



Studying dream content using the archive and search engine on DreamBank.net

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ABSTRACT

This paper shows how the dream archive and search engine on DreamBank.net, a Web site containing over 22,000 dream reports, can be used to generate new findings on dream content, some of which raise interesting questions about the relationship between dreaming and various forms of waking thought. It begins with studies that draw dream reports from DreamBank.net for studies of social networks in dreams, and then demonstrates the usefulness of the search engine by employing word strings relating to religious and sexual elements. Examples from two lengthy individual dream series are used to show how the dreams of one person can be studied for characters, activities, and emotions. A final example shows that accurate inferences about a person's religious beliefs can be made on the basis of reading through dreams retrieved with a few keywords. The overall findings are similar to those in studies using traditional forms of content analysis.

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1. Introduction

Numerous studies of dream reports from all over the world using several different systems of content analysis, but in particular the system resting on nominal categories developed by Hall and Van de Castle (1966), have provided a replicable body of descriptive empirical findings concerning what people dream about. These findings reveal cross-cultural, gender, and individual similarities and differences of the kind that might be expected on the basis of studies of waking psychological variables (Domhoff, 1996). There are also studies of lengthy individual dream series showing that most people are consistent over years or decades in what they dream about, and that the most frequent characters, social interactions, and activities in their dreams are continuous with their waking interests and emotional concerns (Domhoff, 2003).

Still, there remains much dream content that is not understood, and the relationship between dream content and waking thought is more complex than the straightforward continuity that seems to obtain for frequent characters, most social interactions, and emotionally salient waking interests. However, progress continues to be slow in developing a better understanding of these issues for a variety of reasons, including the inability to induce or manipulate dreaming to any significant extent, and the impossibility of receiving verbal reports about dream content while the dream is occurring. Researchers who study dream content are by and large restricted to studying written or transcribed reports based on memories of the dream experience, even when dreams are collected immediately after awakenings in a sleep laboratory, which means that the data are two steps removed from dreaming itself. After all that, there are still further problems, such as the difficulties in obtaining good samples of complete dream reports and the labor-intensive nature of any thorough and reliable system of content analysis.

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Fortunately, problems with databases and reliable coding can be overcome to some extent due to the wide availability of high-speed computers and the increasing sophistication of their analytical software. It is the purpose of this paper to show how these technological advances can be used to build and analyze large databases by presenting results obtained from studies using the dream reports on DreamBank.net, a Web-based research site available to everyone. Dreambank.net features a collection of dream reports, along with software programs that make it possible to perform many different kinds of content analyses in a 100% replicable fashion in a matter of seconds.

2. Data and methods

DreamBank.net, or “the DreamBank,” consists of over 22,000 dream reports (as of May 2008), approximately 16,000 of which are in English. (Over 6000 dreams in German are also available, and dream reports in other Western languages could also be accommodated by the DreamBank.) Some of the reports are in the form of collections, or “sets,” of dreams from a group of people, such as children, teenagers, college students, and blind adults, while others are part of a “series” of dreams from one individual. All of the English-language dreams currently available were collected in the United States. The German-language dreams come from college students in Germany (Schredl, Petra, Bishop, Golitz, & Buschtions, 2003), Swiss children ages 9–15 (Strauch, 2004, 2005; Strauch & Lederbogen, 1999), and a retired Swiss professor (von Ulsar, 2003). The dream reports were collected in a variety of settings, ranging from the sleep laboratory to the classroom to personal dream journals kept for varying reasons by several different individuals.

For example, there are dream sets collected in classroom settings from young men and women at universities in Cleveland, Ohio, in the late 1940s, who were asked to record their dreams over the course of a semester on a voluntary and anonymous basis. Some of these dream reports were later used by Hall and Van de Castle (1966) to create normative findings for all their content categories, which we will draw on frequently in this paper. There also are dream sets collected in the sleep laboratory and at home from the same participants at the University of Miami in the early 1960s (Domhoff & Schneider, 1999; Hall, 1966). More recently, dream reports from high school students in a Midwestern state (“Midwest Teenagers”), seventh grade girls in California (“Seventh Grade Girls”), and University of California, Santa Cruz women (“UCSC women”) were collected with the Most Recent Dream method, which asks volunteers in a group setting to take 15–20 min to write down the most recent dream they can recall; this method has been shown to lead to similar findings for children as young as age 11 to those reported in laboratory studies of children’s dreams (Avila-White, Schneider, & Domhoff, 1999; Foulkes, 1982; Oberst, Charles, & Chamorro, 2005; Saline, 1999) and for the Hall and Van de Castle (1966) normative sample for women (Domhoff, 1996). The major drawback with these dream sets is that the only information available on the dreamers is their age and gender.

The many personal dream series on the site, ranging in length from 15 to 4254 dreams, are best thought of as the kind of archival documents that serve as “unobtrusive” measures of a given phenomenon (Allport, 1942; Baldwin, 1942). According to methodologists, archival sources such as personal dream journals can be very valuable in psychology when they lead to similar results even though they were kept for diverse reasons (Webb, Campbell, Schwartz, Sechrest, & Grove, 1981). In addition, the baselines derived from the sets of dreams provided by children, teenagers, and young adults make it possible to determine how findings with an individual dream series differ from normative expectations, making analyses of dream journals even more valuable.

The dream series in the DreamBank include those of a physiology graduate student at MIT (code named “The Physiologist”) who wrote down 86 of his dreams beginning in 1897, along with his own comments on them; an entomologist (“The Natural Scientist”) who kept a dream journal in the summer of 1939; an experimental psychologist (“Dorothea”) who recorded 900 dreams between 1913 and 1965; and a recently retired humanities professor (“Phil”), who wrote down his dreams at ages 15, 30, and 60, thereby providing the first dream journal to encompass a major part of the human lifespan. There is demographic and biographical information available on some of those who contributed dream reports, but very little on others. The most detailed information is available on Barb Sanders, a middle-aged woman who recorded 4254 of her dreams for a period of 25 years; this information is based on extensive interviews with Sanders and four of her women friends.

The dream sets and series in the DreamBank can be useful to researchers who simply need good samples for their own content analyses, as shown with the first example in the results section. However, they also can be analyzed using individual words, word strings, and phrases that are entered into the search engine on DreamBank.net. By default, the results of the searches are then converted into frequency counts and percentages that are presented in tables. An option on the search form makes it possible to determine the consistency of elements per a given number of dream reports in an individual series; another option makes it possible to find contingencies between two elements in a set or series of dream reports. All of the dream reports containing the search terms can be displayed in either a full or abbreviated form, with the abbreviated form containing the sentence with the relevant word or phrase. Either way, the word or phrase appears highlighted in the dream report to make it easier to identify. (The search and computational programs can be used by researchers who want to put their own sets or series of dream reports in a password-protected space in the DreamBank.)

In addition, Hall and Van de Castle (1966) codings are available for over 2000 of the dream reports in English and 437 dream reports in German at http://dreambank.net/coding_search.cgi, which make it possible to compare findings based on word searches in the DreamBank with Hall and Van de Castle findings. The most important of the coded dream reports are the 500 dreams from men and 500 dreams from women that were used in establishing the norms for every category in the Hall and Van de Castle (1966) system. In addition, there are also 744 reports from the lengthy Barb Sanders series that

were coded for characters, social interactions, and emotions, as well as 500 from a series of 1221 dreams that a housewife and mother code named “Emma” wrote down from 1949 to 1951 and then from 1960 to 1997, when she was in her late 70s. There are also 143 coded dream reports from Ed, a widower who wrote down every dream in which his deceased wife appeared over a 22-year period (Domhoff, 2008).

Although searches on the DreamBank are substantially faster than anything that could be done in the past, and completely reliable in picking out words and phrases, for some analyses the findings have to be refined by scrolling through the dream reports and using human judgment to eliminate “false positives,” that is, dream reports with words or phrases which have more than one meaning, or are used figuratively. For example, a search for bridges across rivers and valleys would also find dreams where the word refers to a card game or to a type of dental work, or where it is used figuratively, as in “bridging the gap.” Several other shortcomings of the search capabilities built into DreamBank.net are commented in Section 4.

To demonstrate the usefulness of the DreamBank in studying dream content, and the relationship between dream content and waking consciousness, the results of several different analyses will be presented:

- The similarities of the social networks in dreams to waking social networks will be demonstrated with work on two different dream series.
- The frequency of several different religious and spiritual elements will be determined for the English-language dreams in the database.
- A similar frequency analysis will be carried out for references to sexual intercourse in dream reports.
- A search for the word “flying” will be conducted to show how unusual dream content—in this case, dreams of flying under one’s own power—can be studied using the DreamBank.
- An analysis of a dream series from a college student will be undertaken to show how word and phrase searches can reveal the main contents in a lengthy dream journal that otherwise could only be studied through dozens of hours of work on representative subsamples from the series.
- The consistency of selected characters, activities, and emotions throughout the 25 years covered by the dream series from Barb Sanders will be determined.
- Simple examples of how to determine whether or not there are contingencies between pairs of words in a dream series will be provided.
- We will show that reading through dreams with religious elements, which were located through a search using a few keywords, can lead to accurate inferences about a person’s religious beliefs.

3. New findings based on DreamBank.net

3.1. *Social networks in dreams*

Studies using several different dream series on DreamBank.net have shown that the social networks in dreams—that is, the pattern of direct and indirect relationships among the characters—have the same properties as waking social networks in that the paths between characters are short and the clustering of characters is high (e.g., Schweickert, 2007c). These results also hold for subnetworks within the overall network, which are created by removing key characters from the overall network (Schweickert & Xi, 2007). Moreover, the frequency distribution of the characters in a dream series is similar to what is found for many different rankings in waking life, such as the frequency with which words are used in the English language or the size of cities throughout the world. In these frequency distributions, the top few occur very often, with a relatively rapid tapering off to the point where most of the others are far more infrequent. The exact shape of these distributions follows a type of power law, sometimes known as “Zipf’s Law” in honor of the linguist who first discovered it. Since a power law is a mathematical expression, it is not easily described in plain English. However, it is best understood as a law that expresses a proportional relationship between two variables by means of an exponent, such as squaring or cubing, although most exponents are less than one in the distributions under consideration here (Schweickert, 2007b).

To take one of several examples that might be used, the near-perfect adherence to Zipf’s Law for the frequency distribution of main characters in the Barb Sanders dream series is shown by the r^2 of .91 in Fig. 1 (Schweickert & Xi, 2007). In addition, the “degree distribution,” that is, the extent to which two characters appear together in the same dream, is also consistent with Zipf’s Law, as seen in Fig. 2 for the Merri series (Schweickert, 2007a). Taken as a whole, this body of work showing short network paths between characters, the clustering of characters, and the adherence of character distributions to Zipf’s Law is the best demonstration to date of the lawfulness of dreams and of the structural properties they share with waking thought.

3.2. *Religious and spiritual elements in dreams*

Using the same breakdown of dream content into settings, characters, objects, and activities which is at the foundation of the Hall and Van de Castle (1966) coding system, Krippner, Jaeger, and Faith (2001) developed a scale for uncovering religious and spiritual elements in dream reports. This scale can be approximated using DreamBank.net because there are a lim-

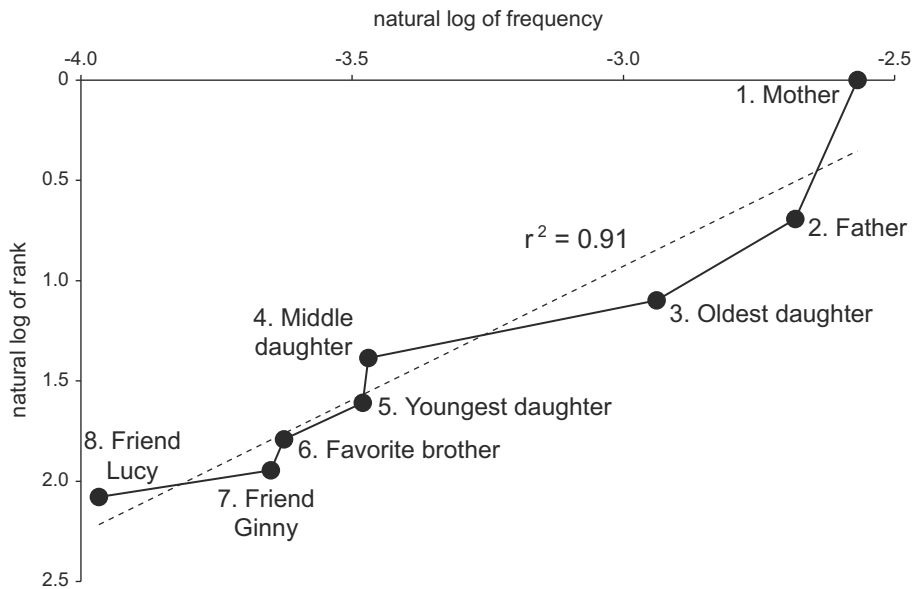


Fig. 1. Demonstration of Zipf's law using character frequencies (expressed as proportions of all characters) from the Barb Sanders dream series.

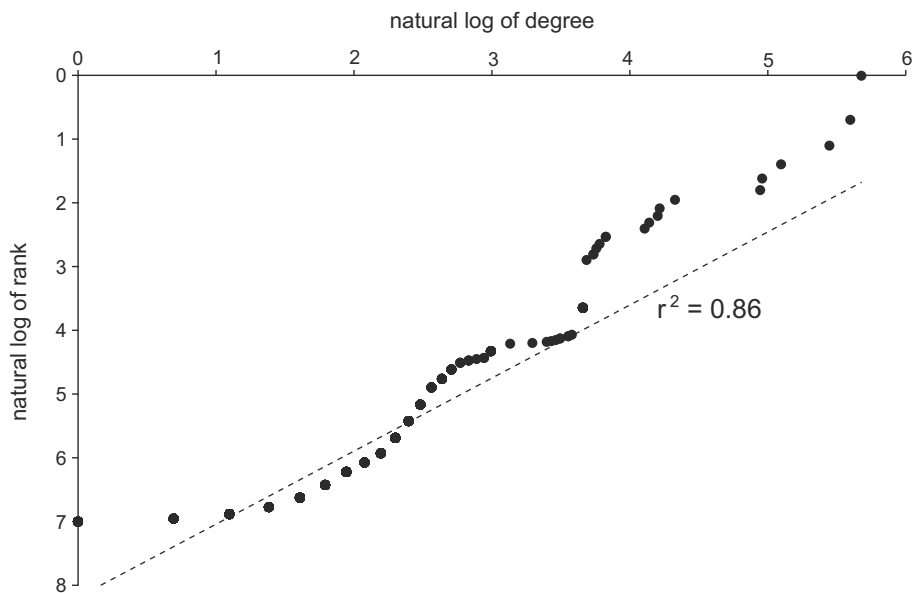


Fig. 2. Zipf's law for degrees, illustrated by all dream reports from "Merri": the degree of clustering between characters is compared to the ranks of the degrees from Schweikert (2007a). Note. Points with a degree of zero were omitted.

ited number of terms that relate to religious and spiritual concerns. Furthermore, these terms usually do not have additional, non-religious meanings, except when used figuratively (e.g., it was a "church-like" situation). The settings are limited to places like churches, temples, and mosques; the characters to a handful of gods, angels, and spiritual leaders; the activities to such matters as praying and worshipping; and the objects to sacred objects such as crosses, rosaries, and altars.

The religious word searches were carried out on the entire English database of dream reports (see the [Appendix A](#) for the word strings that were used). Such a search yields three main results. First, it shows that religious and spiritual elements are generally infrequent in dreams: only 3.3% of the dream reports mentioned places like churches, cathedrals, temples, and chapels; only 1.6% mentioned religious characters such as deities, ministers, and priests; only 0.8% mentioned specific religions or religious denominations; only 0.9% mentioned religious concepts such as worship, sacred, and nirvana; and only 0.9% mentioned religious objects such as sacred books, altars, and crucifixes. Second, the search provides a few hundred dream reports that can be studied to see how religion is portrayed in dreams. For example, the most prominent religious object

in dream reports is the altar, which appears primarily in dreams about weddings, where the couple is standing before the altar. Third, these findings provide a useful baseline for looking at individual dream series to see if there are individual differences in the appearance of religious elements.

When we examine each dream series in the DreamBank individually, we find, as might be expected from the results just reported, that most of them have few or no mentions of religious or spiritual elements. However, there are two striking exceptions: Merri and Emma. Merri, an artist brought up in a strict Protestant tradition, dreams somewhat more frequently of religious settings, objects, or activities from her childhood, often in conjunction with her parents—even though she is no longer a believer. Her dreams are discussed again in the final section as part of a keyword study of religious elements in dreams that led to a series of inferences that could be confirmed or rejected by the dreamer (Bulkeley, *in press*). As for Emma, who became highly involved in religion as a young married woman, she dreamed frequently of the church from 1960 to 1997, when she stopped recording her dreams. She also dreamed of the ministers who served at her church over four decades—especially one with whom she had a strong emotional attachment—and of taking part in religious ceremonies (Domhoff, 2003, pp. 103–105, for a summary of all findings on Emma; Van Rompay, 2000).

This brief study of one type of dream element establishes two key points related to general studies of dream content using DreamBank.net with an eye to making discoveries about the relationship between dreaming and various forms of waking cognition: it is possible to determine normative baselines, and it is then possible to make studies of sets and series that are above these baselines. In this instance, there are two findings that might contribute to an understanding of how dreams relate to waking thought. On the one hand, it seems surprising that there is very little mention of specific elements of religious experience even though religion is a pervasive part of waking experience. This finding does not fit with the idea of a general continuity between dream content and waking thought. On the other hand, the two individual series that are above the baseline on religious elements suggest that dream content sometimes corresponds with a person's most important personal interests and emotional concerns, which is consistent with past studies (Domhoff, 1996, 2003).

3.3. *Sexual intercourse in dreams*

Although dreams and sexuality are often closely related in popular culture, perhaps in part due to Freud's well-known theory concerning the hidden sexual meanings said to be present in most dreams, systematic studies of dream content suggest that there is very little explicit sexual content in dreams. In the Hall and Van de Castle (1966, p. 181) normative sample, only 12% of male dreams and 4% of women's dreams had as much as a sensual thought or a romantic kiss.

Since our past research suggests that a relative handful of terms are usually used by adults in reporting their sexual activities in dreams, it is possible to attempt generic searches for references to sexual activities in dreams. Such searches will miss some references to sexual activities, and will pick up some false positives, such as “we decided not to have sex,” but the baselines and samples that are obtained are nonetheless useful for studying sexuality in dreams. The most useful terms for this purpose include the past and present tenses of “making love,” “having sex,” and “kissing.” Exact terms and euphemisms referring to sexual organs also can lead to references to sexual interactions. In studies of long dream series from individuals, it is possible, and indeed essential, to tailor the sexual references word string to include pet terms and idiosyncratic phrases, thereby making the searches even more encompassing.

For purposes of this paper, the focus will be on the frequency of sexual intercourse because terms like “kissing” and terms for sexual parts lead to many false positives. (The word string used in his study to find references to sexual intercourse can be found in the Appendix A.) When the various tenses of “making love” and “having sex” are searched for in the same dream reports that Hall and Van de Castle used to create their normative findings, the results show an even lower frequency of references to sexual intercourse than that found with the Hall and Van de Castle's coding categories: 2.0% for men (vs. 3.4% in the Hall and Van de Castle normative sample) and 0.4% for women (vs. 1.0% in the Hall and Van de Castle normative sample). However, this result does provide a cross-validation in that the frequency of sexual intercourse is very low and men have more mentions of sexual intercourse than women according to both methods.

As was the case with religious and spiritual elements, the search for sexual elements provides a sample of dreams that can be studied for themes or patterns in sex dreams, from which we learn that sometimes the sexual activity is interrupted by others or is rendered problematic in the dreamer's mind because the partner is an unexpected one.

The findings from this search also raise the same general question raised by the findings on religious elements. Why is thinking about sexuality more pervasive in waking thought than it appears to be in dreaming?

3.4. *The frequency and content of “flying” dreams*

Popular culture stresses the bizarre and unusual nature of dream content, and dream researchers argue about the degree to which this image is accurate. Researchers have tried to classify these kinds of elements into a handful of categories and determine their frequency. One type of bizarreness involves highly unusual or impossible events, such as flying under one's own power, having teeth suddenly loosen or fall out, appearing inappropriately dressed or without clothes in public, or falling through space. Questionnaires asking people if they have ever experienced such dream elements lead to findings in which at least a large minority say they have done so (Nielsen et al., 2003).

DreamBank.net provides a way to approach some aspects of bizarreness in a large-scale and systematic fashion. For example, elements such as flying under one's own power and losing teeth can be studied for their frequency and context

because a few specific words capture most references to such events. Studies of metamorphoses are also tractable because they are usually described by the phrases “turns into,” “changes into,” “is transformed,” and “becomes.” Abrupt changes in characters, activities, and settings are often indexed by “suddenly” or “all of a sudden.”

For purposes of this paper, sets of dream reports and individual dream series were searched for the few terms that reference the experience of flying. The results were analyzed for frequency and context. Turning first to 3309 dream reports in sets of dreams from children, teenagers, and young adults, we found that flying, gliding, or floating appeared in 134 dreams, which is 4% of the total. When we scrolled through the 134 dreams to see how many involved the dreamer or some other character flying under his or her own power, we found that 106 of the 134, or 79%, were false positives. They either described realistic events, such as flying in an airplane, floating in water, or gliding on a surface, or else were used metaphorically (papers were “flying” around the room, the person was “floating” after hearing the good news). Thus, only 18 of the dream reports had characters who were flying under their own power, which is 0.5% of the total reports. This is also the percentage we found when we restricted our search to the dream reports that Hall and Van de Castle used to establish the norms for their coding system. In addition, this is the percentage found in a study of 983 dream reports collected at the University of California, Santa Cruz over a 2-week period from 126 students (Domhoff, 1996, p. 198). It thus seems very likely that flying occurs in less than 1% of dreams.

When we turn our attention to individual series, we find that most people do not differ from the baseline expectations. However, Elizabeth, an adult woman who keeps a dream journal as part of her involvement in dream discussion groups, had 10 such dreams out of 564, which is 1.8% of the total. In these dreams she flies when she is confronted by a physical obstacle she wants to bypass, such as a wall or boulder, or is facing a danger from which she wants to escape.

When the rarity of flying dreams—and, we might add, other “typical” dreams like losing teeth—is added to the rarity of religious and sexual elements in dreams, it raises the question of what people usually dream about. This topic is discussed in the next section on the basis of word searches in DreamBank.net.

3.5. *The Substance of a dream series*

Most previous studies of dream content suggest that a large majority of dreams deal with everyday settings, characters, and activities for American, Swiss, and German dreamers (e.g., Domhoff, Meyer-Gomes, & Schredl, 2005–2006; Dorus, Dorus, & Rechtschaffen, 1971; Hall, 1951; Snyder, 1970; Strauch, 2004; Strauch & Meier, 1996). This finding can be tested using individual dream series on the DreamBank. For this purpose, a dream series from a college student with the code name “Kenneth” provides a good example. Kenneth wrote down every dream he remembered for this first three years of college: a total of 2022 dreams, which is an average of two dreams per night. Reading through the first 50 to 75 of his dream reports, it is clear that he dreams frequently of his family and friends. He is also driving a car or truck, eating, playing sports, or taking part in outdoor activities, such as boating, fishing, and hunting. DreamBank.net makes it possible to see how frequently these characters and activities appear in the entire series.

To begin with, either his mother or his father appear in 23.9% of the dream reports, and a handful of friends in 53.9%. If we ask what percentage of the dream reports have at least one parent or close friend, the answer is 62.6%. Terms relating to eating appear in 13.7%, terms relating to driving in 24.5%, terms related to sports in 6.1%, and terms relating to outdoor activities in 17.0%. Overall, 76.7% of the dream reports mention at least one of the 18 words we entered that have to do with Kenneth’s parents, his friends, eating, driving, playing sports, or taking part in outdoor activities.

Results such as these, which can be duplicated with other series in the DreamBank, do not refute the claim that dreams sometimes contain highly unusual content. Many people have experienced the sensation of flying under their own power in dreams, or awakened with the distasteful memory of a dream in which their teeth became loose or fell out. Still others have dreams of unusual creatures or unlikely adventures. However, the findings of most dream studies, now supported by our brief example from the DreamBank, is that as many as 75–80% of dreams deal with everyday personal concerns and interests (Domhoff et al., 2005–2006; Hall, 1951).

The everyday nature of most dream content might provide one key starting point in theorizing about dreams and their relationship to waking consciousness. Within that context, it might be possible to gain a better understanding of unusual elements. It may even be that some unusual elements can be understood as expressions of figurative thinking—metaphor, metonymy, irony, and conceptual blends—when they are examined within the context of a dream series (Gibbs, 1994, 1999; Glucksberg, 2001; Grady, Oakley, & Coulson, 1999). This is a possibility that is explored in detail with several examples in other contexts (Domhoff, 1996, pp. 202–205, 2003, pp. 131–133). As for those unusual elements that cannot be understood figuratively, perhaps they could be studied to see if they share common features that can be attributed to one or another type of cognitive defect during dreaming (Domhoff, 2007).

3.6. *Consistency over time in a dream series*

Perhaps the major unexpected finding from studying several different lengthy dream series using the Hall and Van de Castle (1966) coding system is how consistent dream content is over years and decades for most people, whatever their motives may be for writing down their dreams (Domhoff, 1996, 2003). This result is best established for adults who wrote their dreams down between the ages of 25 and 75, but there is one unpublished study of a young male showing consistency in several Hall and Van de Castle (1966) coding categories between the ages of 17 and 25 (Schneider & Domhoff, 1995). Dream-

Bank.net makes it possible to repeat such studies in a matter of a few seconds using familiar terms such as “mother,” “father,” and “house,” as well as words and phrases specific to an individual dream series.

For purposes of this example, we chose to look at the consistency in the Barb Sanders series because it contains a very large number of dreams and covers 25 years. This series is also of interest because a Hall and Van de Castle coding of a random sample of 250 of her dream reports for several different categories (characters, social interactions, and emotions) found that the first 125 did not differ on most comparisons from the second 125 (Domhoff, 2003). We therefore made several comparisons of her first 3,116 dreams, which she wrote down before we met her, with the 1,138 she has given us since that time. At least one of the 13 main people in her life (parents, ex-husband, three siblings, three children, granddaughter, and three best friends) appear in 33.6% of the dreams in the first set and 35.1% of the second set. Her continuing interest in theatrical productions—as a writer, actor, and producer—is reflected in the fact that 4.9% of the dreams in the first set contained one of several terms related to this activity, as compared to 5.2% for the second set. These results with a relative handful of key search terms provide a cross-validation of the consistency found with Hall and Van de Castle codings for 250 dream reports.

We also compared the first and second sets of the Barb Sanders series using long word strings that relate to each of the five emotions that are coded in the Hall and Van de Castle coding system: anger, apprehension, sadness, confusion, and happiness. (These word strings, which were developed in part based on phrases and examples used by Hall and Van de Castle (1966) to explain their five emotion categories, can be found in the Appendix A) The percentages are very similar for the two sets, as seen by comparing the first two rows in Table 1. For the total number of dreams with at least one emotion, the figures are also very similar, as also seen in Table 1.

The fact that the random sample of 250 dream reports from Barb Sanders was coded for emotions using the Hall and Van de Castle (1966) system provides the opportunity for a direction comparison with findings using word strings. As seen in the third and fourth rows of Table 1, this comparison shows that the two methods provide very similar results, except in the case of confusion. The percentage of dream reports with at least one emotion differs by only 2.4% points.

The results on consistency in long dream journals do not deny that there is day-to-day fluctuation in dream content, or that striking external events or some unusual physical condition, such as illness, may sometimes affect dream content. However, they do suggest that most dream content might be drawn from a reasonably circumscribed set of schemata and scripts that are also drawn upon in waking life.

3.7. Contingencies in dream content

Contingency analysis is a method for determining what elements tend to be related to each other in a content study where the measurements are at the nominal level. More specifically, it is a nonparametric statistic that provides the exact probability for the relationship between two or more elements in a text (Osgood, 1959). DreamBank.net includes a program for determining contingencies between two elements, which makes use of the formula for the significance of differences between two proportions to calculate *p* values.

For example, since “my dad” appears 147 times in the Kenneth series, and “my mom” appears 274 times, theoretically they should appear together by chance 20 times ($147/2022 \times 274/2022 = 0.98\% = 20$ of 2022). However, we found they appear together 36 times; the difference between the observed and expected values has a *p* value of .03, which supports the perhaps obvious inference that his mother and father are closely connected in his overall cognitive map. There is also a contingency between Kenneth’s terms for sexual relations and his girlfriend, with a *p* value of .00001, which is another connection that comes as no surprise. Even so, there are also many sexual interactions with characters other than his girlfriend, which might lead to other issues that are worth exploring. For now, even though the two outcomes presented here are not unexpected, they do make a basic point: building on such contingencies might make it possible to see which elements are linked together in a dreamer’s conceptual system.

3.8. Inferring religious beliefs from keyword searches

A gradual accumulation of evidence suggests there is considerable continuity between the personal concerns that are expressed in dreams and waking consciousness, as seen in laboratory studies (Hoelscher, Klinger, & Barta, 1981; Nikles, Brecht, Klinger, & Bursell, 1998; Saredi, Baylor, Meier, & Strauch, 1997) and through blind analyses of dream series, which lead to

Table 1

The consistency of emotion in two halves of the Barb Sanders series: percentage of dreams in each set with at least one emotional keyword, compared to the percentage of 250 coded dream reports (the “Baseline 250”) containing at least one Hall/Van de Castle coding for emotion

	Anger (%)	Apprehension (%)	Sadness (%)	Confusion (%)	Happiness (%)	Any emotion (%)
<i>Using keyword searches</i>						
Set 1 (<i>n</i> = 3116)	18.3	30.8	10.3	11.3	13.5	56.1
Set 2 (<i>n</i> = 1138)	15.0	31.8	9.8	14.5	15.5	57.8
Baseline 250	16.8	31.2	10.4	8.4	12.0	58.0
<i>Using codings</i>						
Baseline 250	17.2	33.2	10.4	12.4	11.2	60.4

inferences about waking concerns that can be confirmed or rejected by the dreamer and/or people who know the dreamer well (Domhoff, 1996, Chap. 8, 2003, Chap. 5; Hall & Nordby, 1972, Chap. 6). This relationship between dream content and waking consciousness can be explored in more detail through blind analyses of dream reports found by means of keyword searches on DreamBank.net, as shown in a study of religious elements in three different dream journals (Bulkeley, *in press*). In the case of the Merri series, mentioned in a previous section as being above the baseline on various religious elements, it was inferred through a qualitative analysis of the interactions and emotions in dreams reports containing the words “God,” “Jesus,” “Christian,” and “Bible” that (1) the dreamer was brought up in a strict Protestant tradition, which (2) she had rejected with considerable hostility. In addition, it was further inferred that (3) she nonetheless continued to have strongly held spiritual beliefs that were expressed in a non-traditional way. All three of these inferences, along with several others, proved to be correct according to the dreamer.

In the same general study, a search of the Barb Sanders series for the word string `^God^|priest|minister|church|Bible|death|ceremony|dying` showed that these terms appeared in roughly 1% of the several thousand dreams, and that the dreams about God and the church were primarily positive. The overall results led to the inference that religion had not been stressed in her upbringing and that as an adult she had a positive interest in spirituality, but without any affiliation to a church. Once again, these inferences and others were corroborated by the dreamer. However, the analysis did not reveal Sanders' rather perfunctory conversion to the Episcopal church when she married her husband, many years before she began to write down her dreams, which suggests that dreams only reflect the deeper emotional qualities of people's spiritual beliefs (Bulkeley, *in press*).

In the case of Madeleine, who recorded nearly 1000 dreams as a teenager and young adult, a search using the same word string as in the Barb Sanders study found virtually no mention of any of the search terms. The low percentages and the content of the few dreams that were retrieved led to the inference that she had a very tepid religious upbringing, which proved to be the case, and that she did not have a strong interest in religious and spiritual issues, which also proved to be the case at the time most of the dreams were recorded. However, once again showing the complexity of the relationship between dream content and waking thought, the dreams gave no hint that she had experienced a strong temporary feeling of closeness to God as she was coming out of a period of depression when she was age 19 (Bulkeley, *in press*, for the many detailed findings in this study).

4. Discussion and conclusion

The findings in this paper based on the search and computational programs on DreamBank.net are similar to those that have been reported with other systems of content analysis concerning the frequency and consistency of various dream elements, along with the continuity of some elements with personal waking concerns and interests (Domhoff, 1996, 2003; Strauch, 2004; Strauch & Meier, 1996). Word strings such as those we used to study religious elements in dreams hold out the promise that many substantive issues in dream content can be studied with similar word strings. Moreover, the similar findings on emotions in the Barb Sanders random sample with Hall and Van de Castle (1966) codings and DreamBank.net word strings suggest that some other aspects of the coding system might be approximated with word strings. We think this approach may prove especially fruitful with word strings for forms of thinking (e.g., realizing, understanding, contemplating) and for various types of objects (e.g., types of buildings like houses and hotels) and aspects of nature (e.g., trees, rivers, mountains).

However, we want to caution that there are limitations to computerized searches of the kind we have carried out, starting with the fact that it is highly unlikely that the Hall and Van de Castle (1966) coding categories for characters or social interactions could be duplicated with word strings. DreamBank.net is also limited because it is necessary to enter long strings of words due to the fact that its program does not search for synonyms. Then, too, it is sometimes necessary to scroll through the dream reports uncovered in a search to see if there are any false positives. It is also the case that the dichotomous categories created by DreamBank searches might miss complex thematic patterns or differing levels of emotional intensity. It may be, for example, that religious themes appear in some sets or series of dream reports that elude the word strings for religious settings, leaders, activities, and objects.

Moreover, samples of 125 or more dream reports are usually necessary for quantitative analyses of most dream elements because (1) many dream elements appear in 50% or less of dream reports and (2) the effect sizes between sets of dream reports, or between normative samples and individual dream series, often are not large enough to be detected with small sample sizes (see Domhoff, 1996, pp. 64–67, 2003, pp. 92–94 for studies of necessary sample sizes).

The methodological limitations of DreamBank aside, this paper shows that many aspects of dream content can be studied using the dream reports and computational programs in DreamBank.net. In particular, the findings reported in this paper show that the DreamBank makes it possible to study the ways in which dream content is similar and dissimilar to various forms of waking thought.

Appendix A. Word strings for studying religious elements, sexual intercourse, and emotions in dream reports on DreamBank.net

A.1. Religious and spiritual elements

Settings: church|synagogue|temple|mosque

Characters: God|Jesus|Christ|prophet|guru|Buddha|goddess|^angels?^|spirits|shaman|priest|minister|^Pope^|Virgin_Mary

Activities/processes: religio|spiritual|divine|meditation|meditate|reverence| worship|sacred|holy|mystical|nirvana|spiritual_message

Objects: rosary|crucifix|altar|pew

A.2. Sexual intercourse

Activities: Have/had_sex|make/made_love|made_out|have/had_sexual_intercourse

A.3. Emotions

AN (anger): (?<!not_|n't_)(^ang(er|ers|ered|ry)^|^annoy(s|ed|ing)|^irritat|^mad|^provoked|^furious|^enrag(|e|ed|es|ing)|^incensed|^disgust(|s|ed)|^indignant|^peev^|^infuriat(e|es|ed|ing)|^pissed^

AP (apprehension, anxiety, fear): (?<!not_|n't_)(^apprehens(ive|ion)|^afraid|^fear(|ed|ing|ful)|^anxi(ety|ous)|^guilt(|y)|^embarrass(|ed|es|ing)|^terrif(y|ies|ied)|^horrif(y|ies|ied)|^frighten(|s|ed)|^scar(es|ed|ing)|^worr(y|ies|ied|ying)|^nervous(|ly|ness)|^panick?(|s|ed|ing)|^alarmed|^uneasy|^upset|^remorseful|^regret(|ted|ful)|^sorry|^apologetic|^ashamed^)

SD (sadness): (?<!not_|n't_)(^sad(|ly|ness)|^disappoint(ed|ing)|^distress(es|ed|ing)|^depress(ed|ing)|^lonel(y|iness)|^miserable|^hopeless(|ness)|^heartbroken|^unhapp(y|ily|iness)^)

CO (confusion, uncertainty): (?<!not_|n't_)(^confus(e|es|ed|ing|ion)|^puzzl(ed|ing)|^perplex(|es|ed|ing)|^bewilder(s|ed|ing|ment)|^undecided|^mystif(y|ied|ies|ying)|^surpris(ed|es|ing)|^astonish(|es|ed|ing)|^amazed|^awestruck^)

HA (positive emotions): (?<!not_|n't_)(^happy|^contented|^pleased|^relieved|^amused|^cheerful(|ly)|^glad|^feel|feels|feeling|felt|very)_relaxed|^gratified|^feel|feels|feeling|felt)_wonderful|^elated|^joyful(|ly)|^exhilarat(e|es|ed|ing)|^ecsta(sy|tic)^)

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