the findings on continuity.

Although none of the other dream theories makes use of the systematic findings on dream content in adults or children, there are several nonlaboratory studies of adult dream content by activation-synthesis theorists and one of children. However, their nonlab studies are all inadequate and questionable due to one or more of several methodological problems. Their rating scales and coding categories are not of proven reliability or validity. Their results are very different from those reported by other researchers on many topics, and in particular those concerning bizarreness and emotions. These differences are due to their inclusion of scene changes as bizarre and to the demand characteristics they build into their studies of emotions. As a result, their atypical results have been frequently doubted or directly questioned by other dream researchers (Antrobus, 2000; Foulkes, 1996a, 1996b; Reinsel et al., 1992; Revonsuo & Salmivalli, 1995).

The neurocognitive theory of dreaming, unlike several other theories of dreaming, does not assume most published studies of dreaming and dream content can be taken at face value. Nor is there much, if any, consideration of the issues of a wake-state bias and demand characteristics in studies relying on self-ratings. This general contrast may be especially important on the issues of bizarreness and emotions in dream content. In the case of studies of emotions, the self-ratings are likely prone to the confounds created by a wake-state bias and perhaps especially when they are instructed to include any implicit emotions. Unless new methods are found to study emotions in dreams, it is very likely that the study of emotions will remain the most divisive issue facing dream researchers.

In addition to continuing to insist that bizarreness and emotions are hallmarks of dreaming, several theories assume that findings from well-controlled studies, based on large samples of nonclinical participants, can be used interchangeably with studies focused on a wide range of atypical mental states during both waking and sleep. Those atypical states include psychiatric symptoms, drug states, PTSD nightmares, and self-awareness during sleep. This back-and-forth, grab-bag approach ignores the distinction between foundational and translational models.

Meaning, Lawfulness, and Adaptive Function

Although the meaning of "meaning" is a fuzzy topic, the neurocognitive theory of dreaming leads to the conclusion that there is a considerable degree of meaning in dream content. There is, for example, coherency in dream reports that simulates what are agreed to be meaningful events in waking life. There are also several correspondences between dream content and waking life, which are meaningful because it is generally agreed that individual differences, gender differences, and cross-cultural differences are meaningful in waking life. Similarly, the dream reports in a dream series from an individual are meaningful because the consistencies in them parallel the consistencies in the individual's waking personal concerns and avocational interests. Finally, the developmental regularities in the frequency and complexity of dream reports from children from ages 5 to 12 are meaningful because they parallel the meaningful regularities in brain maturation and cognitive development.

On the other hand, Freudian dream theory claims that much, if not all, of the meaning in dreams is hidden. Meaning therefore can only be found through free association, which has been shown to be a dubious method for many reasons. Alternatively, Freudian theorists often claim that the hidden meaning in dream reports can be deciphered through the interpretation of alleged dream symbolism, which has been found to be rare in blind analyses of dream reports, a finding supported by neuroimaging evidence.

As for activation-synthesis theorists, they claim there is little if any meaning in dreams because they are triggered by random stimuli that are generated in the brainstem. They sometimes grant that there is some degree of coherency in dream content but add that a large percentage of dream reports contain bizarre elements, which are meaningless except as evidence for dreaming as a form of delirium. They also sometimes agree that the content in dream reports is similar to what the dreamer thinks or does in waking life, at least to some degree, but they accord little or no meaning to these similarities because dreams are considered to be cognitive trash in this theory (Hobson, 2002, p. 101). The adaptive theories, on the other hand, are able to accommodate the concept of meaning, and often depend upon it, as in the case of the problem-solving and social-rehearsal theories.

In addition to claiming dreams are meaningful, the neurocognitive theory concludes that there is evidence for dream reports containing more

lawfulness than is usually thought to be the case. This point is best seen in the small-world nature of character networks in six different dream series that have the same properties as waking social networks (Han, 2014; Han & Schweickert, 2016; Han et al., 2015). The claim about dreams being lawful is not problematic for adaptation theories. However, Freudian dream theory cannot accommodate the findings on which this conclusion is based. Any lawfulness that Freudian dream theorists assume to be present in dreams cannot be detected without uncovering the ways in which the dream-work transforms the wishes underlying dream content into a more benign but often opaque, seemingly meaningless narrative. As already noted, the evidence for the theory's main concept related to lawfulness, the dream-work, is meager. To the degree that Freudians can put forth any evidence for this concept, it is based on the flawed method of free association or on unlikely claims about symbolism.

As for activation-synthesis theory, the emphasis on randomness is a claim about lawfulness, which is built into the theory by definition. There can be no lawfulness in dream reports generated by random events in the brainstem. This assumption is refuted by the results discussed in this book, which have been replicated numerous times. Thus, specific gender differences and specific cross-cultural differences can be "predicted" in any future study if sample sizes are large enough to detect them. Then, too, the fact of individual differences in any new dream series can be "predicted" with confidence. Since activation-synthesis theories have explicitly stated in at least one study in the past 15 years that there are no gender or individual differences in dream reports, their randomness theory is in effect refuted at the content level by those two empirically incorrect claims alone (Hobson & Kahn, 2007, p. 854).

Finally, as stated in chapter 10, the neurocognitive theory of dreaming makes no assumptions about the alleged adaptive function(s) of dreaming. It suggests that human imagination has created both cultural and individual uses for dreams in the course of history, often relating to religion, the treatment of illness, artistic creativity, and self-help measures. It thereby differs from Freudian theory, with its unlikely claim about dreams being the guardians of sleep. As also shown in chapter 10, the neurocognitive theory of dreaming also differs from the adaptive theories, which are based on unsupported claims about memory consolidation during dreaming in REM sleep, high levels of metaphoric thinking and hyperassociativity in dreams,

implicit learning during dreaming, the transfer of new strategies acquired during dreaming to waking thought, or the consolidation of updated predictive codes during REM sleep dreaming.

Looking toward the Future

Based on the comparisons of the neurocognitive theory of dreaming with other theories of dreaming in this chapter, the new theory has the virtue that it can be tested, amended, extended, or refuted, due to the numerous hypotheses and replicated findings it has synthesized from a variety of independent research fields. At the same time, the other theories do not appear to have feasible agendas for further development. Few of their claims have been replicated by independent investigators, and most of their basic assertions have been called into question or refuted by a range of replicated studies.

The neurocognitive theory of dreaming could be tested at the level of dream content using various combinations of smartphone apps and home-based sleep-awakening devices that detect sleep stages. Individually or combined, those two devices make it possible to report dreams when they are recalled at any time of the day or night. They also make it possible to carry out awakenings throughout the night from a research office, while individual participants from ages 9 to 90 are asleep in the familiarity and comfort of their own bedrooms. Many basic questions about the frequency of dreaming, the factors involved in dream recall, and the representativeness of nonlab waking samples of dream reports could be studied anew in ways never before possible.

In addition, smartphone apps can be used by children as young as ages 7–8 and hence could be used to document dream recall and the content of dream reports. Smartphone apps, or periodic collections of written Most Recent Dreams (MRDs) in classrooms, make it feasible to study changes in the frequency, complexity, and substance of dream reports in a faster, easier, and more confidential way than was possible in the past. For example, a visit to every classroom in a middle school every two or three months during the school year to collect MRD reports would provide good samples for three one-year longitudinal studies and a three-year cross-sectional study. Such a study would include most of the time period (ages 9–13) during which dream content gradually becomes more adultlike. Then, too, MRD

studies of fifth and sixth graders on the same day across cities, states, or countries might provide a valuable database on the frequency, length, and content of dream reports at the time when children begin to dream in a more adultlike fashion. In addition, greater efforts could be made to locate dream journals kept for a month or more during adolescence. The dream reports in them could be studied with Hall/Van de Castle (HVdC) content categories, individually tailored word strings, and those generic word strings making use of regular expressions to reduce false positives.

The content analyses of large samples of dream reports could be facilitated in several ways. First, the HVdC coding categories could be automated through an online interface that would display each dream report and provide menus or buttons for the entry of the relevant codings. The codings selected could be automatically entered into a spreadsheet at a central location. Codings could be carried out by multiple coders and then automatically checked for reliability. Final codings could be fed into statistical analysis tools similar to those already available on dreamresearch.net. These statistical analyses could be extended to include the extant approximate randomization program for h and p values, as well as programs correcting for multiple testing and for detecting autocorrelation in a dream series. Eventually, codings could be carried out by crowd-sourcing strategies. Although it is unlikely that generic word strings could ever carry out reliable and complete searches for social interactions and other complex aspects of dream content, the few currently available generic word strings for relatively simple types of content (e.g., sensory mentions, mentions of religion-related elements, mentions of nature terms) could be greatly improved by carefully checking for false positives after the results are available.

Based on the gender differences in the frequency and completeness of dream reports, which are documented in several different chapters, it would be methodologically sensible to concentrate on girls and women in order to more readily obtain large samples with complete dream reports, whether using MRDs, two-week diaries, or dream series. This focus on girls and women seems especially plausible because the findings presented in this book suggest studies of gender differences are not likely to make any further contributions to the construction of a neurocognitive theory of dreaming. Dream reports could still be collected in mixed-gender settings when necessary, but the focus of the data analysis would be on the girls' and women's reports.

Finally, there are now neuroimaging technologies that might make it easier to test hypotheses concerning the neural substrates and association networks subserving dreaming. In particular, parts of the theory's agenda perhaps could be tested in dream research laboratories through the use of functional near-infrared spectroscopy (fNIRS), a relatively recent neuroimaging technology in terms of its technical sophistication and feasibility. It does not require the presence of a technician, tolerates motion well, and costs in the $60,000 to $300,000 range. This range is approximately one-fourth to one-tenth as much as equivalent fMRI technologies, depending on size and the quality of resolution (Cui, Bray, Bryant, Glover, & Reiss, 2011; Kamran, Mannan, & Jeong, 2016). Moreover, portable versions of the fNIRS technology are not much bigger than a large kitchen microwave. The usefulness of this technology has been validated in at least one comparison with fMRI scans in adults (Cui et al., 2011) and for use with infants by comparing its results with those from the simultaneous use of fMRI (Bulgarelli et al., 2018). It has been used in two small pilot studies of the default network in adults (Durantin, Dehais, & Delorme, 2015; Harrivel, Weissman, Noll, & Peltier, 2013) and to locate the nascent default network in infants (Bulgarelli et al., 2020). It also has been used to study the early stages of sleep with a handful of sleep-deprived participants who were sitting in chairs (Nguyen et al., 2018).

Because fNIRS tolerates head motion better than fMRI does, its widest use in neurocognitive studies has been in studies of the prefrontal cortex in infants (Grossmann, 2013; Piazza, Hasenfratz, Hasson, & Lew-Williams, 2020). Its disadvantages concern its less detailed spatial resolution and its decreased signal-to-noise ratio, as well as its inability to reach below the cortex (Cui et al., 2011; Kamran et al., 2016; McKendrick, Parasuraman, & Ayaz, 2015). However, these possible limitations did not prove to be a problem in two studies of the default network in adults, which were mentioned in the previous paragraph (Durantin et al., 2015; Harrivel et al., 2013). Still, it might be necessary to make the bulky optode sensors, usually embedded in a cap, more comfortable for sleeping in a reclining position.

Using fNIRS technology, it might be possible to replicate the serendipitous finding of brief episodes of dreaming during drifting waking thought in individual participants reclining in a solitary laboratory setting (Foulkes, 1985; Foulkes & Fleisher, 1975; Foulkes & Scott, 1973). If brain patterns could distinguish mind-wandering from episodes of dreaming, perhaps the

neural substrate supporting dreaming could be studied in more detail than is possible during experimental awakenings at night, when participants may take several seconds to awaken and respond (see Domhoff & Fox, 2015, for suggestions on what a study of this kind might include). The fNIRS technology also might make it possible to study a wide range of atypical dreamers in their home settings (Domhoff, 2020). For example, the two extremes on dream recall (those who have never recalled a dream and those who recall three or four dreams each day) could be compared in greater detail. (See Eichenlaub, Bertrand, & Ruby, 2014, for a study of frequent recallers; Pagel, 2003, for a study of 16 people who have never recalled a dream; and Vallat, Eichenlaub, Nicolas, & Ruby, 2018, for a replication of the findings on frequent recallers.)

The availability of portable fNIRS devices also provides a feasible and unobtrusive way to study the development of dreaming in young children in apartment-like lab settings. It also might make it possible to do neuroimaging studies of children who are precocious or delayed dreamers, or to do home-based longitudinal studies of the development of the default network, the frequency of dream recall, and the nature of dream content in children ages 7–13. All it would take is a few good participants.

If smartphone apps, home sleep-awakening devices, the two relatively underutilized methods for collecting large samples of dream reports (MRDs and dream series), and the new neuroimaging technologies were used in a sustained way, backed by adequate resources, then the fate of the neurocognitive theory of dreaming, as well as the fate of the other theories discussed in this book, could be decided within a decade.

The Neurocognitive Theory of Dreaming

The Where, How, When, What, and Why of Dreams

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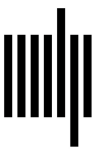

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