Dreaming

Automated Analysis of Dream Sentiment—The Royal Road to Dream Dynamics?

Calvin Kai-Ching Yu

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Calvin Kai-Ching Yu
Department of Counselling and Psychology, Hong Kong Shue Yan University

Valence Aware Dictionary for sEntiment Reasoning (VADER) is an automated software program for analyzing textual data based on an established lexicon and annotated lexical features. Support-vector machine (SVM) is a popular machine-learning model for solving classification problems. VADER and SVM can serve as potential alternatives to the conventional content analysis and Linguistic Inventory and Word Count analysis of dream emotions. The study presented here aimed to evaluate the overall affective valence of dreams using both the VADER and SVM methods. A total of 2,600 dreams primarily obtained from an open source—including dreams reported by American, German, Hong Kong, Peruvian, and Taiwanese people—were subjected to the 2 automated algorithms for sentiment analysis. The mean VADER and SVM sentiment scores indicate overall balanced sentiment in dream reports. Accordingly, an average dream report contains positive and negative emotions of similar intensity. Notwithstanding their different algorithms and methodological strategies, the marked consistency between the VADER and SVM scoring suggests that VADER and SVM can provide reliable, effective, yet distinct tools for dream sentiment analysis. In addition, the analysis of Chinese people's dreams suggests that the discrepancy between dream sentiment scored by automated algorithms and subjective feelings experienced by dreamers may reveal some dynamic processes during dreaming, such as working through concerns and desensitizing feelings.

Keywords: dream emotion, machine learning, sentiment analysis, support-vector machine, VADER

Copious evidence lends support to the notion that dreams are mostly unpleasant regardless of culture or race (Domhoff, 1996; Hall & Van de Castle, 1966; Merritt et al., 1994; Nielsen et al., 1991; Valli et al., 2005, 2008). This notion still holds true even when adopting the classification systems that equalize the numbers of positive and negative categories for dream coding, such as supplementing the Hall and Van de Castle system (HVC; 1966) with Bulkeley's (2006) Good Fortune Scale

(Hsu & Yu, 2016). The unbalanced categories of positive and negative emotions, therefore, cannot explain the preponderance of dream unpleasantness. Indeed, substantial discrepancies can be observed when comparing the scoring of diary dreams by external judges and by the dreamers themselves, particularly around the emotion categories (Fosse et al., 2001; Schredl & Doll, 1998; Sikka et al., 2014). Self-ratings often result in more emotions being reported because external raters can only code an explicitly expressed emotion. This is especially true for positive emotions, which tend to be missed out by external raters (Sikka et al., 2014).

Automated text analysis offers another option for studying dream content. This method is more objective in that its word-search process based on a predetermined lexicon is computerized and does not involve raters' subjective judgment. The Linguistic Inventory and Word Count (LIWC; Pennebaker et al., 2001, 2007, 2015) system, which has been used across many disciplines, is probably the most popular lexicon. Researchers (Barrett, 2020; Bulkeley & Graves, 2018; Hawkins & Boyd, 2017) have used the LIWC program to study dream narratives. They found either more positive emotions (Hawkins & Boyd, 2017) or similar frequencies of positive and negative emotions in normative dreams (Barrett, 2020; Bulkeley & Graves, 2018). Nevertheless, dreams collected during the COVID-19 pandemic exhibited more negative than positive emotions (Barrett, 2020).

In the HVC, emotions are coded only when the dreamer directly describes their affective states with words for emotions, such as *delighted*, *sad*, and *furious*. By the same token, LIWC categories of emotion words are explicit, such as *worried* and *nervous* for the anxiety category and *hate* and *annoyed* for the anger category. Moods or feelings about something can however be implied without explicitly depicting them. For instance, a sexual encounter with the adored one would be a joyful experience, but failing an examination would probably bring about the feeling of shame. Accordingly, the analysis of affective dream experiences does not necessarily rely merely on emotion words.

As Hutto and Gilbert (2014) pointed out, the LIWC and other lexicon-based software programs for text analysis ignore the sentiment intensity of words and some important lexical features, such as acronyms, emoticons, and slangs. In view of these common drawbacks of lexicon-based analysis, Hutto and Gilbert (2014) developed the Valence Aware Dictionary for sEntiment Reasoning (VADER) for fine-grained sentiment analysis. Specifically, they constructed the VADER with consideration of popular word-banks (e.g., LIWC), normative ratings of word valence (e.g., Affective Norms for English Words; Bradley & Lang, 1999), acronyms (e.g., LOL), emoticons (e.g., ☺), and slangs (e.g., giggly). According to Hutto and Gilbert, the accuracy rate of the VADER in classifying text sentiment surpasses that of human raters. In comparison with the LIWC, using the VADER to analyze dream content has two major advantages. First, in addition to a wordlist for affective processes, the VADER factors in lexical features, which modify valence or intensity of emotion words. Second, the VADER can yield a compound score for indicating sentiment intensity of a text. This compound score, which ranges between -1 (*extremely negative*) and 1 (*extremely positive*), is computed by aggregating and normalizing individual valence scores of all annotated words in a text.

It is important to note that the VADER is still a lexicon-based approach; it hinges on a fixed wordlist for emotions and discards those words outside the lexicon.

In other words, despite its wider coverage in comparison with the other lexicons, the VADER approach to text analysis is not exhaustive. Indeed, no preset lexicon can properly cover the multitude of words that carry affective connotations. To tackle the infinity of lexical expressions for emotions, the dream coder should learn from a sample list of target words and then go beyond the list to recognize other words with similar meanings. This can be done by machine learning. The support-vector machine (SVM; Boser et al., 1992; Cortes & Vapnik, 1995), also named support-vector network, is one of the most popular machine-learning algorithms for solving a classification problem. This supervised learning model draws on the critical data points of the training data (i.e., support vectors) to determine the maximal margin, based on which the optimal hyperplane is constructed for separating data into two categories. Similar to the VADER, a text-sentiment score can be calculated by averaging the sentiment scores for all words composing the text. SVM sentiment scores range from $-\infty$ to $+\infty$, with a score > 0 indicating positive sentiment and a score close to 0 corresponding to neutral sentiment.

There have been some studies that developed learning machines using linear regression, Naïve Bayes, and other algorithms to model human word search and sentiment scoring (Amini et al., 2011; Nadeau et al., 2006; Razavi et al., 2014). They were mostly designed to validate the application of artificial intelligence in dream research through comparing dream emotions coded by automated programs and human judges. In these studies, manual coding was taken as the benchmark against which the accuracy of automated coding was measured. By using this method, Nadeau et al. (2006) showed that the General Inquirer (50%) and the LIWC (48%) had a better accuracy rate of scoring negative sentiment than did the bag-of-words approach (38%) and the weighted lexicon derived from the General Inquirer and Hatzivassiloglou and McKeown's (1997) corpus of adjustives (35%). In this early study, dreams were scored primarily based on a fixed lexicon. Moreover, automated scoring of positive sentiment was discarded because of the unsatisfactory interrater reliability (57.7%). Later, Amini et al. (2011) supplemented their automated scoring with a word-association matrix built upon the LIWC list of affective words and the concurrent frequencies of words used in their sample of 458 dreams, Wikipedia.org, and WordReference.com. This enhanced the machine–human agreement up to 62.5% ($\kappa = .485$) in negative sentiment scoring and 76.9% ($\kappa = .520$) in positive sentiment scoring.

Besides the standard content analysis and LIWC analysis of dreams, the VADER and SVM can provide other options for investigating dream emotions. Compared with the former, they may capture more subtle affective expressions in dreams in that they consider the tone of every sentiment-relevant word used in a report. In addition, they provide a relatively objective evaluation of the intensity of dream sentiment. This can somehow give an answer to the long-drawn-out debate over the pleasantness or unpleasantness of the phenomenological experience of dreaming. Some studies have been undertaken to test the accuracy of the application of machine learning in dream content analysis. None of them used the VADER and SVM to examine the general emotional tone of normative dreams across cultures. The study presented here was therefore geared toward demonstrating the overall affective valence and intensity of some normative dreams using both the VADER and SVM. Furthermore, the VADER and SVM

affective scores were compared against dreamers' subjective experiences and the HVC categories of emotions coded by independent judges.

Method

Samples

Domhoff and Schneider (2008) developed an open source, which documents over 22,000 dream reports. Their dream bank (www.dreambank.net; Schneider & Domhoff, n.d) contains three normative adult samples: Hall and Van de Castle's (1966) American sample of 980 dreams (489 female dreams), Urbina and Grey's (1975) Peruvian sample of 768 dreams (384 female dreams), and Schredl et al.'s (2003) German sample of 649 dreams (490 female dreams). In addition to these three normative samples, 100 Hong Kong dreams (75 female dreams) and 103 Taiwanese dreams (86 female dreams) were included for a preliminary Sino-Western comparison. This gave a total of 2,600 dreams. German and Chinese dreams were translated into English by Google Translate before the VADER and SVM analyses. The translated dreams were spot-checked by assistants proficient in English and German.

Sentiment Analysis

Automated VADER and SVM analyses of dream sentiment were performed using MATLAB. VADER compound scores were generated to indicate the valence and intensity of each dream. In addition to the compound scores, the ratios of positive to negative VADER elements in a dream were calculated for statistical tests. An SVM model was built up by training the algorithm with Hu and Liu's (2004) lexicon. This lexicon encompasses 6,789 sentiment words, 2,006 positive and 4,783 negative words. Approximately 10% (652) of the sentiment words were randomly set aside for testing the classification accuracy of the trained SVM model. The tested SVM model was then used to score the sentiment of each dream. The SVM sentiment score was an average of sentiment scores of all words of dream reports. In addition to this standard SVM sentiment score, the SVM sentiment total, positive, and negative scores without divided by the number of words of each dream, and the ratio of SVM positive to negative elements were computed for comparing with the VADER scores.

Subjective Affect and HVC Emotions

In addition to the SVM and VADER analyses, 203 Chinese dreams were independently coded by two judges in accordance with the HVC classification of emotions. There are five HVC classes of emotions: happiness, anger, apprehension, sadness, and confusion. Each judge rated the frequency of each emotion occurring in a dream report. The average frequency for each dream emotion was computed using the frequencies scored by the two judges. The average frequencies for anger, apprehension, sadness, and confusion were added up to yield the average frequency of negative emotions for each dream. The interrater reliability for the HVC happiness was

excellent (intraclass correlation = .946, F = 18.469, $p < .001$), that for the HVC negative emotions being good (intraclass correlation = .786, F = 4.676, $p < .001$).

The instruction of the Most Recent Dream Form (Domhoff, 1996) adopted for collecting the 203 Chinese dreams consists of a direct prompt for asking respondents to describe their feelings during the dream. In the two Chinese samples, 156 (76.8%) of the 203 participants explicitly described their positive or negative feelings in their dream reports. Dream affects experienced by the participants themselves, observed by the external judges, and detected by the automated algorithms were juxtaposed to examine their consistency.

Results

Of the 449 negative words randomly selected for testing the classification accuracy, 438 (97.6%) were correctly predicted by the trained SVM model. Likewise, 189 (93.1%) of the 203 positive words were correctly predicted. Figures 1 and 2 present some positive and negative sentiment words identified by the trained SVM model in the lexicon, respectively. Affordably, congratulations, graciously, outstanding, and excellently were the most positive words among the 652 sentiment words for testing, with unclean, mishandle, dismissively, lethargic, and unexplained being the most negative words. Figures 3 and 4 present some positive and negative sentiment words identified by the SVM in the 2,600 dream reports, respectively. Personable, thanked, warmly, informative, and beautifully were the most positive sentiment words among the 2,600 dreams, with discolored, malformed, misshapen, disfigure, and blames being the strongest negative dream words.

Automated Sentiment Analysis of the Five Samples

The mean VADER and SVM sentiment scores were close to 0—that is, .139 (SD = .671; range: −.998—.999) and −.021 (SD = .462; range: −1.697–2.205), respectively. This indicated overall balanced sentiment in dream reports. Kolmogorov–Smirnov tests showed that both the VADER (D = 6.615, $p < .001$) and SVM (D = 1.904, p = .001) sentiment scores did not follow a normal distribution. The magnitude of the correlation between the VADER compound score and the standard SVM sentiment score was large (ρ = .549, $p < .001$) and that between the VADER compound score and the SVM total score being even larger (ρ = .566, $p < .001$). The average SVM positive and negative scores were 29.519 (SD = 2.2589; range: .000–255.135) and −32.308 (SD = 2.682; range: −323.104–.000), respectively. The average VADER and SVM ratios of positive to negative dream elements were .570 (SD = .300) and .495 (SD = .128). The two ratios were moderately correlated (ρ = .434, $p < .001$).

The word count of dream reports showed a very small, opposite correlation with the VADER sentiment score (ρ = .072, $p < .001$) and the SVM sentiment score (ρ = −.109, $p < .001$). The sex difference for both the VADER (U = 817,655, z = −.120, p = .905, r = .003) and SVM (U = 775,615, z = −2.350, p = .019, r = −.054) sentiment scores was negligible. Likewise, the sex differences in the VADER and SVM scores were nonsignificant for all five samples, except the SVM score being slightly larger in American women than in American men (U = 106,904, z = −2.967, p = .003, r = .095). To examine the sex differences in sentiment intensity irrespective of

Figure 1
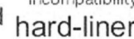*Positive Sentiment Words in the Lexicon*

Predicted Positive Sentiment in Lexicon

Note. A larger font indicates a larger individual positive sentiment score.

affective valence, tests were rerun with individual sentiment scores being trans-formed into their absolute values. Similar to the pattern of sex differences just reported, only the American sample showed a significant sex difference. As indi-cated by their larger absolute VADER value, American women's dreams were more affectively intense than American men's dreams ($U = 109,865$, $z = -2.299$, $p = .022$, $r = .073$).

Figure 2

Negative Sentiment Words in the Lexicon

Note. A larger font indicates a larger individual negative sentiment score.

The five ethnic groups differed significantly in the VADER compound score ($\chi^2 = 32.489$, $p < .001$, $\mathcal{E}^2 = .013$) and SVM standard score ($\chi^2 = 62.582$, $p < .001$, $\mathcal{E}^2 = .024$), with the effect sizes being very small ($\mathcal{E}^2 < .08$). Specifically, the Peruvian sample showed greater average VADER (.241, $SD = .671$) and SVM sentiment scores (.069, $SD = .500$) than did the American, VADER = .086 (.663), SVM = −.109 (.384), German, VADER = .119 (.641), SVM = −.005 (.519), Hong Kong,

Figure 3

Positive Sentiment Words in Dream Content

Note.   A larger font indicates a larger individual positive sentiment score.

VADER = .070 (.763), SVM = .033 (.396), and Taiwan samples, VADER = .076 (.769), SVM = −.018 (.386).

Appendixes A to H provide eight sample dreams with relatively large and small VADER and SVM sentiment scores. Because the VADER algorithm also

Figure 4
Negative Sentiment Words in Dream Content

Predicted Negative Sentiment in Dream Content

Note. A larger font indicates a larger individual negative sentiment score.

considered lexical features such as degree modifiers (e.g., rather unusual vs. unusual, very attractive vs. attractive), it tended to give more weights to more elaborate dreams. On the other hand, the SVM tended to favor short dream reports with condensed emotional expressions because the SVM score was calculated by averaging the sentiment scores of all words used for describing a dream. The most positive dreams identified by the SVM model is a dream obtained from a Peruvian woman

(Appendix F). This dream was also the dream made up of a greatest proportion of positive sentiment in accordance with the VADER analysis (positive = .465, negative = .000, neutral = .535). By the same token, the most negative dreams identified by the SVM model was also the dream with the highest density of negative sentiment according to the VADER (positive = .000, negative = .432, neutral = .568; Appendix H). Furthermore, the most negative dream identified by the VADER was also the most negative dream as measured by the SVM total score (Appendix C). Appendix I presents the dream that exhibited the greatest SVM total score. This dream also had a very large VADER compound score (Appendix I), albeit its merely modestly large SVM mean score.

Comparison of Sentiment Scores, Phenomenological Feelings, and HVC Emotions in Chinese Dreams

Of the 203 Chinese participants, 116 (57.1%) spontaneously mentioned unpleasant feelings in their dream reports, 40 (19.7%) described pleasant feelings, and 47 (23.2%) had not explicitly reported positive or negative feelings. The frequency of pleasant feelings explicitly described by the participants was positively correlated with both the VADER ($\rho = .511, p < .001$) and SVM sentiment scores ($\rho = .386, p < .001$). On the other hand, the frequency of unpleasant feelings explicitly described by the participants exhibited a negative correlation with both the VADER ($\rho = -.489, p < .001$) and SVM sentiment scores ($\rho = -.413, p < .001$). Similarly, the average HVC happiness score was positively correlated with the VADER ($\rho = .425, p < .001$) and SVM sentiment scores ($\rho = .426, p < .001$), with the average HVC negative emotion score being negatively correlated with the VADER ($\rho = -.415, p < .001$) and SVM sentiment scores ($\rho = -.435, p < .001$).

The κ value comparing dichotomized VADER scores and subjective feelings reported by the participants was .471, $p < .001$ (agreement = 73.8%), that comparing dichotomized SVM scores and subjective feelings being .352, $p < .001$ (agreement = 68.6%). In 39 (50.6%) of the 77 dreams with a positive VADER score, the participants expressed a negative feeling. By contrast, only two (2.5%) of the 79 dreams with a negative VADER score were labeled positive by the participants. In both dreams with a negative VADER score, the dreamer felt calm and peaceful despite the threatening scenes—that is, an elevator inside a skyscraper suddenly dropping from the top to the ground, seeing one's ex-boyfriend turn into a beast in a dark forest.

In 17 (43.6%) of the 39 dreams with a positive VADER score but a negative remark, the scenario was a typically positive event or enjoyable activity (e.g., playing with one's father as a child again, singing, wedding, being with the loved one or ex-boyfriend, playing sports, doing something that the dreamer is familiar with or competent in) but was spoiled by a fear that judging by the dreamer's real life was unjustified (e.g., father turning into a decapitated robot, being scolded by a teacher, being unable to invite guests to the wedding ceremony, separating from the loved one, being cheated by the loved one, discovering the loved one being one's sister, failing to complete a job normally easy to the dreamer). In addition, nine (23.1%) dreams scored positively by the VADER presented an ordeal with concomitant negative feelings reported by the dreamers, who however eventually managed to resolve the ordeal, for example, being able to secure the evidence for the boyfriend's infidelity

and being able to let go of him. There were also three (7.7%) positively scored dreams, which featured romantic and passionate scenes (e.g., kissing, hugging, reliving sweet memories) but deeply saddened the dreamer with or without an apparent reason.

In 32 (15.8%) of the 203 Chinese dreams, no emotions were directly expressed by the dreamers or could be coded in accordance with the HVC system. In these dreams, since the participants had not explicitly labeled their feelings or described their affective states, neither their self-expressed emotions nor HVC categories of emotions could be coded. Of these 32 dreams, 13 (40.6%) exhibited a VADER score larger than .8 or smaller than $-.8$. Only three (9.4%) dreams had a VADER score within the range between .3 and $-.3$; the affective tone of the remaining dreams could be easily discerned or interpreted. For examples, the dream in the following text displayed no explicit emotions or HVC codable emotions but was scored relatively highly by the VADER (.807) and SVM (.726). This dream seemed to satisfy the Taiwanese woman's erotomaniac wish for becoming the lover of a handsome celebrity.

> The environment in the dream was London. It was an environment that I am not familiar with. The only person in the dream was Leonardo (the gender is male), who looked like how he is now, so his age should be his current age. He is my favorite foreign movie star. Then, no animals appeared in the dream. I dreamed of studying abroad in London, met Leonardo, and became a couple with him.

In another dream mentioned in the following text, the Taiwanese female dreamer did not directly tell her positive or negative feelings and no HVC emotions were coded. However, she underwent a spate of persecutory events in her dream, which was evidently negatively toned, with both low VADER ($-.981$) and SVM scores ($-.289$).

> I woke up from my sleep in the middle of the night and found that the familiar world had changed. Not only did the pets at home become very violent but even family members disappeared. Apart from meeting a colleague who was 2 years younger than me and her boyfriend, all I came across were monsters in human form that were irrational and ferocious. It took me a lot of effort to escape from this bloody place, but it was not much better outside. In this way, we cautiously walked on the road. For some reason, the way forward turned out to be the direction to the city! However, halfway through the road, I encountered a monster with a height of four or five storeys tall. There was a chaos. My colleague's boyfriend was eaten up by the monster. When the colleague was about to be slaughtered, a handsome young man suddenly appeared in a jeep and killed the monster with ease. I looked at the young man, was speechless, and felt very familiar. No sooner had I found out who he was than I woke up from my dream.

Discussion

The plethora of evidence for the predominance of unpleasant affects in dreams can perhaps be accounted for by specific methodological artifacts and limitations, such as positive dream emotions being easily missed out by human raters. The HVC coding system requires external raters' judgment and dreamers' direct description of their emotional states. Moreover, the coding of emotions is dichotomous; there is no scale for rating the intensities of dream emotions. Accordingly, dream sentiment analysis can complement the standard method of dream content analysis in three ways. First, it captures subtle, indirect expressions of affective feelings in a dream report by gauging the tone of every word used for producing the report. Second, the automated process can avoid the issue of interrater discrepancies. Third, sentiment analysis can yield continuous scores for indicating the intensities of affective dream experiences.

Sex differences in dream sentiment were found to be negligible in the present study. This appears to run counter to the robust sex differences reported in previous normative studies. Specifically, the total frequency of dream emotions for women (420) was markedly higher than that for men (282) in the Hall and Van de Castle's (1966) American normative sample. By contrast, dream sentiment was significantly yet merely slightly more intense in the women than the men of the same American sample. As suggested by further analyses, dream sentiment can still be scored even without dreamers explicitly reporting their emotions. Accordingly, although women may be more likely to describe their emotions in dream reports, their dreams are not necessarily more emotional than men's.

The evidence of previous LIWC studies demonstrates similar frequencies of positive and negative emotions in normative dreams. Consistent with this evidence, the study presented here suggests overall similar intensities of positive and negative sentiments of normative dreams. Although the pleasantness, unpleasantness, or affective intensity of dreams varies across people and time, dreams usually contain both agreeable and disagreeable elements and emotions. Despite the average neutral sentiment score for all ethnic groups in the current study, Peruvian dreams appear to be more positive than dreams of the other ethnic groups. Peru is a developing country with a relatively high poverty rate. This stands in contrast to the social and economic conditions of America, Germany, Hong Kong, and Taiwan. Future studies might investigate the extent to which social and economic factors would play a part in personal dream experiences.

Both the VADER and SVM approaches can effectively evaluate dream sentiment, but they are operated by distinct algorithms and coding mechanisms. The conventional SVM approach to sentiment analysis averages the individual sentiment scores of every word in a text. By contrast, the VADER approach discards any expressions outside its lexicon, but instead considers also lexical features that in themselves carry no direct emotional connotations. As a result, the former tends to favor dream reports in which feelings are concisely expressed. As demonstrated by the current study, the VADER and SVM dream sentiment scores were strongly correlated, yet the Spearman's correlation coefficient of .566 does not suggest a substantial overlap between the two scoring methods. The same also applies to the medium correlation comparing their ratios of positive to negative dream elements. Accordingly, the two approaches could be flexibly applied in different situations. For instance, in studies where lexical features are of interest, VADER is probably the choice. On the other hand, SVM is preferred when original words of a lexicon and their variants are just equally important for deciphering a dream report. All in all, VADER and SVM can constitute very effective and resourceful tools for dream content analysis without involving human raters.

In this study, the VADER and SVM scores were compared against the subjective feelings explicitly depicted by the Chinese participants and the HVC emotions separately scored by two judges. As indicated by the medium-to-large correlations and moderate κ values, the VADER and SVM scores concur with both the dreamers' and the external judges' ratings. This suggests that the automated linguistic scoring method can to some extent reflect the phenomenological experiences of dreamers and may be used for a fine-grained objective measure of dream affect in conjunction with the HVC categorization of dream emotions.

Automated sentiment analysis, external rater coding, and subjective rating all have their advantages and measure distinct, yet associated, facets of a dream. The κ values indicate that VADER and SVM are only moderately consistent with subjective feelings. Nevertheless, it is precisely the incongruity between objective dream tones and subjective dreamers' feelings that underscores the dynamics of dream experiences. In the current Chinese sample, the affective tones of 90% of dreams without dreamers' explicitly labeled emotions could be discerned with the evidence provided by the VADER scores. Also considering a few dreams distinguished by their subjective peacefulness in the face of the apparent threats, the phenomenological experience of the reduced affect intensity as opposed to objective scores might imply a desensitization effect of dreaming.

Apart from those dreams lacking in expected emotions, a considerable number of Chinese dreams were positively scored by the VADER but were perceived by the dreamers to be disagreeable. These dreams typically involved an enjoyable event, which ended with a hazard that was very unlikely to happen in the dreamer's real life. For instance, a decent student who had never received bad comments from her teachers dreamed about being harshly scolded by a teacher. In a similar vein, a son with a loving father in his real life dreamed about his father turning into a dreadful robot. Unrealistic threats such as these could explain the subjective experience of displeasure in otherwise positively toned dreams. From the psychodynamic perspective, the dreamers in these dreams might have been confronted with the unconscious, analogous concerns that had not been properly processed during their waking lives.

The comparison of objective sentiment scored by automated machines, objective emotions rated by external judges, and phenomenological experiences reported by dreamers highlights that affective experiences during dreaming are sometimes complicated, with mixed feelings that might not be easily explicated by dreamers themselves. Some dreams present a romantic, passionate moment, yet deep down the dreamer felt an inexplicable sense of sadness. Other dreams intimidate the dreamer with repeated failures, thorny problems, or vicious monsters, which are somehow solved in a magical manner. It seems that an inconsistency between rating methods does not necessarily indicate a reliability issue but ipso facto exposes dream dynamics that deserve further exploration. In retrospect, whether manual coding can serve as the standard and is more accurate than automated coding is arguable, especially when the interrater reliability is low, target codes are too subtle for human raters to detect, or the coding system is too convoluted for human raters to handle.

The major limitation of the study presented here is the categorical nature of dream emotions labeled by the participants and coded according to the HVC system. In future studies, the intensities of dream emotions rated by both the dreamer and external judge could be obtained to better quantify the discrepancy between subjective, external, and automated ratings. The identification of factors for this rating discrepancy might shed light on some important theories of dream formation and functions, such as threat rehearsal, desensitization, and affect regulation.

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Appendx A

Most Positive Dreams Identified by the VADER: Peruvian Man

VADER Compound Score = .998, SVM Sentiment Mean Score = .070

I dreamed I was drinking beer with some friends, but the place was rather unusual. It was some sort of a cave whose exits led into aerial terraces; as a matter of fact, the cave itself was in the air. Then I went with these friends to where there were some beautiful girls clad in baby dolls. They were very attractive, and I went over to one of them and undressed her, and then we made love. Later my friends and I went to the house of one of them; he is in real life the brother of my ex-girlfriend. Well, we were talking in the living room and then he asked us to go to his room to "fly" or smoke marijuana. I refused and ran to another bedroom, but when I got in, I saw the sister of this friend having sexual relations with a good friend of this friend (excuse the redundancy). When I saw this, I was surprised, but she—naked as she was—was laughing and at the same time apologizing to me, but saying it was necessary for her to do this. At that moment, her brother and the other two friends came in and were not disturbed; on the contrary, they talked to me. I was explaining to them what was happening, but they said it was not important. After this, I left. But as I was going out of the house, the girl—already dressed—pulled me and kissed me, and later we threw ourselves on the floor and made love, but I felt disgust rather than satisfaction. Then she cried, and we did it again and she, as well as I, felt great joy. When I tried to get up, her parents were in front of us, not angry as usual, but on the contrary, inviting me to go and forget everything.

Appendx B

Most Positive Dreams Identified by the VADER: Hong Kong Woman

VADER Compound Score = .996, SVM Sentiment Mean Score = .383

[I was] In a crowded, noisy, and very bright shopping mall, but I had never been to it, and I was not familiar with it. In the dream, there were me, a group of passersby, a man I did not know, and there were no animals. The man and I met in the mall; the mall became very quiet immediately. We stood a certain distance from each other; our eyes met and didn't separate anymore. He walked over slowly and said something to me, something like, "Can I get to know you?" or the like, it felt love at first sight. The next scene was when we were dating, we arrived at a shop, I was looking at the merchandise and asked him if it was beautiful, but found that he was looking at me. Later, we walked on the street holding hands, and I said, "The fingers are not clasped very tightly when holding hands, and the hands are not very tightly together. I do not know why lovers like to do it." He smiled and held my hand tightly and asked, "How about this?"

Finally, we went to a place with a lot of people, I saw a poster of my favorite singer coming to Hong Kong for a concert, so I acted in a cutesy way and asked him to take pictures for me, he agreed. The dream was over, the whole dream was very warm, sweet, and happy. At that time, I was not in a romantic relationship yet, the man I didn't know appeared to have an ordinary face, but after waking up, I couldn't remember what his face was like. Because the dream made me feel so real, I was inexplicably sad after waking up, and I cried for a long time. The mood in the dream was very positive.

Appendx C

Most Negative Dreams Identified by the VADER: Taiwanese Woman

VADER Compound Score = −.998, SVM Sentiment Mean Score = −.780, SVM Sentiment Total Score = −159.143

In the dormitory where I had lived for 3 years, two roommates and I were sleeping (three females, the other two were 1 year younger than me), and a murderer rushes in with a chainsaw; I was the first one to get killed. The data file was reread, and the dream started from the beginning again; I knew that the murderer (biological man, like Jason, also wearing a mask) was coming, so I got out of bed, locked the door and blocked it with a broom, and then hid. Finally, the murderer first killed the people in the next two rooms (screams were heard), and at last, he used the chainsaw to destroy our room, and we were all killed. The data file was reread the third time; the murderer changed to holding an axe. This time I woke my roommates up to hide in the closets; finally the closet I was in was opened first (omission, fourth rereading data file); it was still an axe, but I do not remember the process. I just remember that I escaped from the door and rushed toward the department office to ask for help, but suddenly felt that it was useless to do anything. I stopped and looked back. I didn't see the murderer but directly became a black screen and proceeded with the fifth rereading. Fifth rereading the data file, murderer changed to hold a kitchen knife, this time I hid under the desk. As soon as the murderer entered the center of the room, me and my roommates rushed up with our fruit knives, and then my head seemed to be chopped off. Sixth rereading the data file, two roommates hid in the closet while I was hiding under the desk and did not dare to make a sound. The murderer first discovered one of my roommates. When he used the kitchen knife to slash my roommate to his heart's content (while the other was trying to stop him), I finally couldn't bear it and grabbed the fruit knife, I stabbed him in the back of the neck, and then smashed his head. There was no rereading of the data file this time, but I seemed to be prosecuted, I ended up hanging myself in jail. No animals appeared in the whole dream. The emotions at the beginning were fear and panic, followed by confusion and wanting to escape, then anger and helplessness (obviously I was angry but couldn't do anything), and finally, despair when the fury reached its extreme (basically all negative emotions).

Appendx D

Most Negative Dreams Identified by the VADER: American Man

VADER Compound Score = −.998, SVM Sentiment Mean Score = −.5358

This dream took place in back of my home. I was in the army and defending the area against the Japanese or some Asian group. There were six or seven other soldiers with me, and I remember several of them were my friends here at school. I went out into the field before me which extended about 40 yards before the ground level rises to form a hill. It seems that the enemy was located on the other side of the hill. I was very frightened, in a feeling of helplessness more than real fear. I no sooner started out than I could see the enemy beginning to advance. I quickly went back to the rest of the group to stand off the attack. I took my rifle and began shooting at the enemy. I shot them with no effect, and I found that I had not taken the safety off the gun. Now I was out of ammunition, as I borrowed some from the soldiers around me. Now when I shot, the advancing enemy would be killed. The other soldiers now seemed to be doing very little, and I was defending the whole group. The enemy soldiers would almost get to me, and I would kill them. I had no moral compunctions about killing them, but a feeling of to kill or be killed, along with a feeling that they were making me kill them. Finally, I had killed enough so that the remainder retreated. As soon as the enemy retreated, three men came up to me and said to one another, "This is the one," pinning a medal on me. I felt good but that turned to fear, like now every one of the enemy would be out to get me. Our group then retreated back to our house. A new group of the enemy attacked from the rear, but I saw them soon enough to give warning and avert a surprise attack. At this point, I killed a man with my bare hands (a knife that is). This being the first time I had ever done anything like this. I viewed his body afterward and felt no pity whatsoever. Then, the dream changed into some other theme.

Appendx E

Most Positive Dreams Identified by the SVM: Peruvian Man

SVM Sentiment Mean Score = 2.205, VADER Compound Score = .852

I was directing a children's group. Everyone sang with great fervor. And the meadows sang and the flowers sang. It was a very beautiful song. I remembered my childhood. It was a children's ceremony.

Appendx F

Most Positive Dreams Identified by the SVM: Peruvian Woman

SVM Sentiment Mean Score = 2.085, VADER Compound Score = .971

I dreamed that love made me happy, and I thought about my future as a professional, faithful wife, and perfect mother. I dreamed about the warmth of a home, the love of a husband and of children.

Appendx G

Most Negative Dreams Identified by the SVM: German Man

SVM Sentiment Mean Score = −1.697, VADER Compound Score = −.844

My boyfriend and I are sitting in his apartment; he is on the couch and I on his bed. We're arguing about some really ridiculous little thing, and I feel a sense of despair over the fact that it is. We have such a pointless argument. It's a feeling of powerlessness and nausea.

Appendx H

Most Negative Dreams Identified by the SVM: German Woman

SVM Sentiment Mean Score = −1.645, VADER Compound Score = −.914

Animals everywhere in long cages (underground) that screamed with hunger. And I couldn't give them anything. I was to blame for her suffering, her death.

Appendx I

Largest SVM Total Sentiment Score: Peruvian Woman

SVM Sentiment Total Score = 186.763, SVM Sentiment Mean Score = .894, VADER Compound Score = .989

We were in a speech class. The teacher was a well-known professional in the field of psychology. In this class, each one of the students had to expose a theme that would attract general attention. First, it was Mary Ann's (a classmate) turn. She did it very well and was applauded by the audience. The second one to speak was a boy named Edgar (also a classmate, very intelligent, cultured, and able, whom I admire especially). He spoke brilliantly about Sophocles' tragedies. Then it was Louise's turn (a friend and classmate). She spoke all right but was not able to narrow down her topic very well. Afterward, Roland (a quite intelligent classmate) exposed his topic. I do not remember well what he spoke of or how well he did it. The fifth one to speak was Cindy (a friend and classmate, an intelligent and quite studious girl). But something strange happened with her, because instead of exposing a theme, the same as the others, she began to hum a song and to sing and dance. Together with her performance, she presented another great number: It turned out that this girl had the power to transform herself into birds of multicolored plumages and butterflies of extremely beautiful colors; besides she could transform her surroundings, changing the lighting. I believe it would be hard for me to explain the beautiful picture I had before my eyes. At last, Cindy finished her performance and was applauded most of all. The last one to present a theme (which was I) did not fare so well. First, I did not know whether to give a talk or sing as the one before me had done. Finally, I decided on the latter, but in the meantime, the auditorium had been emptied, and the only ones left listening were Louise, the teacher, and Roland. In short, I was in a ridiculous situation, but I did not care and continued to sing until the end. Louise came over and started to make some criticisms; I was silent and accepted it. Going out, I tried to find Cindy. Once I found her, I asked to explain how she had acquired

those wonderful gifts. Cindy told me that it was Saint Martin who had given them to her. I continued to ask whether it was the Black saint or Jose de San Martin. It was the latter who had given her those gifts as compensation for the effort that Cindy made in her studies and for having an altruistic spirit. But before this, Cindy told me that to get in touch with San Martin, one had to go to the cemetery and stand watch by his grave all night. I thought that it was all a fantasy, a realizable dream, but perhaps it could turn into reality. I would give it a try and go to the cemetery and stand watch by the grave of San Martin.