8 The Occurrence of Emotions in Dreams

This chapter first examines the empirical findings from the mid-1960s to 2020 on the most difficult and contentious issue in the study of dream content: the frequency and nature of emotions in dream reports. In the process, the chapter of necessity discusses relevant methodological issues. The studies serving as the basis for the chapter were carried out in both laboratory and nonlaboratory settings and include dream reports from children and adolescents as well as adults. Using the emotions categories in the Hall/Van de Castle (HVdC) coding system or very similar coding categories devised by other dream researchers, these studies led to an unexpected discovery. Only half of women's dream reports and one-third of men's dream reports contain an emotion, and as many as 17% of dream reports contain no emotions in situations that would have produced emotions in waking life. Moreover, even fewer dream reports collected from children and younger adolescents include an emotion. These studies also reveal that the majority of the emotions in samples of adult dream reports is negative, which is consistent with the predominance of other negative elements in dream reports, such as aggressions and misfortunes, as discussed in chapter 3. However, in children and adolescents' dream reports, the preponderance of emotions is positive, as is the case with other elements in their dream reports, as discussed in chapters 6 and 7.

These descriptive empirical findings have been called into question by some of the results in four later studies. These studies make use of the dreamers themselves to make ratings of their own dream reports on 4-point or 5-point rating scales. The ratings concern the presence or absence of emotions, the intensity of the emotions, and the degree to which the emotions in each dream are positive or negative. Self-ratings by participants lead to

much higher percentages of dream reports containing at least one emotion and higher percentages of dream reports in which the emotions are predominantly positive, as opposed to predominantly negative. Independent raters of the same dream reports, who are given the same instructions as the dreamers, sometimes produce results different from those provided by the participants and also from the results in studies based on quantitative coding systems. These differences are discussed in a section of the chapter that compares coding systems and rating systems.

The final section begins with an overview of Darwinian-derived ideas on emotions. It next turns to waking neuroimaging studies of the neural substrates and associative networks underlying the emotions of fear, anger, sadness, disgust, and happiness. The waking neuroimaging results are then compared to the neuroimaging findings during dreaming, which reveals large differences between the neural substrates active during waking emotions and the more truncated neural substrate active during dreaming.

The neurocognitive theory of dreaming therefore suggests the relative lack of emotions in dream reports, as found in studies using coding categories, is very likely due to cognitive insufficiencies during dreaming. More specifically, only portions of one of the association networks involved in the experiencing of emotions, the default network, has a relatively high level of activation during dreaming. This analysis is supported by studies of people who frequently experience highly emotional and frightening nightmares. Unlike people who do not suffer from frequent nightmares, people with frequent nightmares have continuing high levels of brain activation during sleep, as revealed by both neuroimaging and EEG studies.

Quantitative Content Analyses of Emotions in Dream Reports

The most rigorous coding categories for studying emotions in dream reports were created as part of the detailed process that led to the comprehensive HVdC coding system, which was overviewed in chapter 3 (Hall & Van de Castle, 1966). In carrying out this general work, the emotions categories proved to be the most difficult to construct: "The problem of reducing the hundreds of words in the English language that represent affective states to a fairly small number of classes that seemed to be fairly comprehensive, yet discrete in coverage, was a formidable one" (Hall & Van de Castle, 1966, p. 110). In addition to the difficulties in classifying emotion terms,

there were problems in establishing high intercoder reliability, even with a slightly more general set of categories than was initially considered. Since high reliability is an absolute necessity for any coding system, the two researchers had to collapse a few of the initial categories into the categories that comprise the final system (Hall & Van de Castle, 1966, p. 110).

In creating the category labeled as "Fear/Apprehension," the two researchers note that there are "recognizable" differences among the emotion states in this category but nonetheless conclude that they share a "common denominator." In each case, "a threat of some potential danger exists," whether physical or psychological (Hall & Van de Castle, 1966, p. 110). There is "the possibility of physical injury or punishment, or the possibility of social ridicule or rejection" (Hall & Van de Castle, 1966, p. 111). In theoretical terms, these are the same type of categories that cognitive psychologists and cognitive linguists now understand as natural categories. They are based on prototypes and families of resemblances (Rosch, 1973; Rosch & Mervis, 1975; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976; Sullivan & Sweetser, 2010).

Due to the fears people have about social ridicule or rejection, this category also includes guilt, embarrassment, and shame. Disgust is also included in this category because it seems to have its origins in a fear of contamination by specific immoral actions, often related to sex, and a similar fear of bodily excretions and specific types of food (Gifuni, Kendal, & Jollant, 2017, p. 1171). However, guilt, shame, embarrassment, and disgust are infrequent in the normative samples.

Hall and Van de Castle concluded four of their five categories are intuitively sound: Anger (AN), Fear/Apprehension (AP), Sadness (SD), and Happiness/Joy (HA). (Joy was relatively infrequent and difficult to reliably distinguish from happiness, so joy was made part of a Happiness/Joy category.) However, the two researchers debated back and forth on whether to include what they decided to call Confusion (CO) as an emotion. Confusion is indexed by "surprised, astonished, amazed, awestruck, mystified, puzzled, perplexed, strange, bewildered, doubtful, conflicted, undecided, and uncertain," as mentioned in chapter 3 (Hall & Van de Castle, 1966, p. 112). Although they thought "it may be debatable as to whether confusion is a condition possessing the same degree of autonomic involvement as the preceding emotions," they decided the "feeling state" that accompanies uncertainty may begin to shade toward "a type of free-floating anxiety."

They therefore decided it belonged "most appropriately in the classification of emotions" (Hall & Van de Castle, 1966, p. 112).

As explained in chapter 3, the introduction of the concept of cognitive appraisals into cognitive psychology has made Confusion a better fit as a cognitive category. Surprise or confusion may or may not lead to an ensuing emotion state (Dixon, Thiruchselvam, Todd, & Christoff, 2017; I. Roseman & Evdokas, 2004; I. Roseman & Smith, 2001) This rationale fits well with Hall and Van de Castle's (1966, p. 112) starting point as to the origins of confusion: "Confusion is generally produced either through confrontation with some unexpected event or else through inability to choose between available alternatives."

Coders are instructed to code explicit mentions of emotions, with one exception that happens infrequently in the normative ample: "If the dreamer describes definite autonomic activity accompanying an event, and it is clear from the combination of context and autonomic description that the dreamer was experiencing an emotion," then an emotion would be scored. Two examples are provided. If the dreamer says, "Tears began running down my face when I received word of my mother's death," that would be an instance of Sadness. If the dreamer begins to "sweat and tremble, and tries to cry out, but no words would come," that would be an instance of Fear/Apprehension (Hall & Van de Castle, 1966, pp. 112–113).

The normative findings for the four remaining emotions categories in the HVdC coding system—Fear/Apprehension, Anger, Sadness, and Happiness/Joy—are presented in table 8.1 for women, men, and women and men combined. In addition, this table includes figures for the percentage of dream reports in the normative samples that do not include any emotions, which leads to a "no emotions percent" or its inverse, an "at least one emotion percent." It is calculated by dividing the total number of dream reports with no emotions by the total number of dream reports with or without an emotion. There is also a percentage for at least one instance of one of the three negative emotions categories: Fear/Apprehension, Anger, or Sadness. The table also includes the normative findings for a "Fear/Anger/Sadness Percent" (FAS%), which is determined by dividing the total number of "negative" emotions by the total number of coded emotions in the four emotions categories combined. The FAS% replaces a former measure, the "Negative Emotions Percent," which included confusion as one of the negative emotions. Although this change to a new FAS% is conceptually

Table 8.1
Frequency of emotions in the Hall/Van de Castle norms for women and men

	Women's norms ($n = 491$)	Men's norms ($n = 500$)	Women and men combined ($n = 991$)
Percentage of dreams with NO emotions	49.7	66.8	58.3
Percentage of dreams with at least one:			
Happiness/Joy (HA)	13.8	9.2	11.5
Fear/Apprehension (AP)	26.5	17.2	21.8
Anger (AN)	10.0	7.2	8.6
Sadness (SD)	10.2	4.8	7.5
Fear/Anger/Sadness (AP+AN+SD)	40.9	26.4	33.6
Any emotion	50.3	33.2	41.7
Fear/Anger/Sadness Percent (AP+AN+SD ÷ all emotions)	75.9	75.1	75.6
Negative emotions (F/A/S) compared to positive emotions, expressed as a ratio	3.0	2.9	2.9

necessary, it leads to a difference of only 4.6 percentage points for women and 5.4 percentage points for men.

The detailed results presented in table 8.1 provide a baseline for examining several of the studies that follow. The combined norms that are included in it, along with normative figures for women and men separately, are useful for comparisons with studies that combine women and men in presenting their results.

The normative HVdC normative findings concerning emotions in nonlab dream reports are replicated in detail in samples of men's dream reports from the methodological study of lab and nonlab dream reports in the Miami sleep-dream lab in the mid-1960s (Hall, 1966a). Since the study used the same men as participants in both the lab and nonlab conditions, the dream reports make it possible to compare nonlab findings with those in the HVdC normative study and to provide norms for lab findings on emotions as well. However, Hall (1966) did not code these dream reports for emotions. They were coded for emotions in 2014–2015 by two of the author's research assistants, who were not aware of their origins. The few disagreements were resolved by a highly experienced coder, Adam Schneider. In

order to have equal numbers of dream reports from participants in both the lab and nonlab settings, the analysis is based on 167 extant dream reports from seven of the young adult male participants (see Domhoff & Schneider, 1999, for information on how these comparable samples were created).

The percentage of dream reports with no emotion in the Miami nonlab reports, 67.0%, is almost identical to the percentage in the HVdC norms, 66.8%. This percentage is higher in the lab dream reports, 76.0%. The FAS% for the nonlab reports, 82.9%, is a little higher than it is in the HVdC normative findings, 75.1%. The percentage for the lab dream reports, 81.5%, is very similar to the Miami nonlab result. These findings, along with a few others from this new study of older data, are displayed in table 8.2. These results can serve as another possible baseline for comparing HVdC results with those based on other coding systems.

Following the introduction of the HVdC coding categories and the normative findings, the frequency and nature of emotions in dream reports was next analyzed in a study based on 635 REM dream reports, which were collected in two different sleep-dream laboratories over the space of "250 subject nights." Although the exact number of participants is not stated, the participants were almost equally divided in terms of gender. Only one-third of the dream reports contained at least one emotion, which also can be expressed as 67.0% of the dream reports having no emotions. A subset of the overall sample had been collected from 20 young adult male students

Table 8.2
Emotions in dream reports collected in a sleep-dream lab vs. nonlab-collected dreams, compared to the male norms

	Miami lab ($n = 167$)	Miami nonlab ($n = 106$)	Male norms ($n = 500$)
Percentage of dreams with NO emotions	76.0	67.0	66.8
Percentage of dreams with at least one:			
Fear/Anger/Sadness (AP+AN+SD)	21.0	27.4	26.4
Happiness/Joy (HA)	4.8	7.5	9.2
Any emotion	24.0	33.0	33.2
Fear/Anger/Sadness Percent (AP+AN+SD ÷ all emotions)	81.5	82.9	75.1

for the explicit purpose of studying emotions. The percentage of dream reports with no emotions was only marginally lower, 65.0% (Snyder, 1970, p. 141). These figures are reasonably close to the findings in the combined HVdC normative sample, based on nonlab dream reports. Anxiety, fear, and anger were the most frequent emotions in the overall sample, and negative emotions outnumbered positive emotions by a 2-to-1 margin, which is close to the HVdC findings (Snyder, 1970, p. 141). (Readers may recall from earlier chapters that there were only a few "typical" dreams and unusual elements in this large REM-based sample.)

A study of 104 REM dream reports, obtained by the researchers from colleagues in a University of Cincinnati sleep-dream lab, reported similar low emotions figures. (This study, based on a sample from 20 college-aged men, was also briefly overviewed in chapter 5 in terms of the few unusual elements in it.) Using their own categories for anger, anxiety, guilt, sadness, shame, surprise, and joy, the researchers found anxiety in 14% of the reports, surprise in 9%, anger in 9%, joy in 8%, sadness in 4%, shame in 2%, and guilt in none at all. These categories are very similar to those in the HVdC coding system, except that the HVdC system includes shame and guilt in the Fear/Apprehension category. The study does not provide the percentage of dream reports with at least one emotion, but the sum of the percentages for the six emotions listed in the previous sentence adds up to only 46%.

However, the researchers do say that 8.7% of the dream reports included "more than one affect," which means a maximum of 38% included at least one emotion. If surprise is removed from their emotions scale, due to the fact that it is now considered to be a sign of cognitive appraisal, then the percentage is very likely in the 30–35% range, which is similar to the HVdC normative finding for men, 33.2%, and can be expressed as 66.8% of the dream reports having no emotions (McCarley & Hoffman, 1981, pp. 908, 912). The three negative emotions appeared 3.7 times more often than joy, which occurred in only 8% of the dream reports (McCarley & Hoffman, 1981, p. 908). In the HVdC men's norms, negative emotions appear 3.0 times more often than Happiness/Joy, so the difference between the two is not large on the basis of this ratio comparison.

As one part of a study based primarily on rating scales, which is discussed below, two researchers at the Central Institute of Mental Health in Mannheim also coded 180 nonlab dream reports on the basis of a German translation of the HVdC coding categories for emotions. Their findings are

similar to those in the normative study. Based on their combined findings for women and men, they first found that 39.4% of the dream reports contained at least one emotion, which is close to the HVdC combined normative finding of 41.7% (Schredl & Doll, 1998, p. 640, table 1). They also found that 24.4% of the dream reports contained predominantly negative emotions, whereas only 9.4% contained predominantly positive emotions (Schredl & Doll, 1998, p. 640, table 1). In the HVdC combined normative sample, 75.1% of the emotions were in the Fear/Anger/Sadness content indicator, which incorporates all the negative emotions in the updated norms, and only 24.9% in the Happiness/Joy category. The HVdC findings, based on the total number of emotions in all the dream reports, are not the same as the indicator based on the predominance of negative or positive emotions in each dream report in this study. However, if the two separate sets of findings are expressed in ratios, then the negative/positive ratio is 3.0 in the study carried at the Central Institute of Mental Health and 2.9 in the HVdC combined normative sample.

Generally speaking, then, the three studies by three different groups of independent researchers reviewed above provide very similar results to those in the HVdC normative study and the Miami lab/nonlab study. They all conclude that only 30–40% of the dream reports included at least one emotion, and negative emotions outnumbered positive emotions by at least a 2-to-1 margin.

The relatively high percentage of dream reports with no emotions in the studies overviewed in this section, which included a large gender difference in the HVdC normative sample (49.7% for women, 66.8% for men, $h = .35$, $p < .001$), also led to an unanticipated research question. From the outset of the studies of emotions in dream reports, Hall and Van de Castle (1966, p. 110) were "generally surprised at how few emotions are actually reported," and then added a question about why there would be a difference in emotions between dreams and waking life: "Situations that would undoubtedly be terrifying or depressing for the average individual may be reported in some detail, but a description of their emotional impact upon the dreamer is often curiously lacking."

This impressionistic observation was supported in a later study of the appropriateness of emotions in dream content. The study is based on REM awakenings of 17 young adult college students, nine women and eight men. Each participant was awakened five or six times over the course of two

nonconsecutive nights in a sleep-dream lab, leading to 94 dream reports from 106 awakenings, a recall percentage of 88.7% (Foulkes, Sullivan, Kerr, & Brown, 1988, p. 32). The participants were asked in detail after each awakening about the presence or absence of emotions in the dreams they recalled. They were also asked about the appropriateness of the emotion, or any lack of emotion, in relation to the nature of the dream content. The researchers then asked independent raters, working separately, to make their own ratings based on copies of the dream reports. Both the participants and the independent raters agreed that emotions were absent in situations in 17% of the dream reports in which emotions would have been present in similar situations in waking life. On the other hand, 3.2% of the dream reports included emotions in situations in which there would not have been emotions in waking life. The presence or absence of feelings was appropriate to the dream situation in 60% of the dream reports (Foulkes et al., 1988, pp. 34–35).

The high percentage of negative emotions in all of these studies may come as a surprise to many readers, so it needs to be stressed that this finding is not a function of having fewer categories for positive emotions than for negative emotions, as is the case of all of the studies overviewed in this section. For example, the HVdC coding system for emotions has only one category for positive emotions, Happiness/Joy. However, all of the synonyms for happiness and joy are included in this HVdC category.

The possibility that having fewer categories for positive emotions leads to bias toward overcounting negative emotions has been refuted in a nonlab study. This study used 10 categories for "positive" emotions and 10 categories for "negative" emotions. The analysis was carried out by determining the percentage of dream reports with predominantly negative emotions and the percentage of dream reports with predominantly positive emotions. The percentage with predominantly negative emotions was higher than the percentage of reports with predominantly positive emotions by over a 2-to-1 margin, 28.1% as compared to 12.5% (Sikka, Feilhauer, Valli, & Revonsuo, 2017, p. 374, table 1). If these percentages are expressed as a ratio (2.2), then that ratio is similar to the ratio based on a comparison of the percentage of negative emotions to the percentages of positive emotions in the combined HVdC normative sample (2.9). However, it should be emphasized that this comparison provides only a general idea of the degree to which the two sets of findings are similar. The HVdC ratio is higher, and is based on the total number of emotion elements, not the percentage

of dream reports with predominantly negative or predominantly positive emotions.

Studies of Emotions Using Rating Scales

Studies of emotions during the first 30 years of dream research relied on quantitative content analyses by independent coders. Since the 1990s, however, most of the studies of emotions have made use of rating scales. The participants, and often independent raters as well, are asked to indicate the presence or absence of emotions in each dream report and the degree to which the emotions in a dream report are negative or positive. The results from self-ratings by each participant in these studies are often very different from the HVdC normative findings. However, the results from ratings by independent raters are sometimes very similar to the HVdC norms on the percentage of dream reports with at least one emotion. When the findings concerning negative and positive emotions are expressed in terms of ratios, the findings by independent raters are often more similar than different in comparisons with the HVdC norms. Although the studies using rating systems also included findings on intensity, the focus in this chapter, as also mentioned in the introduction, is on the presence or absence of emotions and on the degree to which the emotions are reported to be negative or positive. (Generally speaking, however, the emotions in dream reports are not usually rated as intense.)

The first large-scale study of emotions in dream reports using ratings by both the participants and independent raters was carried out by the aforementioned dream researchers at the Central Institute of Mental Health in Mannheim (Schredl & Doll, 1998). The first author of the original study and a new coauthor then carried out a second study almost two decades later, which reported similar results (Röver & Schredl, 2017). In these studies, based on nonlab dream reports, the participants and independent raters were instructed to rate each dream report for the degree to which emotions were present on a 4-point rating scale: (0 = none, 1 = mild, 2 = moderate, and 3 = strong). Using a similar rating scale, participants and independent raters assessed the degree to which any emotions in a dream report were negative, and then, on a separate page, they rated the degree to which they were positive (Röver & Schredl, 2017, p. 66; Schredl & Doll, 1998, p. 638). Both the participants and the independent raters were asked to include any

"implicit" emotions and moods in their ratings as well (Schredl & Doll, 1998, p. 638).

The 964 self-ratings by the 293 participants, 190 women and 73 men, led to the finding that 92.7% of the dream reports contained at least one emotion. Ratings by two independent raters, based on one dream report from each of 180 participants, led to the conclusion that 85.6% of the dream reports contained at least one emotion (Schredl & Doll, 1998, p. 640, table 1). The 180 dream reports rated by the two independent raters are the same 180 dream reports they coded with HVdC categories, the results of which were discussed above. Readers may recall that the two researchers' HVdC findings led to the conclusion that only 39.4% of these dream reports included an emotion, which is a difference of 46.2 percentage points between the codings and the ratings by the same two researchers. Readers also may recall that the two researchers' findings with the HVdC coding categories are very similar to the HVdC combined norms for nonlab dream reports, 41.7%.

Ignoring here the 8.3–11.9% of the dream reports in this study that had balanced emotions, the participants rated 42.6% of the dream reports as predominantly negative and 38.2% as predominantly positive. When these two percentages are translated into a predominantly negative/predominantly positive ratio, it leads to a ratio of 1.1. Following the same procedures for the independent raters, the predominantly negative/positive percentage is 56.7%/20.6%, a ratio of 2.8, which is more than double the ratio for ratings by participants. By way of further comparison, the same ratio was 2.5 for the two researchers' HVdC findings in their study, so the independent ratings and codings led to very similar negativity/positivity ratios (Schredl & Doll, 1998, p. 640, table 1). The differences between the ratings by the participants and the two independent raters concern two issues. The participants found a higher percentage of dream reports with emotions than did the independent raters, and they also made higher estimations of the percentage of predominantly positive emotions in the dream reports.

The researchers therefore concluded that there is an "inconsistency" between self-ratings and independent codings or rating by independent raters, which they think "is best explained by the underestimation of emotions by external raters in general but particularly by the strong underestimation of positive emotions and the low rate of explicitly mentioned positive emotions in a dream report" (Schredl & Doll, 1998, pp. 642–643). However, it may be that the wake-state bias, as heightened by instructions

to include implicit emotions, could be the main factor. The tendency toward a wake-state bias also may be increased by the absence of emotions in many situations in dreams that would include emotions in waking life, as evidenced by the finding that emotions were absent in such situations in 17% of dream reports (Foulkes et al., 1988).

The second study, based on 413 participants, 350 women and 63 men, who contributed 1,207 diary dreams, presented similar results. According to the participants, 95.3% of their dream reports included an emotion, whereas the one independent rater in this study reported 82.5% had an emotion. For the participants, the predominantly negative/predominantly positive findings were 44.4% vs. 34.7%, a ratio of 1.7. The independent rater in this study saw things differently: 53.9% of the dream reports contained predominantly negative emotions, as compared to 18.3% containing predominantly positive emotions. This comparison can be expressed as a ratio of 3.8. Once again, an independent rater differed considerably from the participants, which led to an even higher negativity/positivity ratio than provided by the HVdC combined normative figure of 2.9. The researchers conclude that "external judges underestimate emotional intensity in general but especially for positive emotions" (Röver & Schredl, 2017, p. 68).

Very clearly, participants and independent raters agree in these two studies that far more dream reports contain emotions than was found in studies based on coding categories. However, participants and independent raters disagree in both the 1998 and 2017 studies on the degree to which negative emotions predominate. At the same time, the estimates of the degree of negative predominance by the independent raters are similar to those that result from HVdC normative findings based on coding categories. The researchers once again explain this difference in terms of underestimations of both the frequency and positivity of emotions by independent raters (Röver & Schredl, 2017, p. 68). The possibility that self-ratings may be problematic is not addressed. (There is a further discussion of self-ratings as compared to independent codings in the next section of this chapter.)

A series of three studies at the University of Turku in Finland, building on a database created by an academic research psychologist, Pilleriin Sikka, and her coworkers, examined the frequency and the negativity/positivity of emotions in lab and nonlab dream reports (see Sikka, 2020, p. 76, table 9, for a useful summary of all the results that are expressed in percentages; see also Sikka, Revonsuo, Sandman, Tuominen, & Valli, 2018; Sikka,

Valli, Virta, & Revonsuo, 2014; Sikka et al., 2017). Both the participants and the two independent raters assessed the dream reports for the presence or absence of any emotions on a 5-point scale, which ranged from (0) "I did not experience any of these feelings at all" to "I experienced these feelings" (1) a little bit; (2) moderately; (3) quite a bit; (4) extremely. The participants were asked to rate the dream they just had experienced, not the dream report itself. The researchers therefore stress that participants may be drawing upon both their memory of the experience, including mood states, as well as the report they had made. In the case of the independent raters, they were relying exclusively on the transcriptions of the spoken dream reports. The participants and independent raters were instructed to focus on explicitly expressed emotions in making their ratings. They were aided by a list of 10 positive and 10 negative emotions. Three examples were also provided for each emotion.

Due to the fact that the two independent raters worked from lists of 10 positive and 10 negative emotions, made frequency counts, met to resolve differences, and reported reliability scores on the basis of the percentage of perfect agreement method, they were essentially doing a coding study. As stated in a summary of this work, within the context of a full review of the literature on emotions in dreams: "In dream research, external ratings—or third-person ratings—have been the traditional method for measuring dream affect. With this method, narrative (written or oral) dream reports are collected and content analyzed by 'blind' external judges, using a particular scale" (Sikka, 2020, p. 40). Based on this explanation, the independent raters in these studies will be called "rater/coders" in the remainder of this chapter.

Generally speaking, there were dramatic differences between the results derived from the participants' self-ratings and the codings by the independent rater/coders. In addition, as shown below, the results for the two independent rater/coders are much closer to the HVdC normative findings than they are to the findings by the participants. For purposes of this comparison, the presence or absence of emotions in the three studies is expressed in the same terms as in the HVdC normative study, which means the percentage of dream reports with at least one emotion. In discussing the percentage of dream reports rated as having predominantly negative or predominantly positive emotions, the comparisons are made with the HVdC normative findings for the percentage of dream reports with at least one instance of fear, anger, or sadness, as well as the percentage for dream reports with at

least one instance of Happiness/Joy. The FAS% is sometimes employed as well, which readers may recall is determined by dividing the total number of Fear/Anger/Sadness codings by the total number of emotions codings (fear, anger, sadness, and happiness). Finally, this analysis ignores the small percentage of dream reports rated as balanced on the positive and negative nature of the emotions they contained, as well as the even smaller percentage of dream reports for which a rating could not be made. Combined, these percentages vary between 5.0% and 9.8% for participants and independent rater/coders in all three studies (Sikka, 2020, p. 76, table 9).

The first study focused on 115 lab dream reports provided by 17 participants, 10 women and seven men (Sikka et al., 2014, pp. 54–55). The participants found that 100% of their dreams included an emotion, compared to 28.7% for the independent rater/coders. The comparable percentage for the presence of at least one emotion in the HVdC combined norms, 41.7%, is far closer to the findings by the independent rater/coders than it is to the findings provided by the participants. The participants rated only 9.6% of their dreams as containing predominantly negative emotions, compared to 79.1% with predominantly positive emotions. The two independent rater/coders concluded that 11.3% contained predominantly negative emotions, compared to 9.6% with predominantly positive emotions. This is a large disagreement in that the independent rater/coders found more negatively toned dream reports as well as far fewer dream reports with either predominantly negative or predominantly positive emotions (Sikka et al., 2014, pp. 56–57).

The second study focused on 552 nonlab dream reports provided by 44 participants, 28 women and 16 men. It reported that the participants and the two independent rater/coders found very different percentages for at least one emotion, 97.5% compared to 47.8%. The rater/coders' at least one emotion percentage is close to the HVdC normative percentage, 41.7%. In terms of the percentage of dream reports with predominantly negative emotions and predominantly positive emotions, the participants' parentages of 35.3%/55.8%, is the opposite of what the two rater/coders concluded, 28.1%/12.5%. The independent rater/coders' ratio of negative to positive, 2.2, is not much lower than the comparable HVdC ratio for the combined norms, 2.9 (Sikka et al., 2017, p. 367).

In the third study, which has many parallels with the Miami lab/nonlab study discussed above, the researchers focused on ratings by two independent rater/coders, who once again worked independently and then met to

resolve most of their few disagreements (Sikka et al., 2018). This study is based on 151 nonlab dream reports and 120 lab reports from REM awakenings, which came from the same 11 women and seven men. Less than half of the dream reports from either setting contained one or more emotions: 29.3% in the lab dream reports, 45.4% in the nonlab dreams. In the Miami lab/nonlab study, which included only men as participants, the figure was only slightly lower in the lab dream reports, 24.0%. In comparison to the University of Turku nonlab dream reports, however, the Miami nonlab results were lower, at 33.0%. In the case of the combined HVdC norms for women and men, based on nonlab dream reports, the figure for dream reports with at least one emoton, 41.7%, is very close to the aforementioned percentage in the University of Turku study (45.4%).

Similarly, the University of Turku researchers found that predominantly negative dream reports were more frequent than predominantly positive dream reports: 36.7%/2.5% in the nonlab dream reports and 12.6%/8.4% in the lab dream reports. These two percentages lead to ratios of 14.7 and 1.5. In the Miami lab/nonlab study, 21.0% of the lab reports had at least one negative emotion and 4.8% had at least one positive emotion, a ratio of 4.4. The Miami nonlab reports had a negativity ratio of 3.7 and the ratio for the HVdC combined sample of nonlab dream reports was 2.9. Although those ratios vary, they uniformly show a negativity bias in the emotions in dream reports.

The three studies carried out at the University of Turku are the largest and most detailed studies of emotions in dream reports, collected both inside *and* outside of a laboratory setting from the same participants, since the HVdC normative study and the Miami lab/nonlab study in the 1960s. The University of Turku studies and the HVdC studies were undertaken five decades apart, took place in two different Western countries, and used different coding categories. Nevertheless, the similarities in their results are remarkable when the coding is carried out by independent rater/coders, who were using defined categories to study written reports. Based on the well-controlled nature of the University of Turku studies and the similarity of the results with coding studies, it is likely that the results are highly credible.

A Comparison of Coding Systems and Rating Systems for Emotions

As the results above show, coding systems and rating systems for emotions often lead to different results. These differences are in part due to the

different levels of measurement on which they are based. However, there may be other issues involved as well, such as a wake-state bias, which may be even stronger in an analysis of emotions.

Coding systems are based on the categorical (nominal) level of measurement. They involve yes/no, present/absent, and other types of categorical judgments. Rating systems are based on rankings that involve judgments as to the degree to which a person, place, or object possesses certain qualities. Coding systems usually take longer to create and always take longer to learn and longer to apply to large datasets, but they usually have high reliability (e.g., Krippendorff, 2004; Charles Smith, 2000). Rating systems are readily created, although they often have to be fine-tuned. They are easy to learn and do not take as much time to use with large datasets. However, rating the different degrees of the intensity of emotions or of the positivity or negativity in the emotions in a dream report is a far more difficult and subjective judgment than may at first seem to be the case. Individual differences among raters on such judgments may lead to lower reliability scores, which may be part of the explanation for why the various rating systems created by dream researchers in the past were never used by researchers in other laboratories (see Winget & Kramer, 1979, for a discussion of the numerous rating scales from the first 25 years of systematic dream research, which were rarely used more than once or twice).

Coding systems make full use of the potential information available in a document, as seen in the case of the HVdC coding system, in which every emotion is categorized and tabulated, and used in a variety of indicators. Rating systems, by contrast, do not make detailed use of the information available, and the outcome variables are more limited in number. This is because the "unit of analysis" in the HVdC coding system is the elements in the dream content. In rating systems, the unit of analysis is the whole dream report (see Domhoff, 2003, pp. 58–60, 75–76; Hall, 1969a; and Van de Castle, 1969, for discussions and critiques of specific rating scales once used in dream research).

In terms of the coding and rating systems for emotions discussed in this chapter, the results from the use of coding systems are more similar than they are different on the frequency and negativity of emotions (McCarley & Hoffman, 1981; Snyder, 1970). This result may be especially impressive because the similar results include a study based on a German translation of the HVdC coding system, which was used with impressively high reliability

rates, "ranging from 93.4% to 98.3" (Schredl & Doll, 1998, p. 40). Moreover, the findings based on the participants' self-ratings are extremely different from the results produced by the independent raters in the same studies (Röver & Schredl, 2017; Schredl & Doll, 1998; Sikka et al., 2014, 2017).

Nor do the very high percentages of dream reports said to contain positive emotions seem credible in the face of the findings by independent raters and by those using coding systems. The laboratory study reporting that 17% of dream reports do not include emotions in situations that would elicit emotions in waking life suggests that a wake-state bias may account for this large difference (Foulkes et al., 1988). Similarly, the high percentage of positive emotions claimed by self-raters does not fit with the findings by independent raters and coders. Nor does the preponderance of positive emotions fit with the fact that there are more aggressions, misfortunes, and failures in the HVdC normative sample than there are friendly acts, good fortunes, and successes. It is highly unlikely that the relatively fewer friendly acts, good fortunes, and successes would lead to positive emotions, but the larger number of aggressions, misfortunes, and failures would not lead to higher percentages of negative emotions.

For several reasons, then, it is very doubtful that self-ratings by participants can contribute to dream research. The evidence suggests that they provide vast overestimations on both the frequency and positivity of emotions in dream reports, not underestimations. Self-raters appear to be subject to all of the factors that can create confounds in systematic studies during waking, starting with people's self-conceptions and including social desirability factors and expectancy effects. In addition, self-ratings are very likely to be inflated by the instructions to include implicit emotions and by the expectation that there must have been emotions because the same situation would almost certainly include emotions during waking life. As shown when the chapter turns to neurocognitive studies of emotions, the current best conclusion is that the neural substrates that support dreaming are not sufficient to support the frequent appearances of emotion found by dream researchers who make use of self-ratings for emotions. It is also likely that the negativity bias is present during dreaming as well as in waking thought.

However, it should be noted that one group of neurocognitive researchers apparently disagrees with the work on the negativity bias in waking thought and with the findings on the relative lack of emotions in dream

reports, which are based on codings by independent investigators using established coding categories. Instead, they conclude that most self-generated thought is positive or neutral and claim that "*at least* 70–75% of dreams from REM sleep contain emotion" (Fox, Andrews-Hanna, et al., 2018, p. 39; emphasis in the original). They make their claims about the frequency of emotions in dream reports in fair measure on the basis of the studies in which participants carry out self-ratings of their own dream reports and on the basis of the contested claim that the HVdC coding system underestimates the frequency of emotions in dream reports (Schredl, 2010; Schredl & Doll, 1998).

The Frequency of Emotions in Adult Dream Series

The conclusion that half or more of dream reports do not include any emotions and that the FAS% is usually around 75%, based on large group samples of lab and nonlab dream reports, can be examined from another angle by studies of individual differences in dream series, using HVdC coding categories. (As far as can be determined, there are no peer-reviewed studies of dream series that make use of self-ratings for emotions.) The most comprehensive study of emotions in a dream series is based on the sample of 250 dream reports drawn from the Barb Sanders series, as discussed in chapter 4: 44.8% of the dream reports did not include at least one emotion, which is not very different from that for women in the normative sample, 49.7%. The FAS% (84.1%) is also in the same range as earlier findings in lab and nonlab samples. The findings with the Barb Sanders series are supplemented by results from a sample of 100 dream reports, drawn from a dream series documented by "Emma" between the ages of 40 and 77. Fully 67.0% of the dream reports in the sample did not include at least one emotion, and there was a relatively low FAS% of 62.5% (see Domhoff, 2003, pp. 103–105, for findings from samples drawn from the 1,221 dream reports in this series).

Two of the dream series discussed in chapter 4, those from the Natural Scientist and Ed, also provide useful information on emotions in dream series. Only 20.9% of the Natural Scientist's dream reports contained at least one emotion, so 79.1% were without emotion. This finding fits with his description of his dream reports as "emotionless," as mentioned in chapter 4. On the other hand, emotions were present in all but 28.7% of Ed's 143 dream reports, which were highly emotional when he had a social

Table 8.3
Frequency of emotions in four individual dream series and the Hall/Van de Castle norms

	HVdC female norms	Barb Sanders ($n=250$)	Emma ($n=100$)	HVdC male norms	Natural Scientist ($n=187$)	Ed ($n=143$)
Percentage of dreams with NO emotions	49.7	44.8	67.0	66.8	79.1	28.7
Percentage of dreams with at least one:						
Positive emotion	13.8	11.2	15.0	9.2	6.4	32.2
Negative emotion (F/A/S)	40.9	49.6	20.0	26.4	16.0	51.0
Any emotion	50.3	55.2	33.0	33.2	20.9	71.3
Fear/Anger/Sadness Percent	75.9	84.1	62.5	75.1	72.7	65.1

interaction with his deceased wife. However, both men experienced a high percentage of negative emotions. The FAS% is 72.7% in the case of the Natural Scientist and a somewhat lower 65.1% in the case of Ed, who frequently experienced Happiness/Joy when he saw his wife in his dreams. The complete findings on emotions in the four dream series that are discussed in this and the previous paragraph appear in summary form in table 8.3, which also includes the HVdC normative figures for women and men so that readers can examine individual differences more readily. The main conclusion is that there are wide individual differences, which is an example of why it is necessary to have large sample sizes drawn from nonpatient populations in order to develop a foundational theory of dreaming.

Emotions in Dream Reports from Children and Adolescents

The longitudinal studies of children and adolescents discussed in chapters 6 and 7 revealed dreaming to be a gradual cognitive achievement in terms of frequency, complexity, and content (Foulkes, 1982). Here it can be added that only a very small percentage of the dream reports from children contained an emotion, and the figures are well below the adult level in young adolescents' dream reports. Once again, as in the case of studies of dream series, no studies of emotions in children and adolescents' dream reports make use of self-ratings.

At ages 3–5, only 8% of the dream reports had any "feelings," the term the researcher used for discussing fear/apprehension, anger, sadness, and happiness, as well as feelings of hunger and fatigue. Most of the instances of feeling at this early age involve hunger or fatigue, along with a few mentions of happiness and sadness. There were no instances of apprehension or anger (Foulkes, 1982, p. 331, table B.1). At ages 5–7 there were still few emotions. The majority of them were positive, although two of the 64 reports had fear content (Foulkes, 1982, pp. 50, 86). Generally speaking, the percentage of dream reports with at least one emotion increases in each age period for both girls and boys, although the figures decline in the girls' dream reports from a high point of 50% at 9–11 to 42% at ages 11–13 and 40% at ages 13–15. At every age, the girls had a higher percentage of dream reports with at least one emotion than did the boys. The percentage of dream reports with one of the three negative emotions gradually increases for both genders, but the percentage of dream reports with happiness still remains higher (Foulkes, 1982, pp. 337, 345, tables B.2 and B.3). Looking at his findings as a whole, Foulkes concludes that "feeling itself is a cognitive achievement" (Foulkes, 1982, p. 55).

Even lower figures were found in the REM dream reports from lab awakenings in the Zurich replication and extension longitudinal study of 12 girls and 12 boys, which was based on the five-year period from ages 9–11 to 13–15. In the first year, only 8.8% of the girls' dream reports included emotions in any of the five original HVdC emotions categories, which at that time included the Confusion category. The figure for boys was 11.6%. After that first year in the lab, however, the girls had more dream reports with at least one emotion than did the boys (15.0% vs. 11.8% at 11–13, a difference of 3.2 percentage points, and 21.3% vs 14.1% at 13–15, a difference of 7.2 percentage points). The figures at ages 13–15 are well below the findings for the adult Swiss control group, 62.0% for women and 29.3% for men (Strauch, 2005, p. 161, table 4). The emotions findings in this study were not discussed in terms of specific emotions categories. However, in the researcher's book-length presentation of her findings, she reported in a table and in a figure that the emotions were more positive than negative in all three phases of the study (Strauch, 2004, p. 161, tabelle 9-5; p. 177, abbildung 10-4).

The findings on emotions using the two-week dream diaries provided by the Bay Area Girls are similar to those in the two laboratory studies in

that only a small minority of dream reports (20%) contained at least one emotion. However, unlike the Zurich longitudinal study, which included both lab and nonlab dream reports, negative emotions predominated in this study. The FAS% was 80%. The finding on emotions at ages 14–15 in Bea's dream series supplement the picture. Based on the 139 dream reports in her series with 50 or more words, 56% of the dream reports contained at least one emotion. Her FAS% was 89%, which is higher than the 75.9% normative figure for women in the HVdC normative findings. As a very mature teenager, as discussed in chapter 7, she is both on the cusp of adulthood and a person who frequently experiences emotions.

To summarize, the frequency of emotions in dream reports is lower for children and adolescents than it is for adults. Once again, however, there are individual differences, as best shown in the case of Bea's dream series.

The Steps Leading to a Neurocognitive Theory of Emotions in Dream Reports

On the basis of the overall results concerning emotions in dream reports from childhood to adulthood, this section sets the stage for suggesting the neurocognitive theory of dreaming can explain the relative infrequency of emotions in dreams through the concept of cognitive insufficiency. Since this claim does not fit well with many traditional assumptions about emotions, it may be useful to briefly trace the scientific steps that led to the relatively recent neurocognitive explanation for waking emotions as cognitive categories. The first one-third of the section relies on psychologist Joseph LeDoux's neuroscience work on the "survival circuits" in mammalian brains, which he originally named a "threat-detection" system. The section makes even more use of his conclusions concerning the basis for emotions in humans (e.g., LeDoux, 2003, 2012, 2015, 2019, 2021). The middle third of the section makes use of the pathbreaking neuroimaging work on emotions by psychologist Lisa Feldman Barrett and her several coworkers (e.g., L. F. Barrett, 2017; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012; E. Siegel, Sands, Chang, & Barrett, 2018; Touroutoglou, Lindquist, Dickerson, & Barrett, 2015). In combination, the work of these two pioneers in the neurocognitive study of emotions provides an ideal context for incorporating emotions into a neurocognitive theory of dreaming, which is the focus of the final third of this section.

From Darwin to the Prefrontal Cortex

Due to Charles Darwin's (1872/1998) highly influential emphasis on the similarities in the emotions of humans and most other mammals in the face of threats and other high-wariness situations, some early brain researchers attempted to develop what they saw as a Darwinian analysis of brain evolution. They organized their observations on brain differences among mammalian species as a "layering of new structures in the forebrain" on top of the earlier reptilian brain. They therefore focused on a seemingly new feature in mammalian brains, the amygdala, which was seen as the seat of emotions (LeDoux, 2019, pp. 183, 185). Since a larger forebrain is a key feature of later species of mammals, the evolution of the brain purportedly led inexorably to a "neocortex" on top of a "paleocortex" (see LeDoux, 2019, chap. 38, for a historical account).

This "ladder" view of the brain, which in fact does not fit well with Darwin's metaphor of a branching tree as a good way to view evolutionary change, was updated in the 1950s by a psychiatrist concerned with brain evolution in relation to emotions. He did his update on the basis of his work on high blood pressure, stomach ulcers, and other putative "psychosomatic" conditions (LeDoux, 2019, chap. 39). He proposed that each part of the "triune brain," as he renamed it, had a different function. The reptilian level is responsible for instinctive reactions, such as aggression and dominance, and the paleocortex (renamed the "limbic region") is responsible for the appearance of emotions in mammals and is the basis for "unconscious emotion" (LeDoux, 2019, p. 188). At the top level, the neocortex was said to be responsible for thinking, planning, and deciding, but it purportedly had relatively little control of the instinctive and emotional layers of the brain. Psychosomatic problems were claimed to be one result, with higher mental states "somehow disrupting" the "regulation of body physiology" (LeDoux, 2019, p. 188).

This model gained widespread acceptance, but it was directly challenged in the early 1960s by two cognitively oriented research psychologists (Schachter & Singer, 1962). As succinctly summarized by LeDoux, these two early cognitive theorists of emotions said that emotions are "constructed by the appraisal, interpretation, and labeling of biological, including neural, signals in light of the social and physical context of the particular experience," and other cognitively oriented researchers gradually provided increasing evidence for this analysis (see LeDoux, 2019, p. 351, for this quotation and

for a list of 20 of the many cognitively oriented psychologists who helped develop the cognitive view of emotions). In particular, this cognitive orientation was strengthened by the new understanding of categorization introduced into psychology in the 1970s, as discussed in chapter 2 (Barsalou, 1982, 2003, 2009; Rosch, 1973; Rosch & Mervis, 1975; Rosch et al., 1976).

Moreover, all aspects of the triune brain theory had been proven to be wrong by the late 1970s. This refutation started with the discovery that the brains of reptiles and birds did in fact share homologous features with early mammals. In addition, reptiles have an amygdala, which leads to the conclusion that the differences among vertebrate animal brains are "mainly one of degree, rather than in kind" (LeDoux, 2019, p. 186). Then, too, areas in the "limbic system" also "contribute in significant ways to cognitive functions like memory and attention, and neocortical areas contribute extensively to felt emotional experiences" (LeDoux, 2019, p. 191). These studies discovered that the concept of a "limbic system," as it later came to be called, was not accurate. Nevertheless, the idea that the brain is "an onion with a tiny reptile inside," is still "widely shared in introductory psychology textbooks," even though this belief "has long been discredited among neurobiologists" (Cesario, Johnson, & Eisthen, 2020, p. 255).

In addition to rejecting the model of a triune brain, LeDoux (2019, p. 364) concluded there are four reasons for doubting that the activation of the amygdala is "the defining condition for the conscious experience of fear." To begin with, the activation of the amygdala cannot be solely equated with fear because many other circuits include at least portions of the amygdala, such as the search for food, drink, and sexual partners. And, as shown in one neuroimaging study, parts of the amygdala also are included in a perception network that detects and interprets social signals from other people. Other parts of the amygdala are active in the neural substrate underlying an affiliation network, which promotes prosocial behavior, empathy, and concern for others (Bickart, Dickerson, & Barrett, 2014, p. 238). Nor does fear invariably occur when the threat-detection system is activated. On the other hand, fear can be experienced when the amygdala is damaged, as shown in a study that induced experiences of fear through the inhalation of 35% CO_2 by three participants, all of whom had rare lateral amygdala lesions (Feinstein et al., 2013). Then, too, other survival circuits can generate fear experiences caused by dehydration, hypothermia, and fear of death from starvation.

Drawing on his experimental work in tracing the survival circuits, LeDoux (2019, p. 359) concluded that several areas in the prefrontal cortex, including the dorsolateral and ventrolateral prefrontal cortices, are necessary for the conscious experience of emotions. The focus on the prefrontal cortex, when combined with the evidence that the amygdala is not necessary or sufficient to experience fear, led LeDoux (1991, 2003, 2012) to abandon the concept of a limbic system. His emphasis on the primary importance of the prefrontal cortex is supported by an integrative analysis of emotions, based largely on neuroimaging studies (Dixon, Thiruchselvam, et al., 2017).

LeDoux also expressed skepticism about the assumption that subjective feelings can be inferred on the basis of similarities of behavior. Since the neural substrates underlying human consciousness differ from those found in other animals, caution is necessary in assuming the subjectively experienced phenomena labeled as "emotions" are present in other animals on the basis of generally similar behavioral responses. According to this reasoning, it is not possible to "use behavioral similarity to argue for similarity of conscious feelings functionally," if "the circuits that give rise to conscious representations are different in two species" (LeDoux, 2012, p. 20). Emotions are "cognitive interpretations" of the "situations in which we find ourselves," and they are the "products of the same general cortical cognitive circuits that generate other kinds of conscious experience" (LeDoux, 2019, pp. 350, 351, 359).

This conclusion is strengthened by two separate studies, both of which demonstrated it is inaccurate to assume that the activation of the amygdala leads to the subjective experience of emotion. In the first of these two studies, 11 epilepsy patients received electrical brain stimulation by means of electrodes implanted in the amygdala. It found that declarative memory for specific images of neutral objects was improved without eliciting a "subjective emotional response," which led the researchers to conclude their findings demonstrate "that the amygdala can initiate endogenous memory prioritization processes in the absence of emotional input" (Inman et al., 2018, p. 98). The second study was based on 15 young adult women and 16 young adult men who were shown hundreds of images of commonly feared animals, animals not feared, and human-constructed objects while undergoing functional magnetic resonance imaging (fMRI) scanning. The researchers found that "subjective fear and objective physiological responses" are correlated in general but that "the amygdala and insula

appear to be primarily involved in the prediction of physiological reactivity, whereas some regions previously associated with metacognition and conscious perception, including some areas in the prefrontal cortex, appear to be primarily predictive of the subjective experience of fear" (Taschereau-Dumouchel, Kawato, & Lau, 2020, p. 2342). In particular, the researchers suggest "regions of the middle frontal gyrus, dorsomedial prefrontal cortex, and lateral orbital cortex were more closely related to the subjective reports of fear" (Taschereau-Dumouchel et al., 2020, p. 2349). They therefore conclude there is reason to doubt "a one-to-one mapping between subjective sufferings and their putative biosignals, despite the clear advantages in the latter's being objectively and continuously measurable in physiological terms" (Taschereau-Dumouchel et al., 2020, p. 2342).

Based on LeDoux's past findings and more recent studies, it is by now well established that the concept of a triune brain is outmoded and that the amygdala is neither necessary nor sufficient for consciously experiencing emotions. However, it is also known there is a limbic network with nodes in the prefrontal cortex, as well as in subcortical regions, which is often involved in emotions (e.g., Fox et al., 2018; Yeo et al., 2011, p. 1135, fig. 11). As noted in chapter 2, this fifth and final association network includes the orbitofrontal cortex, insula, medial prefrontal cortex, anterior cingulate cortex, and the temporal pole at the cortical level, as well as portions of the amygdala and other subcortical regions. As shown by neuroimaging studies discussed in the next subsection, the amygdala node in this network is therefore involved in emotion, as well as in supporting memory, reward, and empathy (Bickart et al., 2014; Inman et al., 2018).

Neuroimaging Studies of Emotions during Waking

Neuroimaging studies of waking emotion states by a group of cognitively oriented emotion researchers fit well with the emphasis on prefrontal cortical areas as necessary to the experiencing of emotions (L. F. Barrett, 2013, 2017; Bickart et al., 2014; Lindquist, Satpute, Wager, Weber, & Barrett, 2016; Lindquist et al., 2012; Polner-Clark, Wager, Satpute, & Barrett, 2016; Raz, Touroutoglou, Atzil, & Barrett, 2016; E. Siegel et al., 2018; Touroutoglou et al., 2015). Based on four separate meta-analyses, their studies focus on fear, anger, sadness, disgust, and happiness. They begin with the autonomic nervous system and move "up" to hedonic tone (emotional valence), activated brain regions, and the role of the five association networks, as well as other

neural networks. This series of studies led to the conclusion that interactions among the five association networks are necessary for the conscious experience called "emotion."

Starting at a basic neurophysiological level, the autonomic nervous system, neuroimaging research consistently shows different emotions do not have separate neural substrates. Most of the autonomic nervous system variables are generally involved in all five of the emotion states that were studied. There is some variation in their roles within each emotion category as well, as shown in a meta-analysis of 202 relevant studies of induced emotions in representative samples of adults (E. Siegel et al., 2018). It was further discovered, based on a second meta-analytic study that included 397 neuroimaging studies, that there is no evidence of a neural substrate underlying a positive-negative (hedonic tone) dimension in the brain. The existence of such a dimension was assumed in the past on the basis of "hundreds of studies of semantics, self-reports of experience, and emotions perceptions in faces and vocal acoustics." Nor is there evidence for an alternative hypothesis on hedonic tone, which claims that positivity and negativity are independent dimensions (Lindquist et al., 2016; see Polner-Clark et al., 2016, p. 147, for a summary statement on their findings).

Instead, a wide range of brain regions are involved in shaping hedonic tone, which is also called "valence of expression" in these studies. This result suggests the same brain regions are involved in both positive and negative hedonic states. Some of these regions are not usually associated with valence or emotions. In particular, two neural substrates mentioned frequently throughout this book, the dorsal medial prefrontal cortex and the ventral medial prefrontal cortex, are involved in the valence of expression during the waking state. This new finding casts doubt on the idea that every mental state has a hedonic tone. In addition, it is consistent with the conclusion, based on neurological findings, that pleasure and pain are not emotions: "While pleasure and pain are often treated as emotions, they are actually different" (LeDoux, 2019, p. 218). Pleasure and pain "are tied to sensory receptors that detect particular kinds of stimuli," but there are "no sensory receptors for fear, anger, sadness, joy, or other emotions—the content is determined by the brain" (LeDoux, 2019, p. 217).

Still another meta-analytic study by the neuroimaging group of emotion researchers provided important new evidence on another longstanding issue. It showed that a variety of brain regions, primarily in the prefrontal

cortex but also in regions in the amygdala, are involved in the experiencing of fear, anger, sadness, disgust, and happiness, and that the same brain regions are often involved in supporting nonemotional cognitions as well (Lindquist et al., 2012). However, the various brain regions are activated to varying degrees in the five different emotions that were induced (Lindquist et al., 2012, p. 132). These findings therefore provide an unexpected negative answer to what is "perhaps the question that has garnered the most interest in the science of emotion." Does each emotion category have a "specific, dedicated neural circuitry in the brain?" (Polner-Clark et al., 2016, p. 152).

Studies of the degree of involvement of the five association networks in the five emotions states provided the fourth and final step in this series of studies. It revealed that the frontoparietal, dorsal attention, salience/ventral, default, and limbic networks, along with the subcortical basal ganglia nuclei, are common to these emotion states. The researchers stress that emotions are therefore very similar to "other basic psychological functions" in this regard, such as attention, language, and memory (Touroutoglou et al., 2015, p. 1263). Very relevant in terms of the neurocognitive theory of dreaming, the salience portions of the salience/ventral network are involved in supporting all of the negative emotional states, and parts of the salience/ventral network are involved in supporting happiness as well (Touroutoglou et al., 2015, pp. 1257, 1261–1262). In the case of the default network, which is central to the neurocognitive theory of dreaming, it is similar to the salience/ventral network in that it is "routinely engaged across all categories of emotional experience, during typical and atypical instances of emotion, and in the representation of emotion concepts, as well as of concepts more generally" (Raz et al., 2016, p. 721).

Overall, these researchers conclude that their "emotion discovery maps reflected combinations of domain-general networks," which is "consistent with the hypothesis that different emotions arise from the interaction of domain-general systems within the brain" (Touroutoglou et al., 2015, p. 1262). Put another way, this study shows that emotion categories can be "distinguished by their profiles of relative activation across networks" (Polner-Clark et al., 2016, p. 155). The fear and anger categories, for example, show greater activation in the default, dorsal attention, and frontoparietal control networks, along with secondary visual areas. However, those areas were less activated when sadness, disgust, or happiness was induced.

Instead, sadness, disgust, and happiness share greater activation of the salience/ventral and sensorimotor networks (Polner-Clark et al., 2016, pp. 155–156).

In concluding this discussion, it is important to add that the conceptualization of emotion categories used by this research group is similar in its rationale to the one developed by cognitive psychologists (e.g., Barsalou, 2003; Rosch & Mervis, 1975). They conceive of emotion categories as a "statistical summary," which makes it possible to "identify the features of a prototypical chair, but no chair need have *all* those features to be a chair" (Polner-Clark et al., 2016, p. 155; emphasis in the original). Put another way, "each instance of the category has some set of features that are sufficient for category membership, but none of them are necessary for category membership" (Polner-Clark et al., 2016, p. 155).

Because this chapter attempts to link the recent neurocognitive findings on waking emotions to quantitative studies of dream content, it is also relevant to emphasize again that the four HVdC coding categories for emotions are based on a similar conceptualization of emotion categories in that they rest on a very general characterization of a category. To return to the example of fear/apprehension used earlier in the chapter, Hall and Van de Castle (1966, p. 111) state that the emotions in this category have "differences" that are "recognizable," but in all of them "the person feels apprehensive about the possibility of physical injury or punishment, or the possibility of social ridicule or rejection." Therefore, "the common denominator" is that "some potential danger exists," whether physical or psychological (Hall & Van de Castle, 1966, p. 111). It is also striking that all five emotions studied by the waking neurocognitive researchers—fear, anger, sadness, disgust, and happiness—are also included in the HVdC coding system for studying emotions in dream reports, although disgust is rare in dreams and is part of the Fear/Apprehension category.

Explaining the Infrequency of Emotions in Dreams through Neuroimaging Findings

Based on the waking neuroimaging findings, the task facing a neurocognitive theory of dreaming is to explain the quantitative findings on emotions in dream reports. Why are there no emotions in 59.3% of the 991 dream reports in the combined normative sample from 491 women and 500 men (as documented in table 8.1)? Why do 17% of dream reports in another

study include no emotions, even though there very likely would be emotions in similar situations in waking life? The foregoing meta-analyses of waking neuroimaging studies provide a basis for plausible answers to these questions. Due to the relative deactivation of four of the five association networks, the neural substrate underlying dreaming appears to be very limited in its ability to support emotion states.

This point is perhaps best demonstrated in a study mentioned in chapter 2, which analyzed 20 separate datasets, both individually and collectively, using a "combination of techniques" (Uitermarkt et al., 2020, pp. 1–3). Consistent with a meta-analysis (Fox et al., 2013), as well as the findings in the neuroimaging study of high and low recallers (Eichenlaub et al., 2014), the "REM-activation networks" involved regions within the default network, secondary visual cortices, and sensorimotor regions. On the other hand, the "REM-deactivation network" included regions within the frontoparietal control network as well as the frontal/right orbitofrontal cortices, the right anterior insula (which is a key substrate in suppressing the default network when need be during waking), and the right antero-ventral thalamus (Uitermarkt et al., 2020, p. 5 and supplementary table 3). (Readers may recall that the relative deactivation of these and other neural substrates during all stages of sleep is also presented in table 2.2 of this book.) These findings demonstrate that portions of the default network are activated at various times during sleep, but it is important to emphasize that it is insufficient for supporting the full range of waking cognitive capacities. More specifically for purposes of this discussion of the relative infrequency of emotions in dream reports, it is unlikely that the default network alone is able to support the full range of waking emotions.

The concept of cognitive insufficiency also may help account for the fact that young children and young adolescents dream even less often of emotions than do individuals over age 15. Several of their association networks, and in particular the default network, which is the only association network that has activated portions during dreaming, do not reaching adultlike-levels until ages 9–13. Young children do not have an autobiographical self until ages 5–7, and they do not reach full cognitive development in terms of imagination and narrative skills until the middle years of childhood and the early years of adolescence.

The neurocognitive theory of dreaming is also able to explain why the emotions in the dreams of adults are more negative than positive, as

measured by the FAS%. It does so by drawing upon the concept of a "negativity bias" in thinking, as already discussed in chapter 3 as evidence for the continuity between the personal concerns expressed in both waking thought and dreaming (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Norris, 2021; Rozin & Royman, 2001). Moreover, the negativity bias in the HVdC normative samples is higher for emotions in dream reports than it is for other "negative" elements (aggressions, misfortunes, and failures) when they are compared to the combination of "positive" elements in dream reports (friendly acts, good fortunes, and successes). Women's negativity ratio for emotions in dream reports is 2.97, compared to only 1.40 for the ratio that makes use of aggressions, misfortunes, and failures. For men, the negativity ratio for emotions is almost has high as it is for women, 2.87, as compared to 1.65 for the ratio that involves aggression, misfortunes, and failures.

This analysis can be made more comparable to the self-rating studies discussed earlier in the chapter, which analyzed the percentage of dream reports with predominantly negative and predominantly positive emotions. For women in the HVdC normative sample, 40.9% of their dream reports had at least one negative emotion, compared to only 13.3% with at least one positive emotion, a negativity ratio of 2.96. For men, 26.4% of their dream reports had at least one negative emotion, compared to 9.2% with at least one positive emotion, a negativity ratio of 2.87, which is very close to the negativity ratio for women.

In terms of adding a developmental dimension that might explain the higher portion of positive emotions in the dream reports of children and young adolescents within the confines of the concept of a negativity bias, one plausible hypothesis, based on the dream findings, suggests that the negativity bias develops gradually and is not fully developed until middle adolescence. The waking negativity bias emerges at ages 5 to 7 in children, at about the same time as the autobiographical self develops, but it is not known when it becomes as strong as it is in adulthood (Haux, Engelmann, Herrmann, & Tomasello, 2017). The developmental trajectory of the negativity bias aside, there are two other plausible hypotheses that may explain the higher proportion of positive to negative emotions at younger ages. Perhaps children and young adolescents do not have as many enduring negative personal concerns as older adolescents and adults, or perhaps they do not have the cognitive capacities to imagine and articulate enduring

personal concerns during dreaming. However, these possible explanations for the far lower FAS% in the dream reports of most individuals under the age 16–18 have yet to be tested.

The neurocognitive analysis of the infrequency of emotions during dreaming, whether in children or adults, may provide a plausible starting point for creating a translational model for understanding the strong and upsetting emotions experienced in nightmares, and in particular in the nightmares experienced by victims of PTSD. People who suffer from frightening nightmares, and especially those with PTSD, can be viewed as the victims of a cruel natural experiment in which sleep is flooded with greater activation in the attention and limbic networks. As briefly mentioned in chapter 2, the frightening dreams of those who report great suffering from their nightmares are correlated with the expansion of the neural substrates active during dreaming beyond their usual boundaries (see Levin & Nielsen, 2007, and Nielsen & Levin, 2007, for a somewhat similar neurocognitive view). Based on past EEG studies of nightmare sufferers and victims of PTSD, it is known that their brains are more activated during sleep (Germain, Jeffrey, Salvatore, Herringa, & Mammen, 2013; Marquis, Paquette, Blanchette-Carrière, Dumel, & Nielsen, 2017; Simor, Horváth, Ujma, Gombos, & Bodizs, 2013). This heightened activation in turn leads to atypical dream reports, with high levels of fear and anxiety (Robert & Zadra, 2014; Zadra & Donderi, 2000a; Zadra, Pilon, & Donderi, 2006).

As also briefly mentioned in chapter 2, a highly activated and vigilant brain in victims of PTSD, whether waking or sleeping, points directly to the salience/ventral network, which has been shown in the previous subsection to be active in the five emotion states that have been studied. This point is demonstrated in a waking fMRI study, which was based on 102 active-duty US Army soldiers, 50 who suffered from PTSD and 52 who did not. Each of them was studied during the resting state and in an experimental condition in which participant-specific script imagery was used to trigger the fear and anxiety that are hallmarks of PTSD. The salience/ventral networks of those who suffered from PTSD were more activated during the experimental condition than were those of the soldiers in the control group (Abdallah et al., 2019). The likely importance of an activated salience/ventral network as a source of nightmares during sleep is supported by EEG findings in an earlier study. Although this nighttime EEG study did not analyze the findings with regard to the salience/ventral network, it showed that the relevant brain

regions are as highly activated in both REM and NREM sleep in nightmare sufferers as they are during waking (Marquis et al., 2017).

Conclusions and Implications

Due to cultural beliefs and earlier scientific understandings of what dreams are like, the empirical findings on the infrequency of emotions in dream reports do not fit with most people's expectations. Nor does it seem feasible within this cultural context that the dreaming brain may not be able to support the experiencing of emotions, except in unusual circumstances. These expectations also may be in part based on the Darwinian-derived assumptions about the similarities in the emotional experiences of most mammals, including humans, which are consistent with the intuitive sense that emotional feelings, as humans see and experience them, are deeply rooted in human nature and often are not controllable.

In addition, the clinical theories of dreaming, which came out of psychoanalytically oriented psychotherapy, also continue to influence cultural and scientific assumptions about emotions. Moreover, all too many people have suffered from one or more frightening nightmares, whether during a physical illness, the transition to a new medication, or when under great stress, to conceive of nightmares as atypical. Then, too, as shown in chapters 9 and 10, emotions figure prominently in both of the traditional comprehensive theories of dreaming and in two adaptation theories.

However, in contrast to the widespread emphasis on emotions as central to dreaming, the neurocognitive theory of dreaming suggests the neural substrates that enable dreaming do not have the capacity to support the cognitive abilities necessary to experience emotions as often and as fully as they are experienced in relevant situations in waking life. Of the five association networks involved in creating the conscious experience of fear, anger, sadness, disgust, and happiness during waking, only portions of the default network are activated at various times during sleep. The frequent absence of emotions during dreaming, as most dramatically seen in situations in dreams that would have led to emotional experiences in waking life, can therefore be explained within the context of the neurocognitive theory of dreaming by the concept of cognitive insufficiency.

Nor are nightmares a prototypical example of the importance of emotions in dreaming. They are the exception. A focus on clinical symptoms

during times of illness, medication changes, or great stress once again leads away from the development of a foundational theory of dreaming. Instead, nightmares actually reveal the lack of sufficient support for emotions in everyday dreaming. Both EEG and fMRI studies of people who suffer from frequent nightmares demonstrate high levels of brain activation in brain areas that are not usually activated during sleep. Based on a waking neuroimaging study of heightened activity in the salience/ventral network when experiencing PTSD symptoms, it is likely that the salience/ventral network remains highly activated in the sleep of PTSD victims as well (Abdallah et al., 2019). Within the context of a foundational theory of dreaming, such as the neurocognitive theory of dreaming attempts to provide, the findings on the brain activation levels of those who suffer from nightmares provide a good starting point for developing a translational model of this atypical syndrome, with the dorsal attention, salience/ventral, and limbic networks as the primary focus of attention.